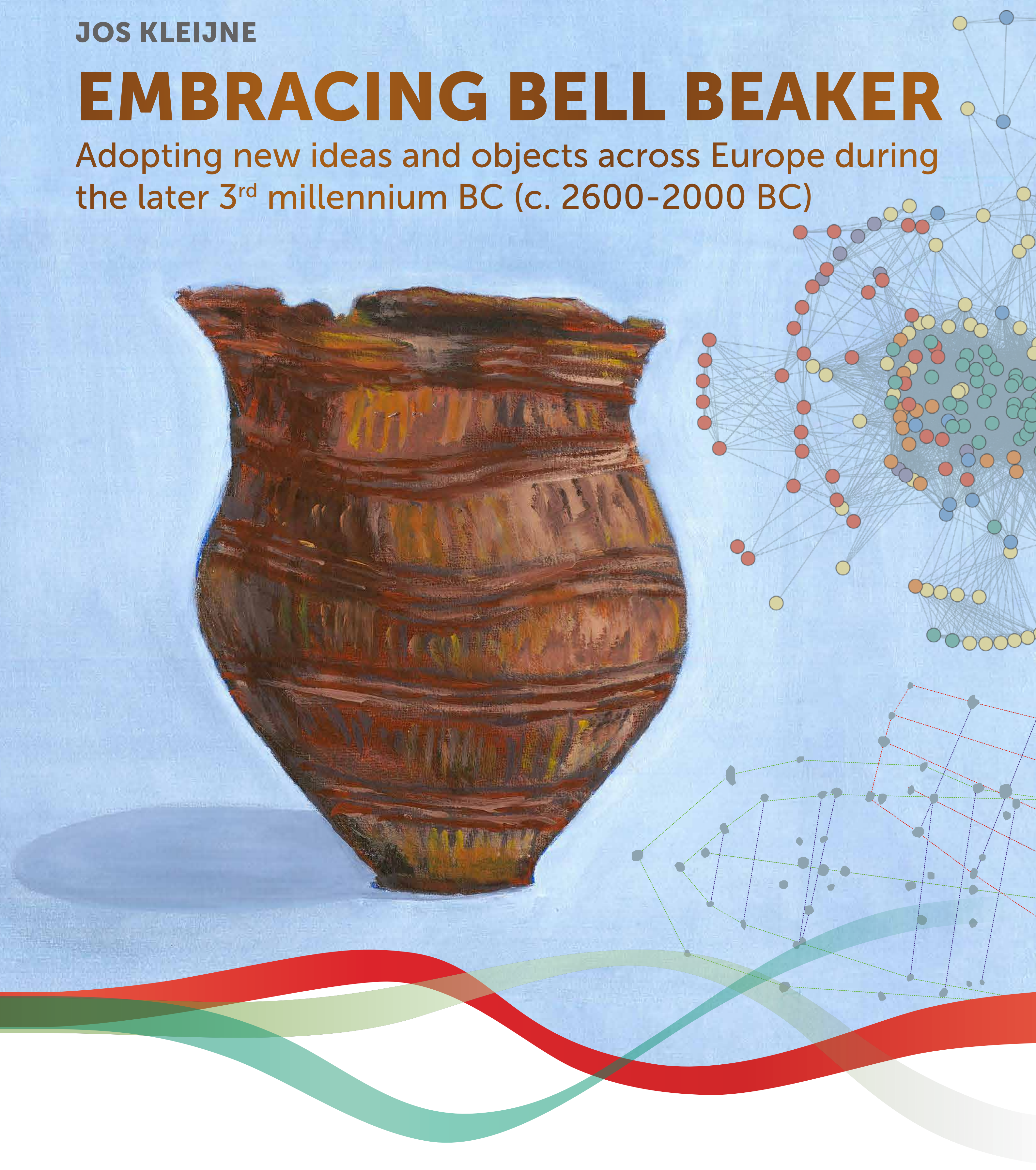
JOS KLEIJNE

EMBRACING BELL BEAKER

Adopting new ideas and objects across Europe during the later 3rd millennium BC (c. 2600-2000 BC)



SCALES OF TRANSFORMATION IN PREHISTORIC AND ARCHAIC SOCIETIES | 2

EMBRACING BELL BEAKER

Sidestone Press

JOS KLEIJNE

EMBRACING BELL BEAKER

Adopting new ideas and objects across Europe during the later 3rd millennium BC (c. 2600-2000 BC)

Published by Sidestone Press, Leiden
www.sidestone.com

Imprint: Sidestone Press Dissertations
Layout & cover design: CRC 1266/Carsten Reckweg and Sidestone Press
Cover images: Collage of the potbeker vessel from Emst-Hanendorp (painted by M. Mak-Kalkman, also figure 3.2), the house plans from Molenaarsgraaf (from Kleijne/Drenth in press) and a pottery network (from figure 6.10).

ISSN 2590-1222

ISBN 978-90-8890-755-5 (softcover)
ISBN 978-90-8890-754-8 (hardcover)
ISBN 978-90-8890-756-2 (PDF e-book)

The STPAS publications originate from or are involved with the Collaboration Research Centre 1266, which is funded by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation; Projektnummer 2901391021 – SFB 1266).

Preface by the editors

With this book series, the Collaborative Research Centre 'Scales of Transformation: Human-Environmental Interaction in Prehistoric and Archaic Societies' (CRC 1266) at Kiel University enables the bundled presentation of current research outcomes of the multiple aspects of socio-environmental transformations in ancient societies by offering this new publication platform. As editors, we are pleased to be able to publish monographs with detailed basic data and comprehensive interpretations from different case studies and landscapes as well as the extensive output from numerous scientific meetings and international workshops.

The new book series is dedicated to the fundamental research questions of the CRC 1266 dealing with transformations on different temporal, spatial and social scales, here defined as processes leading to a substantial and enduring reorganization of socio-environmental interaction patterns. What are the substantial transformations that describe human development from 15,000 years ago to the beginning of the Common Era? How did the interaction between natural environment and human populations change over time? What role did humans play as cognitive actors trying to deal with changing social and environmental conditions? Which factors triggered the transformations that led to substantial societal and economic inequality?

The understanding of human practices within the often intertwined social and environmental contexts is one of the most fundamental aspects of archaeological research. Moreover, in current debates, the dynamics and feedback involved in human-environmental relationships have become a major issue looking at the sometimes devastating consequences of human interference with nature. Archaeology, with its long-term perspective on human societies and landscapes, is in the unique position to trace and link comparable phenomena in the past, to study the human involvement with the natural environment, to investigate the impact of humans on nature, and the consequences of environmental change on human societies. Modern interlinked interdisciplinary research allows for reaching beyond simplistic monocausal lines of explanation and overcoming evolutionary perspectives. Looking at the period from 15,000 to 1 BCE, the CRC 1266 takes a diachronic view in order to investigate transformations involved in the development of late Pleistocene hunter-gatherers, horticulturalists, early agriculturalists, early metallurgists as well as early state societies, thus covering a wide array of societal formations and environmental conditions.

The publication on detailed aspects of Bell Beaker Societies on a European scale includes the analysis of both single domestic sites and regional comparisons.

We are very thankful to the author Jos Kleijne and to graphic illustrator Carsten Reckweg for their deep engagement in this publication. We also wish to thank Karsten Wentink, Corné van Woerdekom and Eric van den Bandt from Sidestone Press for their responsive support in realizing this volume and Katharina Fuchs for organizing the whole publication process.

Wiebke Kirleis and Johannes Müller

Contents

Preface by author

This PhD thesis is the result of three and a half years of research (between November 2014 and March 2018) by the author as part of the doctoral programme at the Graduate School 'Human Development in Landscapes', supervised by Professor Müller, Dr. Furholt and Professor Fokkens. At the Graduate School an interdisciplinary working environment provided the necessary equipment to answer the research questions that were posed at the start of this research project. This research project started its early days when the author was still a student at the Faculty of Archaeology at Leiden University, under the guidance of Professor Fokkens. During lectures, at conferences and in workshops many discussions were conducted concerning the Bell Beaker phenomenon, its meaning, the new evidence for mobility and the differences between funerary and settlement contexts. This theme further developed while working as a researcher at the Cultural Heritage Agency, when the author became part of the Odyssee project. Within this project several Late Neolithic Corded Ware settlements from the Dutch coastal area were studied in great detail by a group of specialists. While many remarkable and exciting results were published, the lack of a specific methodology and concepts dealing with overarching themes on a larger scale, such as the concepts of cultural transformations, innovation and mobility, became notable. While this PhD thesis specifically focuses on the Bell Beaker phenomenon, and hopes to address these specific themes, it is also suggested that the answers and methods provided here can be useful in other cultural contexts.

The dataset that is gathered as part of this PhD research is stored and available for future research on both the Kiel University Johanna Mestorf Data Exchange Platform (https://www.jma.uni-kiel.de/en/research-projects/data-exchange-platform) and at DANS (https://doi.org/10.17026/dans-2aa-t6vp).

Jos Kleijne

1 Setting the scene

1.1 A recurring picture: The Beaker People

For long, many archaeologists around Europe have marvelled at Bell Beaker pottery. Its sudden, Europe-wide distribution, the fine pastes, elegant curves, and enticing, almost enchanting, decoration motifs are surrounded by many pictures and stories (see for instance Childe 1925 or Cunliffe 2001). These stories centre on drinking, warfare and luxuries. They talk about far-away origins and invading hordes of nomadic tribes with strange rituals, exotic ideas and new cosmologies such as solar worship. The repeated association of these pottery vessels in conspicuous funerary contexts, the procurement of artefacts from new precious materials such as gold, ivory and copper and the seeming absence of any settlement traces further enforce this image. Archaeological terminology also illustrates the values assigned to objects associated to this phenomenon: ‘daggers’, ‘battle-axes’, ‘wrist guards’ but also ‘beaker’. In these stories and pictures people using Bell Beaker pottery are always opposed to the ones not using Bell Beaker pottery and an “us-vs.-them” imagery is created. It is hereto that the concept of a Bell Beaker People or “Beaker Folk” can be traced.

These pictures haven’t changed much throughout the past century. This can be seen when comparing images of the Bell Beaker phenomenon, based solely on funerary finds. The Amesbury Archer (Fitzpatrick 2002; Brayne 2016, see also fig. 1.1) is one of the more recent additions to this palette, while in the early 20th century similar images were produced (Atkinson 1959, 6, see fig. 1.2). Other examples, such as the 1990s beautiful *bande dessinée* about the standing stones of Petit Chasseur at Sion in Switzerland (Houot 1995) shows a similar picture of opposing communities in which warfare, exotic goods and elaborate funerary rituals played an important role.

1.2 Migrant? Smith? Stranger? King? Enemy? Friend?

These pictures present us altogether with a story we know all too well from history and the present day. Remnants of early theories about the Scythian or Hunnic invasions from Eastern Europe and Asia, or the disintegration of the Roman Empire are probably partly responsible for this. The modern-day world is also a period in which ‘migration from the east’ has been a hot topic since the 1990s in public debates (see also Anthony 1990).

Fig. 1.1 Reconstruction drawing of the Amesbury Archer by life (copyright: Wessex Archaeology, Salisbury).

A reinforcement of this picture is presented by other elements of the burial evidence. The new ways of interment, an individual under a barrow, the sudden provision of lavish grave goods, the introduction of new materials such as gold and copper, is often understood as a rapid break from the past and the rapid arrival of new people bringing new ideologies, practices and objects (Childe 1925; Harrison/Heyd 2007).

These are also pictures about a life not so different to our own, where highly influential individuals control vast amounts of resources, wealth and exotic items and dress themselves lavishly in an international style. For some archaeologists, these images of wealthy elites also form an important part of an argument in interpreting the subsequent period, the Bronze Age. The start of this epoch is envisioned as a development towards an even more hierarchical society, dominated by warfare, prestige goods exchanges and specific elaborate ritual cosmologies (Meller 2017; Kristiansen/Larsson 2005; Kristiansen 2007; Kaul 2005; Anthony 2007).

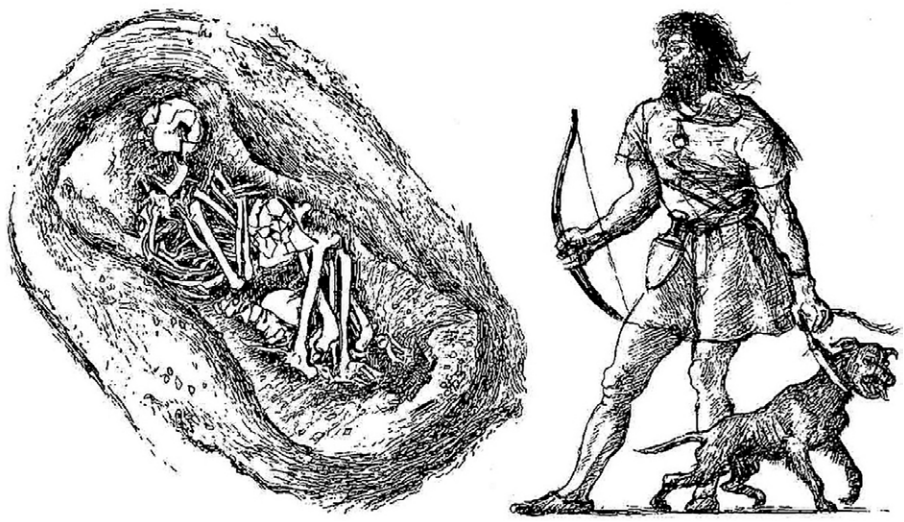


Fig. 1.2 Reconstruction drawing of the Stonehenge Bell Beaker burial by life (by Alan Sorrell, by permission of Historic England).

Some important questions can be raised to this picture, and these have been raised in the past. Can we really talk about the prestigious objects deposited in graves as if they were used by Bell Beaker warriors in life, or should we conceptualise these objects in a different manner (*e.g.* Fokkens 1999)? Is there really a complete change in the burial ritual related to individualism and new warrior-elite hierarchies or is this a more variable transition in which aspects of personhood, ancestry and identity play a role (*e.g.* Brück 2004)?

Finally, however, and for this study the most important observation, is that in many regions of Western and Central Europe, the Bell Beaker phenomenon is not simply just a burial record: settlement finds do exist quite frequently. While not as conspicuous as the highly-furnished Bell Beaker graves underneath round barrows or within megalithic tombs, the large enclosed settlements of the Portuguese Estremadura (*e.g.* Kunst 2007) or the large rectangular and oval houses of the Csepel Island in Hungary (*e.g.* Endrődi/Reményi 2016), both associated with Bell Beaker material culture, do make an impression. These settlement finds tell us a different story and show us a different picture. It is the settlement finds specifically that provide an insight in the Late Neolithic daily life, the changing traditions of various practices and the adoption of new ideas and innovations. That is the picture this book is about.

1.3 A Brief History of Beakers

In order to understand this development of archaeological discourse into the present day, the appearance of the "Beaker People", it is necessary to shed some light on the historical trajectory of its study in 19th and 20th century Europe and to further characterise the dataset that these debates were based upon.

The Bell Beaker phenomenon forms one of the most-studied aspects of Western and Central European prehistory. It was first identified as a separate entity within the (only recently proposed) "Three Age System", in the late 19th and early 20th century by scholars such as the earlier mentioned Thurnam (1872), Greenwell (1877) and Abercromby (1912) in Britain, Reinecke (1900) in Germany, Pallardi (1914, 1919) in the Czech Republic and del Castillo (1928) and Schmidt (1913) in the Iberian Peninsula. Already from this moment onwards many studies focus on the identification of local Bell Beaker pottery vessels and interpretations of where this influence comes from.

Illustrative is one meeting of the *Berliner Gesellschaft für Anthropologie, Ethnologie und Urgeschichte* in 1895, where F. Jagor, A. Voss, R. Virchow and J. Olshausen discussed the recent finds from the Spanish cemetery of Ciempozuelos near Madrid (Jagor *et al.* 1895), possible parallels across Europe and the technological aspects of producing these vessels. A few years later, Reinecke (1900) replied to this discussion and first coined the term *Gruppe Der Glockenbecher* (*idem*, Tafel XII), referencing to the already locally used terms *Campaniforme* in Spain, *Vase a Campana* in Italy and *Zvoncovitych Poharu* in the Czech Republic (*idem*, 230).

On the British Isles, Thurnam (1872) studied the different types of barrows and their chronological order in relation to Thomsen and Worsaae their "Three Age System". He identified the difference between Neolithic long barrows and Bronze Age round barrows, and the material remains found in these monuments, ranging from stone tools to bronze objects to human remains and pottery. He identified changes in cranial morphology, barrow type and pottery style with the appearance of the Beaker vessel. It was Abercromby (1912) who systematically studied the Bronze Age pottery of the British Isles. He connected his "Drinking Cups" (a term coined by Thurnam, later he changed this to Bell Beakers) on the British Isles and the related funerary record to material from the Rhineland from which by that time the first burials were being published.

Thus, a first period of identification and chronological positioning took place in the 19th century. After this time, scholars from all over Europe, being able to read each other's works, compared their Bell Beaker material culture with each other. They defined shared characteristics and similarities, often based on detailed studies of decoration motifs and vessel shapes. Subsequently, they tried to find external influences for observed changes in these variables. Between the 1920s and 1950s this view condensed into the works of Childe (1925, 1929) and Gimbutas (1965) who quickly glossed over this period in their accounts of European prehistory and popularised the "Beaker folk", also among archaeologists. Childe (1925, 270-276) does not point to a specific origin of the Beaker folk, but he does relate the archaeological evidence to "…bands of armed merchants, engaged in trading copper, gold, amber, callaïs, and similar scarce substances…" (*idem*, 270). These merchants roved the coasts of Atlantic Europe, settled in regions of natural wealth or at important trade routes and obtained political and economic authority over the traditional local communities. About the pace of this expansion he notes that the uniformity can hardly be explained by anything other than a rapid migration and the conservatism of the migrants (*idem*, 271).

In the 1960s, Sangmeister came up with his (now-famed) *Rückstrom*-hypothesis (Sangmeister 1963), in which he connected all the chronological and cultural evidence with a first migration of people from the Portuguese Estremadura towards Western and Central Europe along the coast where the cultural elements merged with the more Eastern Corded Ware culture, and again migrated south into France and Spain and westwards to the British Isles. With this intricate model (revised in Sangmeister 1966) he was able to explain the variability and mutual influences between the different regional pottery decoration styles (such as the Ciempozuelos, Middle-Rhenish and Veluwe types), wristguards and copper daggers found primarily in graves.

In that same decade, the advent of New Archaeology also left its marks on the study of the Bell Beaker culture. Clarke (1976) proposed a different, more social and economic perspective towards the changes occurring in this period, in which elite consumption practices and the trade and exchange of goods and ideas played a central role. Additionally, Lanting and Van Der Waals (1976a) provided an alternative for the Rückstrom-hypothesis from a typochronological perspective. Instead they argued for a continuity in pottery typology and funerary customs between the Corded Ware and Bell Beaker phenomena in the Lower Rhine Area. This debate, the Iberian or Lower Rhine Area origins for the Bell Beaker phenomenon, was not resolved in that decade, and even continues to linger on until today. While most researchers have favoured the Iberian hypothesis ever since its inception (*e.g.* Harrison 1980; Cunliffe 2001; Müller/Van Willigen 2001), several critical considerations of the foundations have lead to inconclusive outcomes (Ullrich 2008, Beckerman 2012; Grossmann 2017). In general, we can follow Furholt (2003), who proposed a system for the Corded Ware period taking a phased approach following the various plateaus radiocarbon calibration curve. His approach is based on Raetzel-Fabian's (2001) analysis of Wartberg chronology in South-West Germany. Because one of these plateaus in the calibration curve is situated at the start of the Bell Beaker phenomenon (Furholt's phase E, between 2620-2480 cal BC), it is impossible to state on these grounds alone whether either the Dutch model or Iberian model are more fitting the data. However, at present the Iberian-origin hypothesis is still favoured as a benchmark against which the studies of ancient DNA are being put to the test (*e.g.* Brandt *et al.* 2014; Haak *et al.* 2015).

1.4 Migrations: burials are the basis

The dataset on which all these studies based themselves consisted mainly of loose finds and graves, either single inhumation burials mostly beneath round barrows or collective or single graves in megaliths or natural caves. When one, for instance, takes the work of Sangmeister (1963), in which he synthesises the Bell Beaker phenomenon across Europe and outlines his famous "Rückstrom" theory. In this paper, the only evidence comes from different types of burials:

> "Mais ce n'est que dans le domaine européen continental, comprenant en outre une province isolée aux Pays-Bas, que nous trouvons des campaniformes dans des tombes et sous des tumulus, et en outre déjà, dans des sépultures mégalithiques, c'est-à-dire dans des tombes collectives. Si l'on considère tous les differents autres terroirs de la distribution des gobelets campaniformes on y trouvve que les campaniformes proviennent de tombes megalithiques de toutes creusées dans le roc, des tholos, des tombes megalitiques de toutes espèces, et aussi den grottes, et dans des situations que nous ne pouvons plus classer." (Sangmeister 1963, 27).

Summing up, in this early influential work, and in other cases, burial evidence is used to form an argument, while the settlement evidence is either ignored or explained away without any specific mention. Contrastingly, Lanting/Van Der Waals (1976a, 71) state "This article mainly deals with graves, grave structures and grave gifts. (...) It is however quite logical to look for the same continuity in other aspects of those beaker-groups as well, especially in the settlement patterns." Their lack of a substantial dataset, however makes this a very short contribution to their overall paper.

Other work on settlements is often oriented towards the treatment of single sites or presented in a general overview (*e.g.* Vander Linden 2006), without a strict interpretive framework relating this evidence to the wider Bell Beaker phenomenon. Exceptions are the work of Besse (1998, 2003a) and Strahm (2004a). Their studies into settlement and pottery evidence is clear and important. It is Besse (2003a) who studied the Late Neolithic settlement pottery in detail and identified three separate domains within the Bell Beaker phenomenon based on settlement pottery (*domain orientale*, *domain meridionale* and *domain septentrionale*). These domains show different transformations of Late Neolithic traditions into Bell Beaker communities. It is telling that none of these transformations are even mentioned in studies focusing on migrations using ancient DNA or isotopic evidence!

There are several problems with this narrow epistemological viewpoint in which burial evidence accounts for all our interpretive strength. In order to understand this phenomenon to take these problems and try to resolve them somehow. First of all, burial evidence is value specific. At a burial ritual, specific values are played out which are chosen and deliberately put attention to certain elements and purposefully neglect or subdue others. Anthropological studies have shown this in a great detail (*e.g.* Barraud *et al.* 1994; Huntington/Metcalf 1979; see also Parker Pearson 1999) and other archaeologists have argued for this as well (*e.g.* Fokkens 2005). Related to this is the suggestion of cultural homogeneity. Research on symbolism and the meaning behind objects has shown that this is not a given, but formed contextually through practice (*e.g.* Thomas 1991). As Fokkens (2005, 11) exemplifies, a ring on one's finger changes meaning depending on the context of one's marital status. One can therefore not assume a general meaning or value behind every single Bell Beaker vessel.

Next to that, a burial context is only a moment in time. Research has also shown that Bell Beaker burials are rare, not every member of a community got chosen to be buried, and only several of these highly significant and special Bell Beaker burials probably occurred during one generation (*e.g.* Theunissen 1993 for the Lower Rhine Area). Additionally, Müller *et al.* (2015) show that there exist intervals of stylistic change in Bell Beakers of around 150-200 years. These intervals can be connected to the infrequent practice of burying someone with a Beaker. Only at this *moment* of renegotiating and reinforcing meanings, pottery styles and identities change. When considering this, it is not strange that our interpretive models speak of *rapid* changes, *swift* migrations and use arguments based on typochronology, when discussing the advent and transformation of the Bell Beaker phenomenon. The slow movement of tradition and gradual, processual, change is invisible from this perspective, and thus also not part of our various interpretive frameworks.

A final problem with our current, burial focused interpretations of the Bell Beaker phenomenon is its socio-evolutionary trajectory. Since the work of Childe (1925), it is often argued that the adoption of the Bell Beaker phenomenon shows a development in a unidirectional socio-economic development, leading up to the Bronze Age chiefdoms (Kristiansen/Larsson 2005). This would make it a necessity to adopt the Bell Beaker in the first place. It assumes that every community wanted to adopt this phenomenon as a "Bell Beaker package" (*cf.* Burgess/Shennan 1976), without question. However, as is clearly visible on the map by Vander Linden (2006), this is not the case: many voids exist in the distribution of the Bell Beaker phenomenon. In effect, archaeologists often use the label of 'Bell Beaker' to argue for the importance of their site in terms of understanding social developments and cultural transformations. A solution for this particular problem would be to stop naming our settlements 'Bell Beaker' but instead use a more neutral chronological term, such as Late Neolithic, Chalcolithic or Early Bronze Age (depending on the research area). For the sake of clarity and comparison, the term Bell Beaker settlement will be used here.

1.5 What we should be studying

In the above we have seen that present-day interpretations of the Bell Beaker phenomenon are fraught with some very important pitfalls and problems. The background of these interpretations, basically the perceived lack of settlement evidence, and the lack of attention for the settlements that did exist, in favour of burials has led to a skewed picture. This skewed picture is presenting the appearance of the Bell Beaker phenomenon as an instance, an incident, a historical event caused by the migration of peoples.

So how did the scarce number of archaeological research on Bell Beaker settlements develop? Most work on Bell Beaker settlements in the 19th and early 20th centuries focused on the collection of loose finds across Europe. Not surprising, the earliest large-scale excavations of Bell Beaker settlements were carried out in the Portuguese Estremadura, where settlement remains and fortifications were still

visible above ground. Here, A. do Paço, M. de Lourdes Costa Arthur, and E. Jalhay excavated in the 1930s at Vila Nova de São Pedro (*e.g.* do Paço/Jalhay 1942; do Paço/de Lourdes Costa Arhur 1953a, 1953b, 1956). Later research, since the 1960s, was conducted by the DAI at Zambujal (*e.g.* Sangmeister/Schubart 1972; Kunst 1987) and at other sites, such as Cova da Moura (Spindler/Gallay 1973). In Spain, Britain and in the Netherlands the excavation of Bell Beaker settlements took off in the 1970s (Priego/Quero 1992; Bradley 1970; Bamford 1982; Gibson 1982; Louwe Kooijmans 1974), in France and Denmark in the 1980s (Blanchet 1984; Simonsen 1983; Boas 1991), in Hungary and the Czech Republic in the 1990s (Endrődi 1998; Turek 1993; Ondráček *et al.* 2005) and in Germany only even more recently (Ethelberg *et al.* 2000; Hecht 2007; but see Kossian 2007 for the 1930s excavations at Hunte 1, at Lake Dümmer or Schwabedissen 1958 and Mischka *et al* 2007 for the early excavations of peat-settlements in Schleswig-Holstein with Funnel Beaker and later Neolithic presence). Thus, until relatively recently any comparative study of Bell Beaker settlements was fraught with difficulties. Most regional comparisons were based

Fig. 1.3 Reconstruction drawing of the Late Neolithic, Bell Beaker, settlement of Molenaarsgraaf, the Netherlands (by Bob Brobbel, reproduced with permission).

primarily on surface collections and relatively few excavation results (*e.g.* Burnez 1976, Neumann 1969, Simpson 1971, Gibson 1987; see also papers in Benz/Stadelbacher 1995 and Benz/Van Willigen 1998).

It is only recently, with the advent of commercial archaeology, and the final publication of several older excavations, that a comparison of settlement finds from the third millennium BC in Western and Central Europe has become possible (see for instance Fokkens *et al.* 2016). The amount of published data has increased, and novel techniques to allow for the comparison of large datasets across time and space have become available (*e.g.* Furholt 2011). Only now it becomes possible to move away from earlier interpretations that focused primarily on funerary evidence, to move away from a picture focused on "Beaker folk".

Thus, it becomes possible to create different pictures, like the one produced by Bob Brobbel (see fig. 1.3). Pictures that see the appearance of the Bell Beaker phenomenon in terms of processes of cultural change, following up on the work of Clarke (1976) all those years ago. Taken from Clarke (1976) is also the use of settlement data and the concept of reconstructing a 'Bell Beaker network'. Summarizing, this approach is focused on the ways in which local communities take part in the Bell Beaker innovations set against the continuity of their Late Neolithic traditions. In the following chapter the theories behind the study of this innovation, its methodology and its application within our study of the Bell Beaker phenomenon will be addressed.

After realising the above, it becomes possible to formulate research questions that will be, addressed in the subsequent chapters of this thesis. The main theme of this thesis centres around the following problem.

How have local communities across Europe adopted the Bell Beaker phenomenon?

This question follows from our treatment of the current accepted understanding of the way in which the Bell Beaker phenomenon was adopted across Europe. We have seen that scholars have all focused on the swiftness of this development and the complete conversion as it were. Next to that we have seen how this picture is primarily concerned with external factors involved in this development (migrations, new elites), without any attention to local developments, long-term processes of change or agency from the proposed adopters themselves. In order to test this common narrative, this ubiquitous picture, we divide the main research problem into three research questions. These three distinct questions are related to the aspects of temporality and processes, the social landscape and mechanisms of innovation involved, and practices of tradition and innovation. Processes here reflect both the rapidity of the innovation. The concept of social landscape refers in this respect to the combination of all the actors in the innovation process and all the media by which innovation takes place (the mobility of objects, people, ideas and practices) seen from a sociological perspective.

The analysis of practices relates this larger framework to the local level at which innovations become reinvented.

In short, the following three research questions will be the main foci for understanding how local communities adopted the Bell Beaker phenomenon across Europe.

1. How did the adoption process of the Bell Beaker phenomenon take place in temporal terms?
2. What social landscapes and mechanisms characterise the adoption of the Bell Beaker phenomenon?
3. How should we understand the process of reinvention, the interplay between tradition and adoption of an innovation, when considering the Bell Beaker phenomenon?

1.6 Frameworks and source criticism

This thesis uses some quite specific spatial and chronological nomenclature. In this paragraph the contours are explained to the readers. For specifics regarding the methods of analysis, the reader is referred to chapter 3, where these will be explained in more detail.

1.6.1 Bell Beakers

The most important framework of study is the question what a 'Bell Beaker' actually is. In general, since the 19th century, scholars have agreed upon the definition in most cases: thin-walled, S-shaped vessels, completely decorated with horizontal bands or geometric motifs of dented spatula impressions. Deviations from this standard definition already complicate things with the presence of other completely decorated vessels, sometimes impressed with cord or other implements (so-called 'All-Over-Cord' or 'All-Over-Ornamented' respectively) and vessels half-decorated with dented-spatula impressions. Especially in the Lower Rhine Area, early examples of All-Over-Ornamented pottery have been found in graves that can be characterised as Corded Ware, based on grave goods and funerary practice (Lanting/Van Der Waals 1976a), however this is a localised phenomenon, as All-Over-Ornamented pottery is found in Bell Beaker contexts across Europe (*e.g.* Sheridan 2008, Gonzalez *et al.* 2012). For the sake of international comparison All-Over-Ornamented vessels will be considered part of the Bell Beaker phenomenon.

1.6.2 Bell Beakers contextually

In the previous paragraph it was already highlighted that Bell Beakers are found in various contexts, of which the grave and the settlement are the most common two. The funerary evidence for the Bell Beaker phenomenon is often divided into two categories: Firstly, single inhumation burials, often beneath round barrows are primarily found in Northwest and Central Europe. Secondly, the continued (re-)use of megalithic traditions, and the use of caves, is well-attested for the South and Southwest European Bell Beaker phenomenon (see Fitzpatrick *et al* 2013, 194, fig. 71). This divide is not strict as megaliths in Northern Europe also continued to be re-used for Bell Beaker activities and interments (*e.g.* Lanting 2008, 68-69), and Southwest European Bell Beaker graves also include single inhumation burials, often integrated in older monuments, invoking a sense of collectiveness (Tchérémissinoff 2006; Salanova/Tchérémissinoff 2011, 199). Contextually, settlements present an extremely varied group, consisting of cultural layers, features and structural evidence. These remains are typically found, accompanied by Bell Beaker material culture, all across Europe. In chapter 4 a more detailed picture of Bell Beaker settlement contexts will be described.

1.6.3 Bell Beakers spatially

There has been quite some debate about the question how far the Bell Beaker phenomenon stretches across Europe. Some authors argue for a relative restricted model, presenting the distribution of the Bell Beaker phenomenon as several concentrations across Europe (*e.g.* Vander Linden 2006). Others claim that the distribution of the Bell Beaker phenomenon can be mapped continuously across Europe (Harrison/Heyd 2007) and is also found along the fringes of Europe in places such as Morocco (Turek 2012), Crete (Rahmstorf 2008), Lithuania (Sobieraj 2003), Belarus (Czebreszuk/Kryvaltsevich 2003), Norway (Prescott/Glørstad 2015) and the Shetland

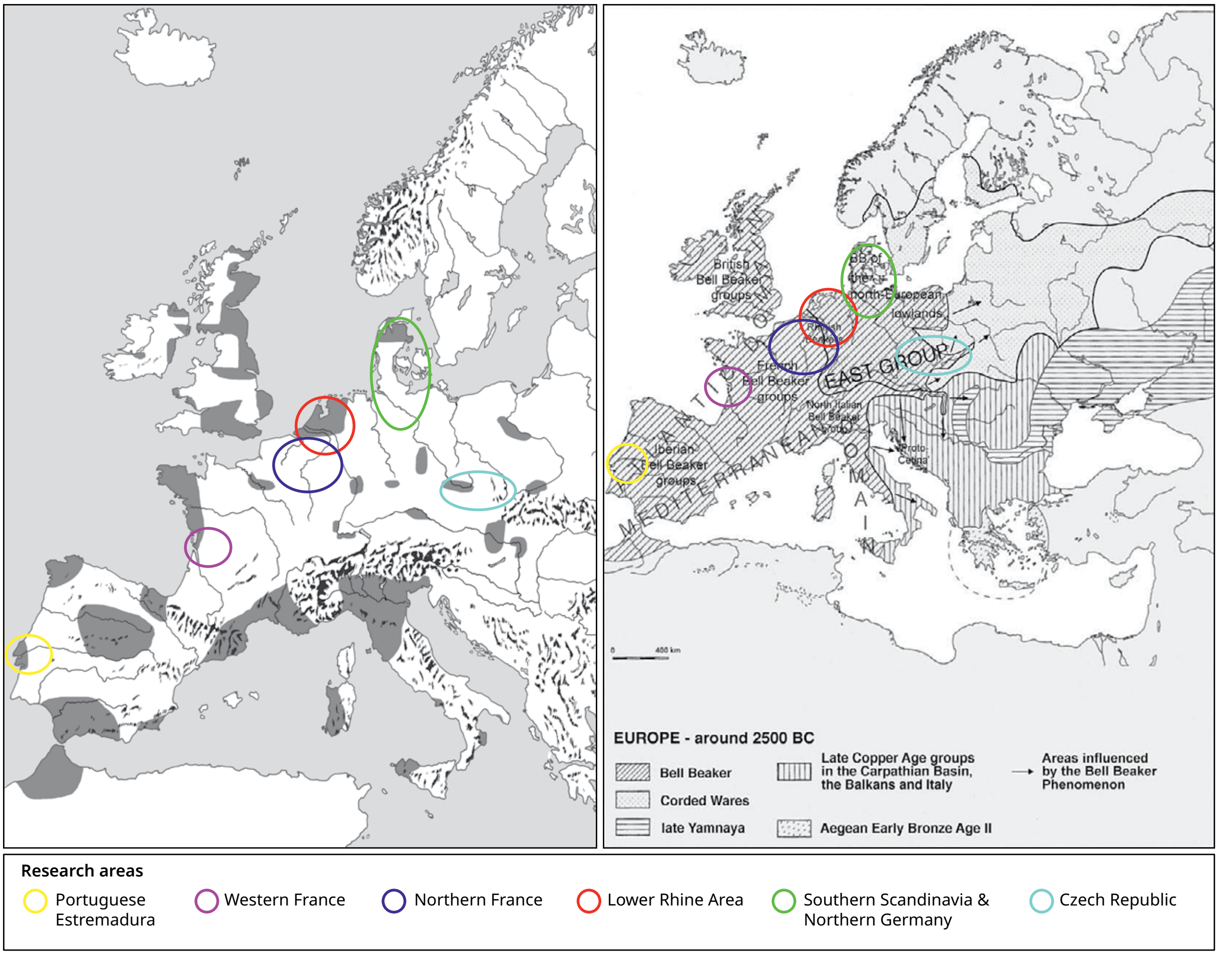


Fig. 1.4 The distribution of the Bell Beaker phenomenon in Europe either after Vander Linden (2006) or after Harrison and Heyd (2007).

Islands (Sheridan 2013). While we're not here to solve the 'splitter *versus* lumper' argument, it is interesting from the point of view of the diffusion of innovation to specifically look at the adoption of the Bell Beaker phenomenon in regions that are characterised differently. Therefore, combined with knowledge on the presence of settlements, several research areas have been selected where the adoption of the Bell Beaker phenomenon can best be studied.[1] These research areas are Southern Scandinavia and Northern Germany (Norway, Denmark, Schleswig-Holstein, Niedersachsen and Mecklenburg-Vorpommern), the Czech Republic, the Portuguese Estremadura, Central Western France (Vendée, Gironde, Charente, Charente-Maritime, Deux-Sèvres), Wallonia/Northern France (Nord, Pas-de-Calais, Somme, Aisne, Oise, Champagne, Haut-Rhin, Bas-Rhin) and the Lower Rhine Area (Netherlands, Flanders and Nordrhein-Westfalen). Taking these specific research areas, it becomes possible to assess the differences between distribution maps on a European scale. Two of the most cited distribution maps are the ones by Vanderlinden (2006, see fig. 1.4 left) and by Harrison/Heyd (2007, see fig. 1.4 right). These two maps present opposite sides of the spectrum with regard to the distribution of the Bell Beaker phenomenon. It is unclear what the reason of this discrepancy is. Do these maps represent different kinds of evidence, different contexts? Are there no people living in the blank areas on Vander Linden's distribution map? Or did the people living here reject the Bell Beaker phenomenon? Or can the distribution of the Bell Beaker phenomenon be

1 Dr. M. Vander Linden is thanked for his helpful comments on selecting these specific research areas.

BC	Portugal	Lower Rhine Area	S Scandinavia & N Germany	Czech Republic	France
3000	Late Neolithic	Middle Neolithic	Mittelneolithikum V	Middle Eneolithic	Néolithique récent
2950					
2900	Early Chalcolithic				Néolithique final
2850			Jungneolithikum 1		
2800		Late Neolithic A		Late Eneolithic	
2750					
2700					
2650					
2600			Jungneolithikum 2		
2550					
2500	Late Chalcolithic	Late Neolithic B			Campaniforme
2450			Jungneolithikum 3		
2400					
2350			Spätneolithikum I		
2300					
2250					
2200				Early Bronze Age	
2150					
2100					
2050					
2000	Early Bronze Age	Early Bronze Age			Bronze Ancien
1950			Spätneolithikum II		
1900					
1850					
1800					

Table 1.1 Overview of different chronological frameworks across Europe and the period studied here highlighted in blue (dates are taken from de Carvalho Amaro 2012 (Portugal), Louwe Kooijmans 2005 (Lower Rhine Area), Hübner 2005, Vandkilde 1996 and Olsen et al. 2011 (Southern Scandinavia and Northern Germany), Neustupný 2013 (Czech Republic) and Cottiaux/ Salanova 2014 (France).

visualised as a blanket covering all of Western and Central Europe, as Harrison and Heyd picture it?

1.6.4 Bell Beaker chronologically

A further point of debate centres on the specific moment at which the Bell Beaker phenomenon appeared, and associated with this, its origins. The most influential hypothesis currently stresses the emergence around 2800 BC in the Iberian Peninsula, and more specifically the Portuguese coast', as forwarded by Müller/Van Willigen (2001) and more recently also advocated by Cardoso (2014). Other parts of Europe present us with different dates for the arrival or the adoption of the Bell Beaker phenomenon. In Denmark Vandkilde (1996) sees the emergence particularly late, around 2350 BC. The British evidence seems to point to an emergence between 2450/2400 BC (Healy 2012; Parker Pearson *et al.* 2016). How are we to understand this chronological difference? Can the adoption of innovation model help with understanding the different moments and paces in the ways communities adopt the Bell Beaker phenomenon across Europe?

Also, it is necessary to consider the various chronological frameworks that are employed and the regional nomenclature within each case study. In many cases this nomenclature is linked to the Three Age System and the introduction of metallurgy in some form or another. While the Bell Beaker period itself is defined by ^{14}C dates, it can be ascribed to, for example, the Late Neolithic I period in Denmark (*cf.* Vandkilde 1996), while being simultaneously the Early Bronze Age II in Hungary (*cf.* Kalicz-Schreiber 1984, 134), the Late Chalcolithic in Portugal (*cf.* De Carvalho Amaro 2012), the final part of the Late Neolithic B in the Low Counties (*cf.* Louwe Kooijmans 2005) and the Chalcolithic or Early Bronze Age in the British Isles (see the discussion in Allen *et al.* 2012). In table 1.1 an overview of the different chronological frameworks is given. Within this study we will use these terms interchangeably when discussing the different research areas.

1.7 Innovation and the Bell Beaker phenomenon

When studying the Bell Beaker phenomenon from the perspective of innovation, one wonders what actually comprises this “Bell Beaker innovation”, what are the mechanisms that cause this phenomenon to emerge and these processes to take shape? As we have seen, the arrival of a very characteristic pottery is ascribed to the Bell Beaker phenomenon. There are however more types of objects and practices that have, in the past, been related to the Bell Beaker phenomenon. Therefore, not only pottery will be the focus of our analysis. Additional data, concerning flint and stone artefacts and raw material use, metallurgical practices and metal objects and subsistence economy will be inventoried and used within the study of communication networks in the first part of chapter 6.

Apart from pottery, we see objects such as for example v-perforated buttons made from amber (Hájek 1942), stone wristguards (Sangmeister 1964) and copper daggers (Zimmermann 2007) appear in graves. Are these objects new or already in circulation in the preceding period, for example in Corded Ware society? How do they spread across Europe spatially and chronologically? Are they associated or products of specific practices?

Three types of objects, not often considered when discussing the Bell Beaker diffusion, will be closely reviewed in the second part of chapter 6, in order to find answers to these questions. In addition, practices that have historically been associated with the Bell Beaker phenomenon in general, and settlement evidence in particular, will be reviewed: copper and gold metallurgy (*e.g.* Brodie 2001), horse domestication (*e.g.* Uerpmann 1995), the introduction of spelt wheat (*e.g.* Lechterbeck *et al.* 2013), the consumption of alcohol (*e.g.* Guerra Doce 2008) and specialised flint production (*e.g.* Apel 2001).

1.8 Overview

This chapter serves as an introduction to the central theme and research problem of this thesis. In chapter 2 the theoretical framework and methodological considerations for this research will be constructed. Following this, in chapter 3 a detailed description of the methods employed in this thesis will be given. These methods serve to answer specific aspects of the central research question as divided up by several sub-questions. Chapter 4 deals with the dataset that was gathered for this study, where it comes from, how it was generated and what choices had to be made. Chapter 5, 6 and 7 contain the bulk of this thesis, with the different analyses carried out for the different sub-questions. Chapter 5 concerns itself with the process of innovation, adoption and reinvention versus rejection, by looking at the phases of innovation, the timing and pacing of the innovation process and the impact and sustainability of the innovations. In chapter 6 a closer look at the mechanisms of innovation diffusion will be presented by an analysis of communication networks, mobility of ideas, objects, practices and people, including a discussion concerning the evidence from natural sciences (aDNA and isotopes). The analysis of practices in relation to innovation processes and diffusion mechanisms is the focus of chapter 7, where the pottery production process is analysed and skill and creativity in relation to adopting the Bell Beaker innovation are scrutinized. In chapter 8 a conclusion is presented, using the discussions in the previous chapters to present the new knowledge that is gained through this approach and the results of this study and the possible avenues for future research into the Bell Beaker phenomenon.

The appendices present several additional datasets: inventories of the studied Bell Beaker settlements, their characteristics and finds assemblages, the details of different Bayesian models explained, the dataset of Common Ware vessel metrics, lists of technologically analysed pottery assemblages, inventories of bone plates and pendants and metal Palmela points. The gathered data is stored in the DANS EASY repository (easy.dans.knaw.nl).

2 Theory and methodology

2.1 Introduction

In the previous chapter, it was outlined that studies explaining the spread and adoption of the Bell Beaker phenomenon across Europe have in the past mainly focused on the migration of peoples, the so-called Bell Beaker People. As argued, however, this picture is based primarily on a funerary record with its own biases, leading to very skewed and limited interpretations. Instead, explaining the Bell Beaker phenomenon should focus on three other questions: How the processes of cultural change take place regionally, how social landscapes define and form the innovation process, and how we should understand the interplay between tradition and the adoption of an innovation from a practical point of view. Only when we understand these three aspects, there can be a nuanced discussion about the place and role of migration.

Taking this perspective towards understanding the Bell Beaker phenomenon, and no long ignoring settlement data, presents a unique opportunity to study this important period of change in European prehistory. The theoretical outline of this study will be presented in this chapter. Important insights can be learned from an adjacent field of scientific research: sociology and more specifically the study of the diffusion of innovations. Instead of seeing migration or social evolution as a motivator for cultural change, change is driven by the arrival and appropriation of new ideas and practices. Most promisingly, the diffusion of innovations allows for regional variability and the comparison of different responses to this innovation. Contrary to models of migration or social evolution, the transmission of a common 'package' is not necessary. Distinct innovation trajectories can be compared between regions and different ways and paces of adopting new ideas and practices can be studied in this way. Furthermore, it allows for the study of the ways in which these new practices were integrated within traditional cultural repertoires. In this chapter the basic principles of this theory and methodology are explained at first. After this, its application in archaeology in the past and in the present study will be outlined.

2.2 Innovation processes

In order to be able to answer the first research question, concerning processes of cultural change and the regional adoption of the Bell Beaker phenomenon, we will look at theories concerning the adoption of innovations first. These (mainly sociological) theories can aid us in understanding the various general processes, aspects and qualities that also involved prehistoric adoption processes such as the Bell Beaker phenomenon.

2.2.1 The S-curve

While there is some literature concerning the study of innovations before the middle of the 20th century (most notably the early work of Gabriel de Tarde (1903) must be named), it is only in the 1960s that the systematic academic study of innovation as a process started to take shape. The most important contribution to the study of the diffusion of innovation within and beyond sociology has been Everett Rogers' influential work. Rogers (2003) gathered all the available research on innovations from many different academic disciplines and created a distinct terminology and methodology to compare the results of these studies. His collected data comes mainly from rural agricultural, family planning, public health and nutritional innovations in the United States. He constructed a frame of reference and a common language for the comparative study of innovations. His definition of diffusion is "the process by which an *innovation* is *communicated* through certain *channels* over *time* among the members of a *social system*" (Rogers 2003, 5).

Innovations are, in Rogers' words: "an idea, practice, or object that is perceived as new by an individual or other unit of adoption" (Rogers 2003, 11). Whether an object is perceived as new does not necessarily equate to its first appearance, other aspects such as knowledge, persuasion and the decision of adoption are also important in this perception.

Communication is, according to Rogers (2003, 17), "the process by which participants create and share information with one another in order to reach a mutual understanding" With respect to diffusion this communication is particularly centred on a new idea. The communication can be visualised and modelled by using the edges of a network (as Rogers 1979 does).

- The concept of time in the diffusion of innovations relates to three different things:
- The timing of the decision process (the moment whether or not to, and how to precisely, adopt an innovation)
- The impact of the adoption and innovativeness of an individual (how fast something gets adopted or someone adopts this thing)
- The rate of adoption within the social system (how fast the innovation spreads through the population).

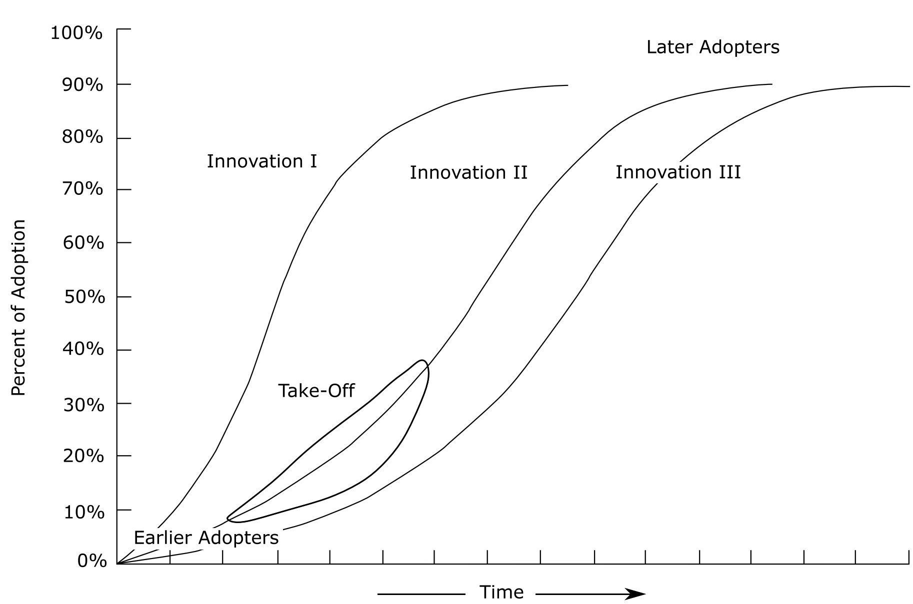


Fig. 2.1 Visual explanation of the S-curve (after Rogers 2003, 11, fig, 1.2).

These different concepts of time are best illustrated with the famous S-curve, by moment of its inception and the steepness of the curve itself (see fig. 2.1). This curve describes the adoption process of any innovation through time. It is based on an observed development in the total number or percentage of a population adopting a certain innovation. Based on this, Rogers distinguishes three categories or stages in the diffusion of an innovation: early adopters, the critical mass and laggards. At the point where the majority has to adopt an innovation, the point an innovation has to take off and reach a critical mass, it can either become accepted or rejected by a community. This model will function as the basis for this research project, and therefore its most important concepts will be further outlined in detail below.

2.2.2 Stages of innovation

The research by Rogers doesn't focus solely on the S-curve or temporality. One could argue that this is even not the most interesting part of his work as it is only an anchor to understanding the more important diachronic processes and practices taking place. According to Rogers, there are several different stages in the innovation-decision process (Rogers 2003, fig. 5.1) of which the decision, implementation and confirmation stages are the most important: it is in these stages that the actual practices of adoption, rejection or reinvention of innovations take place.

The decision stage is the moment when an individual makes a choice whether to adopt or reject an innovation. In general terms, adoption of an innovation is to make use of it, either immediately or through a trial-period. The factors influencing this are related to attributes of the innovation itself (relative advantage over others, compatibility with tradition, complexity, trial ability and observability), who makes this adoption decision (optional, collective or authority), communication channels, the nature of a social system and finally the extent in which the innovation is promoted (Rogers 2003, fig. 6.1).

Rejection on the other hand is every action that is related to the choice not to make use of an innovation. This can be active, considering the adoption of the innovation but deciding against it, or passive, when an innovation is never really considered and thus also not adopted.

The reinvention process takes place after the decision stage, during the implementation stage, when an individual reconciles the innovation with his frame of reference and traditions. For archaeologists this is the most important stage in the process, as its consequences can be directly seen in the archaeological record in the material we observe. It is most prominent in the production process of material culture and the social aspects of technologies, where the interplay of tradition and innovation are found.

Concluding, there are several important aspects of any innovation. These aspects, and the associated qualities, are related to the stages of innovation (see table 2.1).

Table 2.1 Aspects of innovation through time/space.

Decision stage	Aspects	Implementation stage	Aspects	Qualities
1. Adoption		1. Reinvention	1a. Longevity	High Sustainability Low Sustainability
			1b. Impact	High Impact Low Impact
2. Rejection	2a. Passive 2b. Active			

2.2.3 Processes of innovation in archaeology

In the previous paragraph we have seen how processes of adopting innovations have been studied in sociology. Several of these ideas have worked through in a small number of archaeological studies. In the archaeological study of processes and the diffusion of innovations, two different foci of studying innovation can be discerned: Innovation was studied from either a more spatial perspective, focusing on diffusion of ideas, or from a more temporal perspective, focusing on the transformation processes taking place during the adoption of an innovation. Both these trajectories have their origins in the early 20th century and have seen a waxing and waning of popularity to one another.

2.2.3.1 Waves of advance

In early 20th century archaeology, innovation has for most parts been synonymous with the concepts of migration or invasion, revolution and "Ex Oriente Lux", as an explanation for cultural change and in-a-certain-way 'innovation'. Especially the introductions of agriculture (Neolithic revolution) and metallurgy across Europe became related to the emergence of new groups of peoples. According to this narrative, migrating groups brought with them increases in social hierarchy and changes in cultural practices. This view was based on Marxism and anthropological social evolutionism and became popular in archaeology (*e.g.* Childe 1925). In the 1970s, some of these early diffusionist ideas were revisited with a more data-driven and crude modelling background. This lead to several influential studies that, without any social connotations, were concerned with the diffusion of agriculture across Europe. The modelling of radiocarbon dates to describe the diffusion of agriculture was one particular way of understanding diffusion (at first by Ammerman/Cavalli-Sforza 1971) and many other studies followed, such as for example Bocquet-Appel *et al.* (2009). This method was also applied by Müller and Van Willigen (Müller/Van Willigen 2001) in their analysis of Bell Beaker radiocarbon dates arguing for a diffusion of the Bell Beaker phenomenon from the Iberian Peninsula. The method itself was further developed by the UCL research group of Shennan (*e.g.* Timpson *et al.* 2014 and Crema *et al.* 2016 among others), who also associated the processes of innovation with models of Darwinian evolution, related to variability in population pressures and climatic change (*e.g.* Shennan 2000). Of a similar nature is the work of Hansen *et al.* (2016), studying certain specific innovations from the analysis of finds distribution maps. In all these models "waves of advance", based on radiocarbon dates, genetic data or the distribution of very specific finds, are presented by arrows on the map of Europe.

The patterns observed in all these studies are very general and well applicable on European-wide scales, but not on specific case studies concerned with innovation and diffusion of single cultural entities or traits. Next to that, as the authors themselves rightly point out, genetic data and ^{14}C data are maybe relatable, but not one-to-one applicable to human action and the spread of cultural phenomena. As such, these methods are proxies, approximations, for the diffusion of innovations. Most importantly, there is almost no concern with the transmission of these new innovations or the processes behind this transmission, or the ways in which local communities appropriate these new ideas into their traditional ways of life through technology.

2.2.3.2 Availability models

When considering following innovations through time as they affect communities, there have been several important studies that must be mentioned. The paper of Zvelebil and Rowley-Conwy (Zvelebil/Rowley-Conwy 1984) present a hallmark in

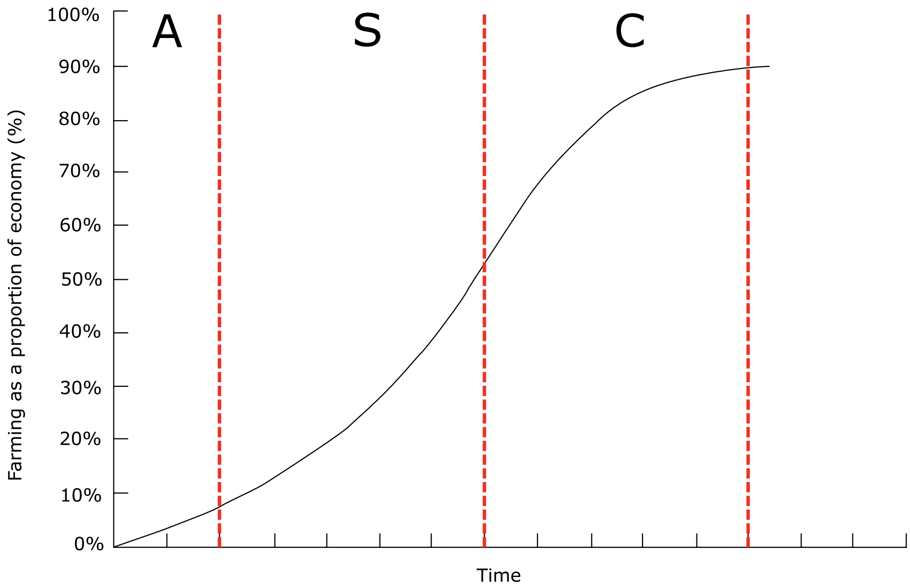


Fig. 2.2 Zvelebil's availability model (after Zvelebil 1998, 10).

the study of innovation by archaeologists. Focusing on the Mesolithic/Neolithic transition in Europe, they propose a three-way system by which local Mesolithic communities could adopt the Neolithic package: the availability phase, substitution phase and consolidation phase. Using this model, they explain the regional diffusion and adoption of the Neolithic innovation in different regions and at different paces, in Europe. Later, Zvelebil (1998) revisits and further clarifies some of these ideas. Summarizing: in the Availability phase, foraging is still the principal means of subsistence, while domesticates and cultigens comprise less than 5% of the total remains. In the Substitution phase farming strategies developed, while foraging strategies retained. Domesticates and cultigens make up 5-50% of the total remains. Lastly, in the Consolidation phase, farming has become the principal mode of subsistence. Foraging has lost its economic, organisational and ideological significance. More than 50% of the total remains consists now of domesticates (Zvelebil 1998, 10, see fig. 2.2).

The work of Zvelebil on the development of agriculture in distinct phases following an S-curve has led to many regional models on Neolithisation and also on explaining the processes of adopting metallurgy (*e.g.* Louwe Kooijmans 2006; Klassen 2004; Strahm 2007; Fokkens 2008). It was Louwe Kooijmans who incorporated this three-stage system in his now-famous *bollenschema* for Neolithisation in the Lower Rhine Area (earliest in Louwe Kooijmans 1976, actualised in Louwe Kooijmans 2011). The Lower Rhine Area presents a local Mesolithic population that is relatively slow in adopting farming. Over the course of three millennia, between 5000 and 2000 BC, these communities adopt certain elements such as pottery, husbandry, crop cultivation and metallurgy at different paces and with different impacts and varied connotations. The farming economy during this timeframe is described by Louwe Kooijmans as an "extended broad spectrum economy" within Zvelebil's substitution and consolidation phases.

In several works, Fokkens (2008, 19-20; 2012b; Fokkens/Arnoldussen 2008) specifically takes the notion of *critical mass* from Rogers' (2003) work. He applies it to the Neolithic and Bronze Age communities in the Low Countries. He argues that the earliest phase of adopting an innovation are archaeologically less visible. We only 'see' innovations archaeologically when a certain number of people or communities, the critical mass, have already adopted the innovation. Next to that, he notes that regional variation in the adoption of an innovation in the Low Countries can partly be due to the regional geography and the possibilities for a farming-based

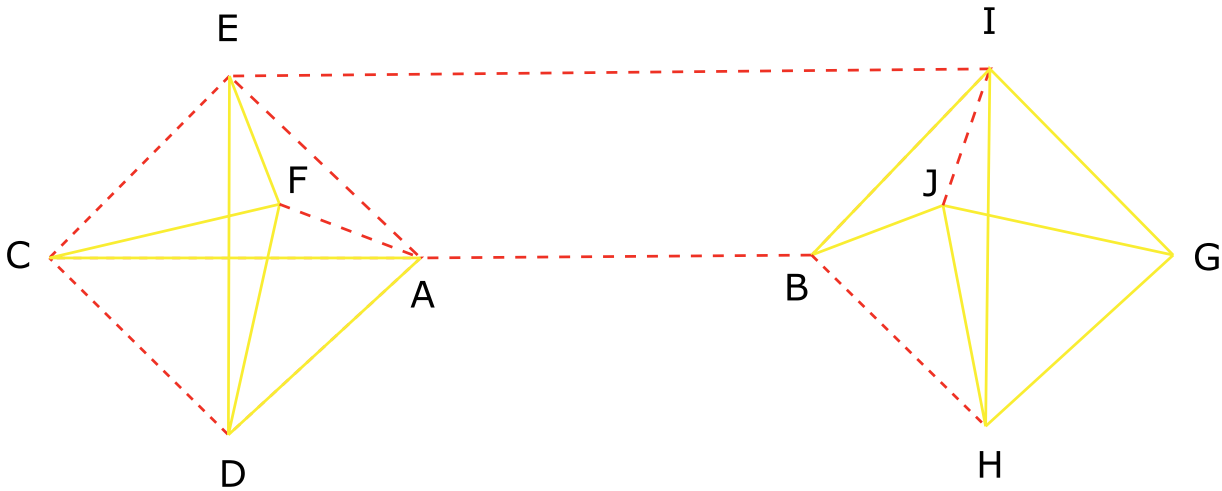


Fig. 2.3 Strength of weak ties model (after Gravovetter 1973, fig. 2a).

subsistence economy in different landscapes. As an example of this Fokkens (2008) mentions the innovation of the ard plough and the adoption of new ploughing technologies in the Later Neolithic.

Another availability model of innovation is based on the work of Strahm (*e.g.* 1982, 2007), who here focuses on the Chalcolithic in Western Europe, and the Alpine area in particular. He makes a distinction between *Chalcolithikum* (the period of use of imported metal objects) and *Metallikum* (the period of local production of metal artefacts). This model is further worked out by Klassen (2000, 2004), who takes metallurgical practices into consideration in his availability model for Scandinavian early metalwork. Most recently, Scharl (2016) studied the innovation processes behind the earliest metallurgy in Central Europe and showed that this was a discontinuous dissemination of new technology and a slow step-by-step process, instead of a revolution. Reasons behind this slow transformation must be sought in the realm of communication networks and the inherently social nature of technologies. While she doesn't go into details as to the nature of these networks, other studies, such as the work of Radivojević and Grujić (Radivojević/Grujić 2017), do.

2.3 The social landscape of innovation: networks and mechanisms

The systematic study of innovation processes presents us with the terminology and possible ways of understanding the diffusion of innovations from a temporal and processual perspective, by looking at specific aspects and qualities. Another development paved the way for a different perspective towards innovation: this concept is the network. This concept will be useful for answering the second research question. In order to understand the social landscape of Bell Beaker adoption, it is necessary to move beyond the processes to study both the actors that spread this innovation, the medium, the innovation itself, and the mechanisms that are involved in its diffusion.

Taken from the field of graph theory in mathematics, the network is the graphical representation and abstraction of entities (nodes) and their relationships (edges) that can be used to study almost anything, from social relationships to biological mechanisms. Graph theory and the network concept was first and famously conceptualised in the mathematical problem of the "Seven Bridges of Köningsberg", solved by Euler in 1736 (*cf.* Barabasi 2003, 10-13).

This way of thinking, of analysing relationships between entities and specifically their adoption of an innovation, was firstly applied to sociology and the study of the diffusion of innovations by Everett Rogers and Mark Granovetter in the 1970s.

In the 1970s Granovetter (1973, 1983) took Roger's ideas about the diffusion of innovation, and he applied them to the study of communication and social networks. This is a shift from the analysis of individuals as units of analysis, to a study based on the communication *between* individuals and their relationships (Liu/Duff 1972, 361). Granovetter's (1973) study focuses on information about the job market and that this information is usually passed on more easily through acquaintances (heterophilous relationships) rather than close friends (homophilous relationships). While close friends form cliques with similar access to information, acquaintances usually move in different circles and have access to other kinds of information. Independently, mathematicians Rapoport and Horvath came to similar conclusions (Rapoport/Horvath 1961) in their analysis of a large dataset of friendship preferences at a junior high school in Ann Arbor. This general model for the adoption of innovation, communication of information and relationships between individuals, became known as Granovetter's "Strength of Weak Ties" model (see fig. 2.3).

For the study of innovations, the use of networks meant a move away from focusing on individuals or communities themselves and the processes that they undergo or react to, towards studies focusing on the mechanisms involved. Studies of these mechanisms place a large emphasis on communication and information exchange between individuals or communities (*e.g.* Rogers 1979). Scholars in the social sciences developed formal methods to study this communication and information exchange (*e.g.* Knoke/Kuklinski 1982; Valente 1995). Next to this mechanism of information exchange or communication, we should also add the exchange of objects and the mobility of people as possible mechanisms by which innovation can diffuse through space.

2.3.1 The social landscape of innovation in archaeology

In the previous paragraph we have seen that sociological studies into the medium and actors behind innovation processes focus on the analysis of networks. In archaeology however, other ways of studying this social landscape have prevailed in the past. By analysing distribution maps and focusing on the distribution of particular practices and objects, scholars have placed a heavy emphasis on the medium, the innovation itself, without spending too much time considering the mechanisms and the actors behind this innovation process. Here we will present an overview of this archaeological research with respect to the Bell Beaker phenomenon, after which an alternative, more balanced understanding, with attention to the concept of 'Bell Beaker network' will be given.

2.3.1.1 Distribution maps

Several studies have used distribution maps as arguments while studying the mechanisms behind the diffusion of innovations. Especially the Digital Atlas of Innovations (Hansen *et al.* 2016) presents itself from this angle. This project creates distribution maps of many different practices, using radiocarbon dates to show the movement of ideas and objects. In their article, Hansen *et al.* (2016) focus specifically on the wheel and wagon. A relatively static and unilateral image is presented, without much attention to social aspects of technological innovations or the networks that play a role in adopting and reinventing innovations regionally.

For the Bell Beaker phenomenon, several studies exist that take a similar perspective, albeit on a much smaller scale, arguing for the association between different practices and different types of material culture. Most famous is of course the image of a "Bell Beaker package" as it was presented by Burgess and Shennan (1976). Their model of a Bell Beaker package sees a pattern in certain combinations of Bell Beaker associated objects and practices recurring across Europe. Instead of this combined approach, the practices of metallurgy, subsistence and flint artefact production on settlements will be reviewed separately here.

Copper and gold metallurgy

As early as Childe (1925) people have associated Bell Beakers with the technology of producing copper and gold objects. It is however now generally accepted that copper metallurgy was not introduced in the Bell Beaker period for large parts of Europe (Klassen 2004; Strahm 2007; Rovira/Montero Ruíz 2013). What we do see in Bell Beaker graves are very specific types of objects made from copper (Palmela points, tanged daggers) and gold (basket-earrings). Other finds used in metallurgical practices dating to the Bell Beaker period include cushion stones and anvils (*e.g.* Drenth/Freudenberg 2008; Drenth/Williams 2011; Freudenberg 2010; Bertemes/Heyd 2002, Abb. 12; Bátora 2002). One way of interpreting this rise in metal object depositions in graves, and the evidence for metallurgical practices is to focus on the restricted access to metal and the emergence of ritualised smithing practices (Brodie 1997, 2001; Fitzpatrick 2009). The diffusion of the Bell Beaker innovation could then be held accountable for this change in practices, something that has been called the "Chalcolithic frontier" in the past. But do we also see this development in settlement assemblages?

Late Neolithic subsistence economy

With regard to Late Neolithic subsistence economy, the general hypothesis is one of substitution and consolidation within the Neolithisation process. Louwe Kooijmans speaks of 'agrarian societies' (*e.g.* Louwe Kooijmans 2011, fig. 1). However, recent studies have shown that this picture is not uniform, and can be challenged on a local level. The evidence from Western France (Laporte 2009), the Netherlands (*e.g.* Fokkens *et al.* 2016; Smit *et al.* 2012), Central Germany (Müller *et al.* 2009) and the Baltic coast (*e.g.* Król 1997) shows that Late Neolithic subsistence was not solely based on agricultural practices and domesticated plants and animals. Instead, a large degree of shell collecting, fishing, fowling, gathering and hunting took place in both upland and wetland landscapes. In addition, the Bell Beaker funerary ritual places a large emphasis on hunting (arrowheads, bows, wristguards: *e.g.* Fokkens *et al.* 2008; Clark 1963). Can we by studying settlements get a better insight in how the adoption of the Bell Beaker phenomenon affected the role of wild animals? Specific subsistence practices must be mentioned here: horse domestication and spelt wheat cereal cultivation.

Horse domestication

A specific practice that historically had been associated with the Bell Beaker phenomenon was the domestication of the horse (*Equus ferus*) in Central and Western Europe (van Wijngaarden-Bakker 1975; Uerpmann 1995; Bőkőnyi 1978).[2] In this respect, several recent methodological developments and new analyses of faunal remains, must be mentioned.

A Europe-wide overview (Bendrey 2012), re-analysis of the dating evidence from Newgrange, Ireland (Bendrey *et al.* 2013) new findings from Late Neolithic Saxony-Anhalt (Döhle/Schunke 2014) and Chalcolithic Iberia (Cardoso *et al.* 2013) and a re-analysis of horse finds from the Czech Republic (Kyselý/Peške 2016), have

2 Identifying domestication in horse bones is near to impossible, and over the years several suggestions have been made, ranging from looking at an increase in the total number of horses (Bőkőnyi 1978), increase in size variability (Benecke 1994; Uerpmann 1995), analysis of kill-off patterns (Bőkőnyi 1978), mapping the distribution of horse bits and cheek-pieces (Kristiansen/Larsson 2005, 184) to the analysis of bit wear traces on horse teeth (Brown/Anthony 1998; Anthony/Brown 2000; Bendrey 2011), a combination of different morphological methods (Kyselý/Peške 2016) and most recently genetic evidence (Librado *et al.* 2016, 2017).

demonstrated that this picture is more complex and regionally varied. For Ireland, earliest domesticated horse remains now date to the Iron Age (Bendrey *et al.* 2013). For the Iberian Peninsula it is argued that a local Pleistocene *refugium* existed, from which domestication could have taken place in the Early Chalcolithic (Cardoso *et al.* 2013). For Northwest Europe the situation is less clear, as some horse remains could still be of wild species (such as possibly at the Middle Neolithic settlement of Swifterbant S3 (Clason 1991) and Corded Ware settlement of Löddigsee (Benecke in Becker/Benecke 2002). The find of horse remains in a Corded Ware grave from Borgstedt (a secondary burial within a megalith; Bauch 1988) illustrates that horses, whether domestic or wild, played an important part in ritual practice.

In Eastern Europe, domestication of the horse probably took place at the end of the Tripiliya culture (Benecke 1994), or with the appearance of the Yamnaya culture (Anthony 2007), after it was first domesticated further east on the Eurasian steppe (Outram *et al.* 2011). This is now also supported by genetic evidence (Warmuth *et al.* 2012). Additional aDNA evidence points to a rapid change in the horse coat colour around 3000 BC, probably associated with domestication in the Eurasian steppe (Ludwig *et al.* 2009). Around the same time, during the later 4th millennium BC, horse domestication took place in the Czech Republic and Central Germany. Here, associated with the Funnel Beaker and Salzmünde cultures, metric evidence is used to argue for horse domestication (Kyselý/Peške 2016; Döhl/Schunke 2014).

So, while horse domestication did not take place in the Bell Beaker period for at least most parts of Europe, there are still several hypotheses regarding horses in the later 3rd and 2nd millennium BC. First of all, the role of the horse in relation to the spread of cultural phenomena and the diffusion of innovations in Western Europe in the third millennium BC is still argued for (*e.g.* Anthony 2007). Secondly, for the Bronze Age of Westfrisia in the Netherlands, van Amerongen (2016) hypotheses (based on a low number of horse bones on these well-studied settlements) that single farmsteads only held a single horse per generation. Consequently, acquiring the acquisition of a horse might have been part of a long-distance exchange network. It will be interesting to study the settlement bone assemblages on the presence of horse remains and their quantities for the Bell Beaker period in order to look for this possible exchange network and the role of the horse in the spread of the Bell Beaker phenomenon.

Introduction of spelt wheat

Similarly, the introduction of spelt wheat has recently been suggested to have a possible association with the spread of the Bell Beaker phenomenon (Jacomet 2008; Lechterbeck *et al.* 2013, 107).[3] Spelt wheat (*Triticum spelta*) has been found on two Bell Beaker settlement sites in the Alpine area relatively recently (Lechterbeck *et al.* 2013; Akeret 2005). Older finds of spelt wheat are known only from two settlements of the Baden and Jevišovice culture in Austria (Kohler-Schneider/Caneppele 2009). Can the introduction of spelt wheat, or changes in the mixture and rotation regime of cultivated crops, be related to the adoption of the Bell Beaker phenomenon?

Bell Beaker contents

Another possible association between specific practices and the adoption and diffusion of the Bell Beaker phenomenon, might be in the content of the Bell Beaker pottery vessel. Evidence for the presence of beer, mead or porridge has been argued for in a number of different cases, with different grades of evidence supporting the claims.

3 Positive identification of spelt however, is notoriously difficult and can only be done on the basis of a combination of seeds and chaff remains. Any identification based on seeds alone could represent misidentified *Triticum dicoccum* (pers. comm. Dr. O. Brinkkemper).

A substantial debate has surrounded the introduction of beer in prehistory and the relation this has had with the spread of the Bell Beaker phenomenon. The first to suggest the practice of drinking was already Thurnam (1872) who coined the term 'Drinking Cups'. Childe (1925) also assumed that the Bell Beaker phenomenon had a role to play in the spread of new practices in which drinking beer played an important part. Sherratt (1987) famously connected the introduction of beer drinking to social hierarchies emerging at the start of the Late Neolithic. Late in the 1990s, pioneer research into pottery residues found evidence for chemically altered starches and certain chemical compounds related to alcohol (esters) in Bell Beaker vessels from Catalonia (Juan-Tresserras 1999; Rojo Guerra *et al.* 2005). According to experimental work, this could only have been a starch altered by alcoholic processes (Juan-Tresserras 1999), however researchers are not sure about the chemical and taphonomic processes behind this experimental work.[4,5] Since then researchers have associated all sorts of starches and even simply cereal remains with evidence for processing and drinking of beer from Bell Beaker and Corded Ware vessels (*e.g.* Meurkens *et al.* 2015; Klassen 2005).

Next to this evidence for a certain kind of beer there have been suggestions for other liquids such as a beverage seasoned with meadowsweet (*Filipendula ulmaria*). Possible examples come from two examples of Scottish Bell Beaker and Bronze Age burials (Lambert in Henshall 1963; Dickson 1978; Gibson/Woods 1997). However, these identifications are not without interpretation. Tipping (1994) suggests that instead of mead, floral tributes are also likely.

An important point in the discussion is the evidence pointed forward by Beckerman (2015), who states that, when comparing the evidence for foodcrusts on pottery and this pottery's technology, there's even more evidence for cooking in thin-walled highly decorated vessels from the settlement of Mienakker than there is in the crude thick-walled undecorated pottery (see also Kleijne *et al.* 2013).

Flint specialisation

The 3rd millennium BC in Western Europe also sees the appearance of a very highly skilled production of very specific flint artefacts: flint daggers, different kinds of knives (foliate, discoidal, plano-convex) and barbed/tanged arrowheads. All these artefacts were made using specific techniques such as pressure flaking, sometimes also accompanied by parallel retouche and extensive polishing. Next to these skilled techniques, the rise of high-quality flint exchange networks is apparent. In particular the Central French (Grand-Pressigny and related) tradition dating between 5000 BC and 2400 BC and the Scandinavian and North German tradition dating from between 2350 – 1700 BC (Apel 2001, Rassmann 2001, Vandkilde 2005) are well known, while also a British insular tradition existed (Gardiner 2008; Frieman 2015).

Grand Pressigny daggers occasionally reach Northern Germany and the Lower Rhine Area (Delcourt-Vlaeminck 2004), where in the latter area some evidence for local re-use has been found (García-Díaz 2013), but most objects end up in funerary contexts. Scandinavian daggers on the other hand, were produced in Northern Denmark, and the settlement of Bejsebakken in particular (Lomborg 1976; Sarauw 2008, 32-37) and on the Western Baltic coast, as indicated by many finds from the island of Rügen, Mecklenburg-Vorpommern (Rassmann 2001), and a complete production sequence in Tegelbarg, Schleswig-Holstein (Arnold 1981). These daggers are distributed in the Lower Rhine Area (Bloemers 1968; Beuker/Drenth 2006; Drenth 2015) but

4 Pers. comm. Prof. Dr. T. Valamoti.

5 The identification of beer rests primarily on the combination of phytoliths, cereal grains and specific modified starches within the pottery residues. However, the modification of starches can be affected by other processes (Pearsall 2015, 341-384), and, as we have seen, cereal remains are a common constituent of Late Neolithic porridges (see also Kubiak-Martens *et al.* 2015).

also known from Norway (Prescott 2012), Sweden, Central Germany (Siemann 2003), the west of Poland (Wojciechowski 1976), the Czech Republic (Přichystal/Šebela 2015) and even possibly as far as Belarus (Czebreszuk/Kryvaltsevich 2003).

Local production of flint daggers, in Moravia and southern Poland, can be attested from ca 2200 BC onwards as well (Grużdź *et al.* 2015, Přichystal/Šebela 2015). On the British Isles, several imported Scandinavian daggers are known, but a local tradition also exists, possibly connected to the production of foliated and discoidal knives (*cf.* Frieman 2015, 106, Fig. 9.2F; *cf.* Gardiner 2008). On the Continent, knives occur in different regional and local varieties: backed blades, discoidal, foliated and plano-convex varieties, but no clear overview exists. The use of these different knives and daggers varies regionally, with evidence for cutting šss in Central and Eastern Europe (Grużdź *et al.* 2015), a more ceremonial use in the Lower Rhine Area (Van Gijn 2015) and ideas about ceremonial hunting and sacrifice of animals (*cf.* Varberg 2015). Barbed and tanged arrowheads occur all over Central, Northern and Western Europe in the period between 2500 and 1700 BC. Danish, Breton and British examples were recently studied by Nicolas (2016). It is unclear how this specialised production and exchange of high-quality flint daggers, arrowheads and knives relates to the adoption and development of the Bell Beaker phenomenon differently within the distribution of the Bell Beaker phenomenon.

2.3.1.2 Networks

Now that we have looked at the history of research into innovation in both temporal and spatial terms, let us see how the concept of networks has been approached by archaeologists in the past.

In archaeology, network analysis is a relatively new method. Before the 21st century, the work of Irwin-Williams (1977) stands out as an early example in which she studies the trade networks between Puebloan settlements in New Mexico. She proposes to use the connectivity between settlements, the density of connections and the internal linkage to study "…the integration of units within a socioeconomic system…" (*idem*, 149). Coining the term "Beaker network", Clarke (1976) is also one of the first to see the importance of this concept for studying the Bell Beaker phenomenon. His model is relatively schematic, and focuses mainly on the quality of natural clays and the need for exchange to arrive at the distribution and percentages in Bell Beaker thin-walled, high-quality, pottery.[6]

The use of networks in studying the diffusion of innovations specifically has been underexplored. Archaeological applications of innovation networks and the adoption of new ideas in prehistory, do present a fruitful avenue for new research in Brughmans' (2013, 635-636) opinion. Most recent work (Brughmans 2010, Brughmans/Poblome 2015, Graham 2006) primarily focused on specific geographical networks and the role of variables such as roads, in the diffusion of specific pottery types or other innovations in Roman times. Examples of network analysis focussing on other datasets and archaeological problems are scarce. An example focusing on communication networks in the Late Neolithic Baden and Corded Ware phenomena, is the work of Furholt (*e.g.* 2011, see fig. 2.4). He uses large datasets of Corded Ware and Baden settlements and funerary assemblages to reconstruct the communication spheres between different regional groups for these two Late Neolithic phenomena, based on network analytical methods. The datasets he uses comprise of many different variables. However, it is not clear whether all of these variables can be treated equally and considered relevant for the study of communication networks (see above).

6 This idea was not picked up after his untimely death in 1976.

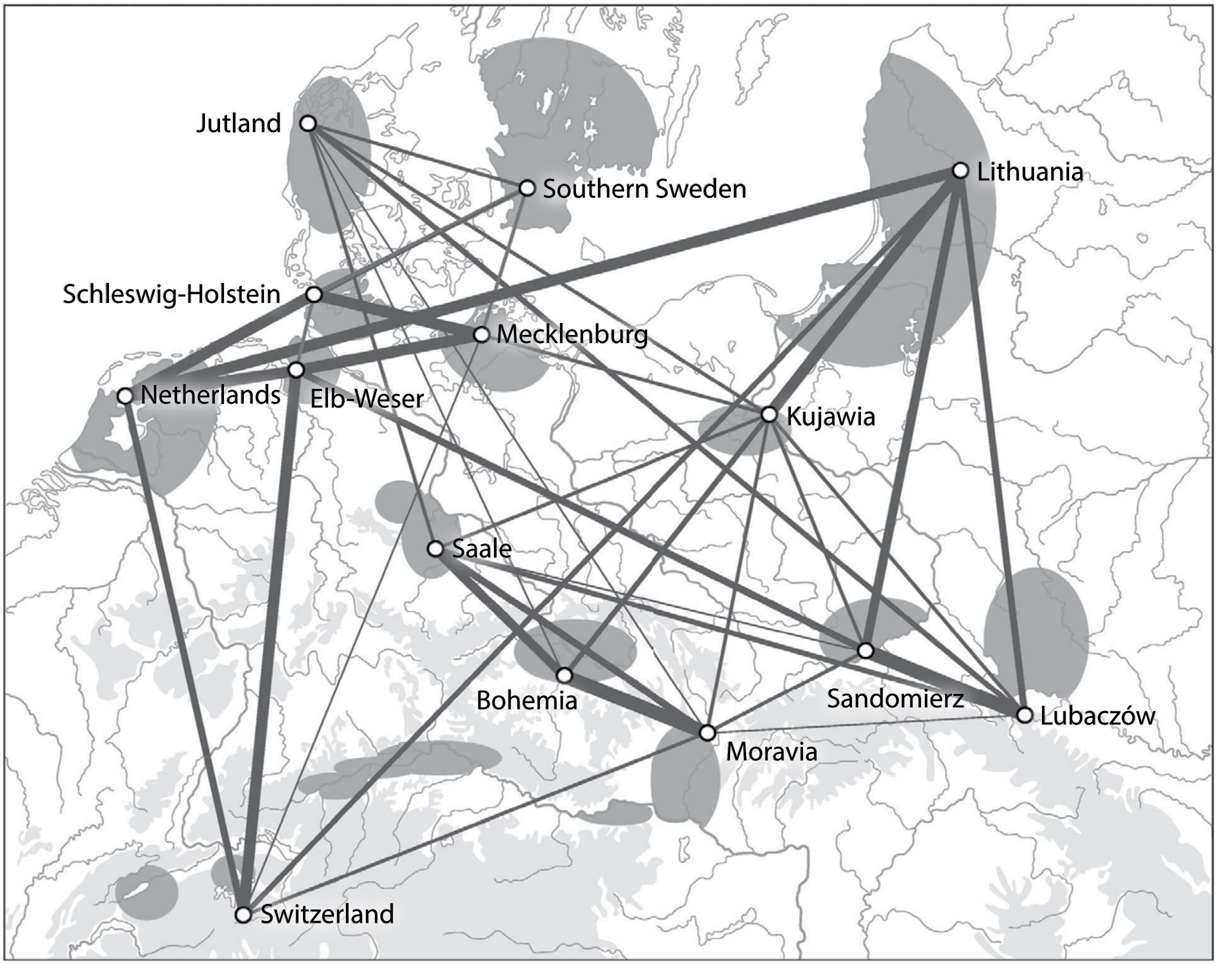


Fig. 2.4 Furholt's model of Corded Ware communication networks in Europe (Furholt 2011, 262, abb. 10).

An example of modelling networks focusing on object exchanges is the work of Golitko *et al.* (2015, see also Weidele *et al.* 2016) and their analysis of obsidian sources and the Mayan collapse. Through reconstructing these exchange networks, both the communication between settlements in cliques and specific obsidian distribution networks can be reconstructed. Finally, a recent example of studying the production and distribution of objects, is the work of Radivojevic/Grujic (2017). They studied many compositional analyses on early metallurgy from Southeast Europe and they developed a method to discriminate between three sources for the production of metal artefacts throughout the late 6th, 5th and 4th millennia BC.

2.4 From innovation processes and social landscapes to practices

Our third research question focuses on the interplay between tradition and innovation in adopting the Bell Beaker phenomenon. Thus, it specifically focuses on the *reinvention* process, but primarily from a local perspective. In order to answer this research question, we will look at several studies from anthropology and archaeology that focus on precisely this: the local reinvention of innovations and technologies as uncovered from the study of techniques and practices.

As studies into the anthropology and the sociology of technology show us, the local reinvention of an innovation does not just appear out of thin air (*e.g.* Lemonnier 1993). The process of reinvention depends heavily on the social context of technologies. According to Lemonnier (1993, 4-5), innovation, or giving shape to a new technique and the choices and decisions that come with it, depends on both “technical” and “non-technical” or “social” actors. Thus, it is this specific social context of technology, and the choices made here, that appropriate an innovation within the already existing cultural values and social relations. This is particularly related to the craftsmen and women who are adopting and, more specifically, producing the innovation. Producing something new puts this person right at the forefront of the innovation process, specifically by the choices this person makes. Their choices basically decide the fate and success of the innovation. These choices are related to the *malleability* of their techniques (“how quick can I adopt this new technique?”), the *salience* or *visibility* of these techniques on the end-product and the *social context* of the technology (“what am I allowed to change and expected to produce?”, *cf.* Gosselain 2000, 187-190).

2.4.1 Making innovation happen: pottery

For pottery production three categories can be discerned in manufacturing stages, according to salience, malleability and social context, based on comparative ethnographic fieldwork (*cf.* Gosselain 2000). The first category of techniques is highly salient, highly malleable and highly dependent of social context: these are tempering and clay modification techniques, secondary forming, decorating and certain specific firing techniques and post-firing techniques. The second category consists of techniques that are technically malleable, but (as practical variability is not very well visible) not salient techniques and relatively independent of the social context. Techniques include the selection, extraction and processing of clays and the firing of the end product. The third category is technically not very malleable, leaves no salient traces and is mainly conducted by the potter on an individual basis. Primary forming techniques fall within this category, as the technique is primarily based on motor habits learned at an early age (*e.g.* Arnold 1985, 235-237). Next to that, its end results are not very characteristic (different forming techniques can produce the same vessel) and the techniques are conducted on an individual basis.

Based on this overview of techniques we can state that most visible innovations are to be expected in the first and third category, where social context and potters’ knowledge plays a pivotal role. This features highly malleable innovations such as new decoration techniques, and not very malleable innovations such as the forming of pottery. Especially when analysing the reinvention of an innovation, the latter practice, pottery forming, becomes interesting as it shows clearly the interplay between tradition and innovation because of its long-learning curve and focus on motor-habits. Pottery forming is in essence a very traditional practice. To see changes and innovation in this respect will be more telling, much more significant, than any fashionable change in decorating techniques. Thus, in our analysis we will focus specifically on this pottery forming practice.

Archaeological studies focusing on innovation processes from the perspective of technology and reconstructing production practices have emerged in the 1990s. Roux and Courty (Courty/Roux 1995; Roux/Courty 1998) study the innovation of ‘wheel shaping’, a specific technique of combined coiling and using an early potter’s wheel, from this perspective, analysing surface features and microfabrics. The innovation of the potter’s wheel can be followed through this technique of shaping traditional coil-built vessels, within the context of socio-political changes and the existence of specialised craftspeople (Roux 2003, 25). This last point, specialised craftspeople introducing innovation. With regard to prehistoric ceramics, several studies exist focusing on innovation in pottery forming techniques, such as the development of specific coiling and finishing methods (*e.g.* Gomart 2014; Manem 2008). Some scholars argue that coiling, as a technique, developed in relation to similar

Technological-signatures	Précis of some possibilities for observartions determining skill variability
Clay preparation	Possible variability may include: no error, air pockets are present in the clay matrix, surface voids or inclusions (detritus) are unintentionally breaking the finished surface of the pot. deliberate inclusions have been poorly sorted through the clay matrix.
Manufacturing	The degree to which the selected manufacturing method (*e.g.* pinching, coiling, slab building) has been successfully executed. Possible variability may include: splitting at the rim: uneven finger indentations: poor coil/slab joins; coil/slab join fractures; clay patches as additions to improve wall thickness. Rim evenness, or support handles and lugs; fracturing of the clay surface; inappropriate weight for vessel form.
Wall thickness	Possible variability may occur in inappropriate wall thickness for the vessel form, e.g, too thin or too thick. Or erratic wall thickness may occur where the porter has been unable to control manufacturing processes.
Additions	This is the degree to which handles, foot-rings or lugs have been applied in a manner that meets the proposed outcome. Possible variability may occur through incorrect vertical or horizontal alignment. Additions such as handles that are either poorly formed or inappropriately attached may be strengthened by an additional catch of clay used to prevent slumping of the handle forrn or breakage once in use.
Interior surface treatment	Possible variability is reflected in the degree to which wiping, smoothing, rustication or burnishing has been executed to meet the proposed outcome. An example of skill variability would be where burnishing failed to cover the pot to the intended degree for a suecific vessel form.
Exterior surface treatment	As above
Decoration	Possible skill variability may be the observation of incised lines being 'rubbed out' and then repeated. The decoration over-shootingthe design area. Applied decoration being inadequately bonded to the pot surface.
Rim deviation on the horizontal plane	Possible variability is recorded as the degree to which the vessel rim circumference is even on the horizontal plane. Potters with low degrees of procedural knowledge may, in particular, struggle with this task. Larger forms may be especially prone to skill variability with the rim having a 'wavy' or sagging profile when viewed on the horizontal plane.
Rim symmetry	This is as above but is a measurement of the rim circumference seen from a plan view. Smaller to moderate sized pots can be assessed against a rim circumference chart. It is, however, important to stress that not all pots are intended to be round.
Handle symmetry	Handles may be expected to be aligned vertically and horizontally, possibly in partnership with handle pairs, in very specific ways to meet an intended outcome. Possible variability can be recorded as the extent to which this has been achieved.
Profile symmetry	Possible variability may be recorded as slumping of the form caused by the potter losing control of the form during manufacturing processes or the addition of too much wet clay in one go so that the wet strength of the clay is exceeded.
Firing	Potential variation may occur through over-firing so that clay becomes brittle and starts to melt or under-firing so that clay is prune to start slaking and degrading. Under-fired pots will have a shortened lifespan and be prone to mechanical failure.

Table 2.2 Skill and pottery production (after Budden 2009, 4, table 3).

techniques found in the production of organic containers and basketry, so-called skeuomorphism (Hurcombe 2008). Innovations in other parts of the *chaîne opératoire* have not been studied so intensively.

Next to malleability, salience and social context, the elements of skill and creativity must be mentioned. Both skill and creativity relate to the quality of the reinvented innovation, and influences its sustainability and impact through time (*cf.* Budden 2009). The role of skill in pottery production is well studied in ethnographic contexts (*e.g.* Kramer 1985; Rice 1987; Rye 1981; Wallaert-Petre 2001). Skill is acquired through learning mechanisms based on two types of knowledge: factual knowledge and procedural knowledge. On the one hand, factual knowledge is based on the rules that apply and “what needs to be done”. Procedural knowledge on the other hand, is learned through repeated practice and “how things should be done”. It is the latter type of knowledge that is embedded in social practices and passed on from generation to generation, leading to an increase in skill through time. When this procedural knowledge fails to transmit, skills might get lost and variability between communities can emerge. Made visible in the production process of pottery, Budden (2009) sees skill in the sizes and shapes of the vessels, and varying degrees of complexity in vessel morphological characteristics. Other aspects of pottery production similarly can provide insight into acquired skill, as Budden illustrates clearly.

Creativity as a concept is studied far less by anthropologists or archaeologists, as it is a more problematic concept in general. The edited volume by Mithen (1998) brings several aspects of creativity together of which some are interesting to the study of the social aspects of pottery technology. According to Boden (1998) creative thinking requires the discipline of rules. It is only with these rules that creative expression can become socially acceptable. However, creativity also needs independence in its execution. As Gosselain (2000) describes, pottery decoration is usually governed by rules, because of its visibility. Therefore, as Barley (1994, 115-117) already states, creativity will probably be low in the decorating practices of pottery. In agreement to this, David *et al.* (1988, 370) see the decorating of pottery at the Mafa tribe “…as part of the craft rather than an art, generally quite neatly but without either much imagination or care.” When we do see the *care* in decorating pottery, it is often not recognised as creativity, but as execution of the aforementioned skill (Budden 2009, table 3). Imagination, or creativity for that matter, however is not easily explained by skill. It can be argued that the ‘social rules’, based on visibility that govern decorative schemes, can also be responsible for a more subtle form of creativity, not answering to the question ‘why pots are decorated’, but ‘why pots are decorated so differently’.

3 Methods

3.1 Introduction

In the previous chapter past research into innovation was reviewed, and specifically archaeological examples of innovation research were described. The theoretical perspectives towards innovation processes, social landscapes and practices were described, and overviews of methodological developments and examples of how innovation is being studied in archaeology were given. We've focused on Rogers' S-curve model and the innovation processes he discerned, the social technology approach of Lemonnier and others, network analysis and Granovetter's strength of weak ties model. We've seen the different ways archaeologists have made use of these works on innovation. From Zvelebil's availability model, to the 'wave of advance'-models, to the use of network analysis in archaeological research.

How now can we practically use all these ideas and examples for answering out own research questions? How can this overview aid in our understanding how local communities adopted the Bell Beaker phenomenon? This chapter will use the aforementioned perspectives in operationalising this research question. In this chapter, based on the theoretical and methodological writing, we will make informed choices on the methods that will be employed, variables that are selected, measurements that have to be taken in relation to the different datasets at hand. This will be done in three different themes, focusing on recognising processes of innovation, revealing mechanisms of innovation and reconstructing practices of innovation. These three themes, as we have already seen in the previous chapter, will further guide us through understanding innovation and the Bell Beaker phenomenon.

3.2 Processes of innovation

3.2.1 Pottery frequencies

In chapter 1 we defined our first research question as follows 'How did the adoption process of the Bell Beaker phenomenon take place in temporal terms?' In chapter 2 we have seen that by studying innovation we can better understand this adoption process, its phasing and the different aspects and qualities involved. By reconstructing the S-curve, both Rogers and Zvelebil give us insight into the temporal aspects of the adoption process, in terms of the phasing of the innovation process, but also with regard to the pace, the impact and the sustainability of the innovation. We have seen that past research into the temporality of the introduction of the Bell Beaker phenomenon favours a swift transition with a large impact on traditional Late Neolithic societies. We will test this here with the study of the Bell Beaker innovation process.

In order to operationalise the study of the Bell Beaker innovation process we have to find ways to measure the Bell Beaker innovation. Measuring the phasing

Table 3.1 The various distinguished pottery categories and their characteristics.

Pottery type	Definition	Literature
Bell Beaker, Glockenbecher	Spatula, cord, cardium or incised partly or completely decorated, thin-walled (2-6 mm), s-shaped vessels	Reinecke 1900
Common Ware, Begeleitkeramik, Céramique commune	Undecorated or finger/nail-impressed, cordoned, thick-walled (10+ mm), s-shaped vessels	Besse 2003
Potbeker	Completely decorated by means of finger/nail impression and motifs in relief, medium thick-walled (5-10 mm), s-shaped vessels	Lehmann 1965
Corded Ware, Schnurkeramik	Smooth spatula, cord or incised partly decorated, thin-walled (2-6 mm), s-shaped vessels	Beckerman 2015
Barbed Wire	Barbed-wire decorated, s-shaped, medium thick to thick-walled vessels	Struve 1955, 51
Schönfeld	Vessels with stab-decoration (*stichverziert*) in alternating horizontal and geometric motifs	Wetzel 1979; Schwarzberg 1994
Vlaardingen	Undecorated or impressed, medium thick to thick-walled s-shaped vessels	Beckerman/Raemaekers 2009
Funnel Beaker	Pottery decorated with deep impressions in geometric motifs, thin-walled, funnel-necked vessels	Bakker 1979
Channeled Ware	Burnished thin-walled, conically shaped vessels with channelled decoration	Blance 1959; Amaro 2012
Kerbblatt/Acacia	Incised decorated, thin to medium thick-walled, globular or conical vessels	Kunst 1995
Artenac	Undecorated thick-walled flat bottomed vases and round bottomed bowls and thin-walled round bottomed burnished bowls decorated with rows of impressions and bosses, with perforated and nasiform handles	Bailloud/Burnez 1962
Artenac tardif	Fine Artenac bowls with continuous horizontal bands of impressed spatula or incised decoration	Cormenier 2009
Gord/Deule/Escaut/SOM	Undecorated or impressed, thick-walled, s-shaped or barrel-shaped vessels	Chambon/Salanova 1996
Dented rim	Undecorated, thick-walled vessels that have flattened rims with intentations	Spindler 1976
Inside decorated	Vessels, bowl or dish-shaped, sometimes handled, with interior incised decoration in geometric motifs.	Leisner 1961; da Veiga Ferreira 1971b
Cord	Medium to thick-walled cord impressed, geometrically decorated vessels	Joussaume 1981
Undecorated	All other undecorated vessels	
Impressed	All other thick-walled vessels with impressed decoration	
Incised	All other thick-walled vessels with incised decoration	
Applied	All other thick-walled vessels with applied decoration	

of the innovation that is known as the Neolithisation process, was done by Zvelebil by studying the percentage of domesticates found on archaeological settlements. A similar study of pottery percentages might give us an indication as to the different degrees as to which the Bell Beaker phenomenon became adopted. As said before, Fokkens (2008, 2012b) states that it is impossible to see the start of an innovation archaeologically, but only the moment at which a critical mass takes it up. Therefore 'finding the earliest moment of adoption' will not be the aim of our analysis. Instead, the three phases described by Zvelebil's availability model are used in a descriptive way, related to an increasing integration of the phenomenon into traditional daily life. Thus, in order to study these different temporal aspects of the innovation process and describe the different phases of the Availability model for our six research areas, the percentages of pottery from settlements will be calculated.

Pottery percentages have been used before in the study of the Bell Beaker phenomenon. Barfield (2001) remarked that we, instead of studying the Bell Beaker phenomenon, should study the Common Ware as it often represents more than 90% of the pottery on settlements. Before Barfield, it was Clarke (1976) who used the percentages of Bell Beakers found on settlements in his model of the Bell Beaker network. So, it is clear that variability in the percentage of Bell Beakers exists and that this variability can be measured with accuracy. The explanatory framework is however different to Clarke's, who focused on pottery exchange networks.

The calculated percentages are based on the presence of certain decorative patterns, vessel shapes, wall thickness and the expert judgement within excavation reports (see figure 3.1). The frequencies of Bell Beaker pottery are counted either as whole vessels or as sherds, either from images or from the descriptive text itself, depending on the publication. Additionally, for some settlements, multiple sources were available. When these sources clearly present different datasets (such as excavation campaigns), these were combined. When these sources talk about the same dataset but using different numbers we use the source that is the most recent.

These pottery percentages from Bell Beaker settlements are combined with associated radiocarbon dates from their specific Bell Beaker occupation phases, to see whether any development is visible from one stage in the Availability model to another. These radiocarbon dates are then used to order settlements chronologically by means of both median and the weighted means/aoristic method (*cf.* Crema 2011). Doing so, we will get an insight into the chronological development of percentages of Bell Beaker pottery through time for each research area. We will then be able to ascribe these to the different phases of the availability model (Availability phase <5%, Substitution phase 5-50%, Consolidation phase >50%). By doing this we will get an insight into the regional phasing of the Bell Beaker phenomenon, and the impact and integration of the phenomenon in daily life. This will allow us to answer specific aspects of temporality addressed in the first research question.

3.2.2 Settlement frequencies

Next to looking for chronological developments with the Availability model for the Bell Beaker phenomenon, we can study the temporal terms of its adoption from a different, more qualitative perspective. By studying the total amount of sites within a range of percentages we can see what impact the adoption of the Bell Beaker phenomenon had on the total number of settlements, and how sustainable this innovation was.

We can distinguish different ranges in the percentages of Bell Beaker pottery on settlements. Settlements with a low percentage of Bell Beaker pottery (0-20%), a low to medium percentage (20-40%), a medium percentage (40-60%), a medium to high percentage (60-80%) and settlements with high percentage of Bell Beaker pottery

	Low % BB pottery	Interpretation	High % BB pottery	Interpretation
low number of sites	low amount of sites with low amount of BB pottery **(A)**	low impact	low amount of sites with high amount of BB pottery **(B)**	low sustainability
high number of sites	high amount of sites with low amount of BB pottery **(C)**	high impact	high amount of sites with high amount of BB pottery **(D)**	high sustainability

Table 3.2 Interpretation of the numbers of sites and percentages of pottery.

(80-100%). For our analysis we only compare the lowest and highest ranges in order to inform us about the impact and sustainability of the phenomenon on this particular research area. For the number of sites, regional specific ranges will be given as total settlement frequencies varies considerably between research areas.

In general, comparing the low and high number of sites with low and high percentages of Bell Beaker pottery, we are presented with four possible outcomes per research area (see table 3.2).

Firstly, a research area can have a low number of sites with low % of Bell Beaker pottery and also a low number of sites with high % of Bell Beaker pottery. This can be interpreted as a region where the Bell Beaker phenomenon has had a low impact and low sustainability during the whole course of the innovation.

Secondly, a research area can have a low number of sites with low % of Bell Beaker pottery and simultaneously a high number of sites with high % of Bell Beaker pottery. This can be interpreted as a region where the Bell Beaker phenomenon has had a low impact but a high sustainability.

Thirdly, research areas can have a high number of sites with low % of Bell Beaker pottery but at the same time a low number of sites with high % of Bell Beaker pottery. This can be interpreted as a region where the Bell Beaker phenomenon has had a high impact but a lower sustainability.

And finally. it can be that a high number of sites with low % of Bell Beaker pottery, coincides with high number of sites with high % of Bell Beaker pottery in a particular research area. This can be interpreted as a region where the Bell Beaker phenomenon has had a high impact and high sustainability during the course of the innovation.

By analysing the frequencies of settlements and their respective range of Bell Beaker pottery percentages, we will thus be able to present further evidence for more qualitative aspects of temporality in the innovation process, specifically aspects dealing with the impact and sustainability are involved here. These aspects are critical in understanding the regional adoption process that is the subject of our first research question.

3.2.3 Bayesian analysis of settlement chronologies

A final analysis with regard to our first research question, takes us deeper into the settlement data and chronology. Taking a proxy-approach, several specific settlements can aid us in a more qualitative understanding of the adoption of the Bell Beaker phenomenon in general terms. By looking at settlements that show a long-term occupation, and by studying their internal site chronology prior to, during and after the Bell Beaker occupation, it is possible to assess more precisely the moment at which an innovation becomes adopted and the sustainability of the adopted innovation.

The method of Bayesian statistics (*e.g.* Buck *et al.* 1991) can provide the mathematical tools to unravel these site chronologies and the intervals between occupation phases needed. Recent studies using Bayesian modelling of radiocarbon data have even achieved chronological resolution on a decadal scale, making it possible for the first time to create generational narratives based on prehistoric archaeolog-

Bayesian interpretation	Bayesian model section	Proxy for innovation	Literature
1. Generational site histories			Bayliss *et al* 2007; Whittle *et al* 2011
2. Interpreting patterns of change	2a. Intervals between occupation phases 2b. Duration of occupation phases	Moment of adoption Sustainability of innovation	This thesis

Table 3.3 Interpreting the outcomes of a Bayesian analysis of radiocarbon dates.

ical datasets (*e.g.* Bayliss *et al.* 2007; Whittle *et al.* 2011). What we will focus on here is however different. Because the product of Bayesian modelling can also be used as an aide in the interpretation of patterns of change and, in our case, a closer look at the adoption of an innovation. When considering the intervals between occupation phases and the duration of occupation phases, these tell us about the moment of adoption and the sustainability of the innovation respectively (see table 3.3). Specifically, the OxCal commands of SPAN () and INTERVAL () are used to calculate these aspects (*cf.* Bronk Ramsey 2009).

As a side note, next to aiding our understanding of the temporality of the Bell Beaker adoption process, these Bayesian models can also help independently test the 'wave of advance' models of Bell Beaker diffusion that have appeared in the past, as highlighted in chapter 2 (*e.g.* Müller/Van Willigen 2001).

Concluding, our approach towards understanding the adoption of the Bell Beaker phenomenon across Europe from a temporal perspective uses three different methods. Pottery frequencies will show the temporality based on the availability model itself, focusing on its phasing. Settlement frequencies will inform us about the aspects of impact and sustainability. Finally, Bayesian models will show us the timing of adoption and the sustainability of the Bell Beaker innovation, and finally also test the generalised models of Bell Beaker diffusion.

If the Bell Beaker phenomenon were to be a single 'wave of advance' migration or other kind of diffusion of ideas, as is currently a favoured interpretation, we would expect the values of these different aspects to be virtually similar across Europe. This especially holds true for the aspects of timing, pace and sustainability. Also, as past models have always stressed the fast-paced nature of this transition, we would expect this to be likewise in Bell Beaker settlement chronologies. Similarly, as many have stressed that the Bell Beaker phenomenon is a uniform 'blanket' over Europe, this would also assume a uniform integration of the Bell Beaker phenomenon through the Substitution and Consolidation phases of the adoption process. With the use of the above described methods and backed up by settlement data, we can test these hypotheses.

3.3 Social landscapes of innovation

3.3.1 Introduction

Our second research question focuses on the social landscapes of innovation. In chapter 1 we have seen that the spatial analysis of the Bell Beaker diffusion is dominated by the study of various objects, raw materials and practices, but mainly confined to distribution maps and interpretations focusing on elite exchange networks. This again is primarily based in the nature of the (primarily funerary) dataset used. Unsurprisingly, these studies do not really consider the mechanisms at play in the adoption of these innovations, associated with the Bell Beaker phenomenon. In chapter 2 we proposed to take a different approach by using the concept of the network, more specifically the Bell Beaker network. This concept allows for a simultaneous study of the mechanisms, actors and media involved. By analysing various distributions of objects from a strictly contextual point of view, and by studying the relationships between settlements, an insight into the various media, actors and mechanisms is gained. This will allow us to answer our second research question concerning the social landscapes of the Bell Beaker innovation. Finding strong and weak ties, more connected and less connected networks, central and less-central nodes within the network, will present a whole new way of understanding the mechanisms of adopting the Bell Beaker innovation.

Our first method focuses on mapping the distribution of specific objects and practices found on Bell Beaker settlements. Our second method studies the relationships between these settlements within a research area, by using methods from network analysis. This will for the first time give insights into the communication networks between Bell Beaker settlements and the cliques within the social landscape in which the Bell Beaker innovation had to be adopted.

3.3.2 Network analysis

In order to assess the communication and exchange of ideas related to the adoption of the Bell Beaker phenomenon, a network analysis will be carried out. The material used for this analysis comprises of the material culture assemblages found on settlements. Based on an analysis of material culture data from the settlements, communication and exchange networks will be reconstructed. This allows for the identification of possible cliques within the dataset. Next to that it will be possible to assess the centrality of specific settlements within each region. More specifically all pottery, metal, stone and flint artefacts and archaeobotanical and archaeozoological data from these settlements will be combined in a single dataset. In the following paragraphs the statistical methods will be explained and after that, an overview will be given of the specific variables that will be measured and artefact types that will be included.

When reconstructing networks, it is important to know what the chosen variables can represent and specifically tell us about past communication and exchange. As we have seen when discussing innovation theory and pottery production, different aspects of pottery technology are affected differently within society, and are thus differently connected to the communication and exchange of ideas between communities. For this matter, the reconstruction of communication and exchange networks is based on both the analysis of the pottery decoration motifs and the analysis of flint, stone and metal artefacts (objects and raw materials) and zoological and botanical data related to subsistence activities. Other aspects such as pottery vessel shape, do not form part of this analysis, because changes therein reflect more deeply rooted changes within traditions in society not primarily constrained by communication and exchange networks.

3.3.2.1 Statistical methods

In order to study the similarities between settlement assemblages, the Brainerd-Robinson coefficient will be used (Brainerd 1951; Robinson 1951). This coefficient is often used in archaeology to compare assemblages from different sites (*e.g.* Flannery 1976). The earlier referred to work of Furholt (2011) uses Correspondence Analysis and the Pearson's r coefficient. However, as Cowgill argues, comparing collections can better be done by other means (Cowgill 1990) such as the Brainerd-Robinson coefficient. Quite recently, Habiba *et al.*, when discussing Correspondence Analysis, state that the Brainerd-Robinson coefficient is better suited "…to assess the proportions of types of objects…" (Habiba *et al.* 2018, 65).

For the Brainerd-Robinson calculations based on the dataset we will be using a script in R (Peeples 2011). The Network Analysis will be carried out using the software Visone (Brandes/Wagner 2004).

Further analysis within the networks will be carried out using the betweenness centrality index and the Girvan-Newman algorithm. The betweenness centrality index measures the extent to which a node lies on the path between other nodes (Newman 2010, 185). Thus, it is used frequently for the analysis of the flows and control of information between different nodes within social network analysis. The Girvan-Newman algorithm was developed for identifying community structure in social and biological networks (Girvan/Newman 2002; Newman/Girvan 2004) and can thus be used to find the cliques in the network that hamper innovation according the Strength of Weak Ties model.

3.3.2.2 Dataset

Pottery (see table 3.4-5)

For the study of pottery, the focus will on a comparison of the frequency of Bell Beaker, Common Ware and Potbeker pottery (taken from the previous analysis) and details to the frequencies in which certain decoration techniques occur and the extent to which vessels are decorated. For Bell Beaker pottery, we distinguish between cord-impressed, spatula-impressed, *Cardium* impressed or incised (or combinations of these) decoration techniques. With regard to motifs we can distinguish between the all-over, zoned and geometric categories. Additionally, the presence of incrustation or paint was recorded.

For Common Ware and Potbeker pottery a distinction was made between applied (cordon, *Wellenleist*, band, rustication, warts) and impressed/incised (nail, finger,

Table 3.4 Bell Beaker pottery variables.

Decoration types	Description
cardium	impression made with Cardium shell (Prieto Martinez/Salanova 2009)
spatula	impression made with a spatula implement (Simpson 2004)
cord	impression made with a cord (Grömer/Kern 2010)
incision/impression	combination of impressed and incised decoration
cord/spatula	combination of cord and spatula impression
spatula/incision	combination of spatula and incised decoration
Decoration extent	**Description**
all-over	decoration covering the whole body of the vessel
zoned	decoration covering either the whole body of the vessel or the upper half, alternating empty zones with horizontally decorated zones
geometric	decoration covering either the whole body of the vessel or the upper half, in diagonal or vertically decorated zones
Decoration extra	**Description**
incrustation	white substance (often bone, Všianský *et al* 2014) placed in the impressed or incised decorated negative surface of the vessel
paint	red or black substance partially or fully covering the vessel (cf. Nadler 1998)

Decoration types applied	Description
Cordon	applied band below the rim of the vessel, horizontal
Wellenleist	applied band below the rim of the vessel, wavy line (Becker 1951)
Bands	pinched or incised horizontal relief on the body of the vessel
Rusticated	irregular lump of clay applied to the body of the vessel
Warts	pinched round or oval relief on the body of the vessel
Decoration types impressed	**Description**
Nail	impression using the tip of the fingernail
Finger	impression using the tip of the finger (tend to be deeper and coarser than nail impressions)
Cord	impression using cord
Spatula	impression using spatula
Incision/Groove	incised line, or broader groove, in any direction or motif
Round/Oval/Triangular	impression by means of any object leaving hollow round, oval or triangular traces
Barbed Wire	impression using a knotted and twisted cord, resembling the appearance of barbed wire
Pseudo-cord	impression using the tip of the fingernail in a pattern that resembles cord or barbed wire impression
Handles	**Description**
Holes beneath rim	the presence or absence of one or several holes (either full holes or partially impressed holes) below the rim
Horseshoehandles	applied cordons in the shape of an upside-down horseshoe
horizontal_perf	horizontal applied handles with perforation
horizontal_unperf	horizontal applied handles without perforation
knobs on/below rim	horizontal applied knobs on or below the rim
vertical	vertical applied handles
Feet	**Description**
Foot_flat	vessel with a flat to lens-shaped base
Foot_protruding	vessel with a protruding base
Foot_round	vessel with a round base
Decoration extent	**Description**
All Over	decoration covering the whole body of the vessel
Random	decoration without a regular motif, covering either the whole or upper half of the vessel
Zoned	decoration covering either the whole body of the vessel or the upper half, alternating empty zones with horizontally decorated zones
Geometric	decoration covering either the whole body of the vessel or the upper half, in diagonal or vertically decorated zones

Table 3.5 Common Ware and Potbeker pottery variables.

Functional category	Tool type
production	droplet
	slag
ornament	band/strip
tool	awl
	chisel
weapon	Palmela point
	dagger

Table 3.6 Types of metal objects.

cord, spatula, incision/groove, round/oval/triangular, barbed wire, pseudo-barbed wire) types of decoration. Other characteristics are possible holes below the rim, the presence and type of handles, the type of foot present on the vessel, and extent of the decoration. Because Common Ware and Potbeker pottery often display complex combinations of decoration techniques, even more so than regular Bell Beakers, it was chosen to describe these on a vessel-by-vessel basis, whenever vessel-specific information was available.

Metal artefacts and production waste (see table 3.6)

For metalwork the analysis will focus on object types that are present on settlements in France, Belgium, the Netherlands, Denmark, Germany and the Czech Republic.[7] Evidence for production debris can inform us on the local or nature of metallurgical practices. For the metal objects a distinction is made between objects related to metalworking itself, weapons (*e.g.* daggers, points, halberds, arrowheads), ornaments (*e.g.* beads, pendants) and tools (*e.g.* axes, awls, chisels). This distinction is a common method in the study of prehistoric metalwork (*cf.* Fontijn 2002, Kuijpers 2008).

Stone and flint tools (see table 3.7)

Stone and flint assemblages from settlements are mainly studied by comparing the frequencies of typologically assignable tool types. Within the different research areas, different methods exist to study flint. A concordance table is provided to be able to compare the different research areas with each other. This can inform us about practices taking place at settlements. Additionally, the raw material of stone and flint will be addressed, considering the interpretation of for example daggers and axes as exotic objects possibly acquired though long-distance exchanges (Drenth 2015). All tools can be either in preform, complete or fragmentary state, this has only been recorded in incidental cases. Preform tools can inform us about the local production of specific tools or the local use of certain raw materials.

With regard to more detailed stone and flint tool typology, several choices have been made. Dagger typology follows the work of Lomborg (1973), with mainly type I and II and the various subtypes occurring in Bell Beaker contexts (Vandkilde 1996, 13-14).

Arrowheads are recorded by using a combination of different regional typologies (see table 3.8 and figure 3.1). Distinguished are triangular, trapezoidal, tanged, miter-shaped, lozenge, hollow based, barbed and tanged, leaf shaped and barbed arrowheads. The Mesolithic and Early Neolithic arrowheads found on some sites are not taken into consideration here. In Portuguese literature lozenge shaped arrowheads

7 The Iberian Peninsula has a completely different development in terms of metallurgy and metal tools and is therefore not taken into account here.

Artefacts		Production waste
adze	hammer stone	blade
anvil	knife	core
arrowhead	microlith	core preparation flake
arrowshaft smoothener	microserrated tool	core rejuvination flake
axe	perforated adze	flake
axe fragment	pic	fragment
battle axe	point	hammered piece
battle axe fragment	polishing stone	notched piece
bec	punch	piece
borer	retouched blade	plate
bracer	retouched flake	potlid
burin	retouchoir	splinter
chisel	saw	splintered piece
chute de burin	scraper	truncated piece
combination tool	serrated tool	waste
cooking stone	sickle blade	
cubic stone	sinker	
cup mark stone	splitted segments	
cushion stone	strike-a-light	
dagger	vessel	
dagger fragment	wedge	
gouge	whetstone	
grinding stone		

Table 3.7 The various stone and flint tools and artefacts distinguished.

are usually named triangular, as the base of these arrowheads is triangular in shape, giving the full arrowhead a lozenge or diamond-shape. Another mention must be made of the Portuguese regional type of so-called Eiffeltower shape, which are hollow-based arrowheads with a very concave point. In this study these Eiffeltower-shaped arrowheads are categorised as hollow-based. Other, more detailed, classifications exist, especially by Uerpmann/Uerpmann (2003) for Portugal taking a morphometric approach, or by Nicolas (2016) focusing mainly on technology and the various barbed and tanged examples. These studies were however not considered here for the sake of conciseness.

With regard to axes, adzes and battle-axes, no typological distinction was made. Flint knives can be produced on backed blades (so-called *couteau à dos*) or surface-retouched as either planoconvex or oval in shape. Scrapers are characterised as either end scrapers, side scrapers or round scrapers, based on the location and extent of the applied retouche.

With regard to stone typology, Knippenberg (in De Leeuwe *et al.* 2008, 101, table 6.3) provided a useful typological framework, against which many determina-

Arrowhead	barbed
	barbed/tanged
	hollow base
	leaf
	lozenge
	mitra/miter
	tanged
	transverse
	triangular

Table 3.8 The types of arrowheads discerned in this study.

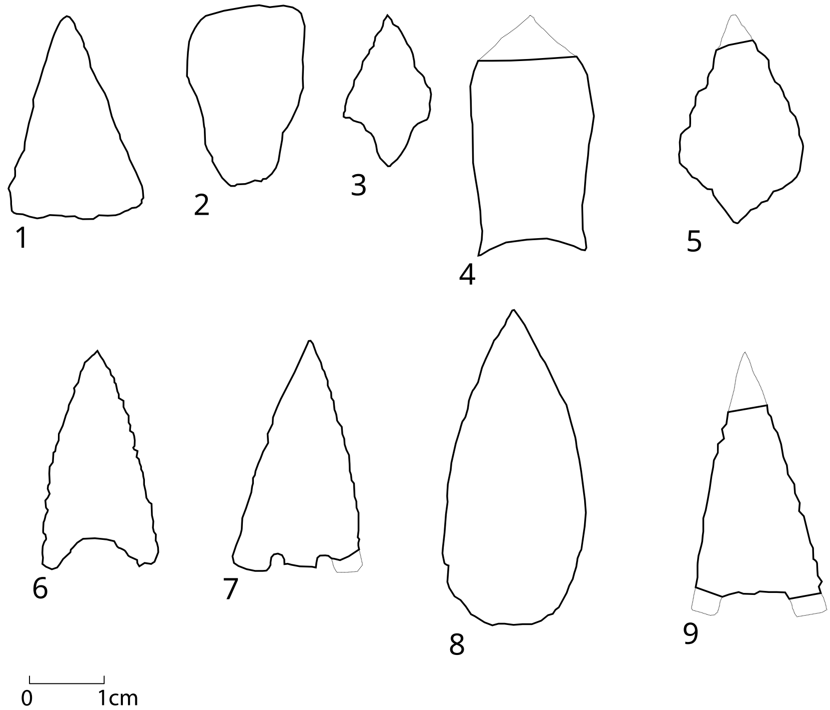


Figure 3.1 The types of arrowheads discerned in this study (not to scale, 1: triangular, after Schreurs 2016, 82.3:1|2: transverse, after Schreurs 2016, 82.3:4|3: tanged, after Scheurs 2016, 82.3:6|4: mitra/miter, after Zbyszewski/da Veiga Ferreira 1958, fig. 5|5: lozenge, after Marolle 1985, fig. 13.2|6: hollow, after Drenth 2016, 31.1:3|7: barbed/tanged, after Schreurs 2016, 82.3:9|8: leaf, after Vanmoerkerke 1986: 77.17|9: barbed, after Liversage 2003, fig. 8.12).

tions from the literature were checked. This is based on the work of Kars (2000) who distinguishes (on the basis of shape and worked surfaces) between anvils, hammer stones, grinding stones, whetstones[8], polishing stones and rubbing stones. Additional types present at Bell Beaker settlements are the arrow-shaft smoother, sometimes however merely categorised as a whetstone[9], the cushion stone (*cf.* Drenth/Freudenberg 2008), and the wristguard/bracer (*cf.* Fokkens *et al.* 2008).

Assigning tools to certain raw materials and their subsequent provenances was done by referring to site specific literature. Not all identifications of rock types were certain or coherent, as some are given at the mineral level instead (see table 3.9).

8 Whetstones are all stones used to sharpen tools, being either passive, active single facetted stones or blocks with multiple facets.

9 See for instance Přichystal/Všianský 2012, 322. Arrowshaft smoothers are found from Late Paleolithic onwards, but have not been studied often. A recent first analysis was done by Riede (2012) on Paleolithic specimen, but more research on the later Neolithic objects and their relationship to arrowhead technologies, combined with experimental work, is necessary.

Stone and flint sources	
Sources	Alpine
	Ardennes
	Belgian
	Escaut
	Grand Pressigny
	Northern France
	Meuse
	Rijckholt
	Saintonge
	Scandinavian
	Southern
	Spiennes
	Wommersom
Approximations	unknown
	local
	non-local
	regional

Table 3.9 Stone and flint sources and approximations.

A useful overview for stone sources in the (stone-poor) Low Countries is given in Niekus/Huisman (2001, table 5.6), where the provenance of stone is related to Northern and Southern sources. This of course is relative, and only works for stone-poor regions of Holocene sedimentary nature lying between the Scandinavian ice-pushed sources and French Tertiary or older sources. Other defined stone sources are all based on the Limburgian, Belgian or French research, from mines such as at Rijckholt (Deeben/de Kort 2013) or Grand Pressigny (Delcourt-Vlaeminck 2004) or well-known sources such as Wommersom. For Scandinavian flint such a sourcing has been attempted (Högberg/Olausson 2007), but this method is not widely used in describing flint yet and hampered by the effects of glacial reworking.

Subsistence data (see table 3.10-11)

Data was gathered from all Bell Beaker settlement sites within the research areas related to the subsistence activities of these communities. The frequencies of wild and domesticated mammals and other animals, and the amount of cereals remains in both grains and waste/processing material (chaff, rachis, stems, etc.) was collected. The method of recovery (sieving or not) was recorded as well.

Two aspects of animal remains will be considered in this study. This is firstly the total percentage of wild versus domesticated animals. Secondly the composition of the bone assemblage in general (distinguishing between wild animals (totals of mammals, birds, fish, reptiles/amphibians and molluscs) and domestic animals (cattle, pigs, sheep/goat, horse and dog)) will be used.

type of rock	type of stone
igneous rock	basalt
	diorite
	dolerite
	granite
	volcanic rock
	pumice (volcanic rock type)
metamorphic rock	amphibolite
	ecologite
	gneiss
	helleflint
	jadeitite
	metamorphic stone
	quartzite
	rock crystal (quartzite type)
	serpentinite
	slate
sedimentary rock	chert
	conglomerate
	flint
	limestone
	sandstone
	siltstone
	quartzitic sandstone
mineral	fibrolite
	quartz

Table 3.10 Stone and flint raw materials.

These two aspects of subsistence economy are not very affected by ecological and geographical circumstances, and this decreases the possibility of having an ecological bias. Settlements that are coastal, for instance, would have more fish remains than inland settlements and would thus be better connected in the network. When comparing only percentages of wild/domestic and percentages of domesticates, this is brought down to a minimum while at the same time taking the subsistence economy, and practices of food consumption, into consideration with regard to the communication networks.

Animal remains	Wild animals	Wild mammals	
		Birds	
		Fishes	
		Amphibians/Reptiles	
		Mollusks	
	Domesticated animals		*Bos primigenius taurus* L. (Cattle)
			Sus scrofa domesticus E. (Pig)
			Ovis aries L./*Capra hircus* L. (Sheep/goat)
			Canis lupus familiaris L. (Dog)
			Equus ferus caballus L. (Horse)
Plant remains	Domesticated cereals	*Hordeum*	*Hordeum vulgare* L. (Barley)
			Hordeum vulgare L. var. *nudum* Hook. f. (Naked barley)
		Triticum	*Triticum aestivum* L. (Bread wheat)
			Triticum dicoccon (Schrank) Schübl. (Emmer wheat)
			Triticum Monococcum L. (Einkorn wheat)
			Triticum Spelta L. (Spelt wheat)
		Avena L. (Oat)	

Table 3.11 Subsistence data (plant names are retrieved from www.theplantlist.org, animal names are retrieved from www.eol.org).

3.4 Practices of innovation

3.4.1 Introduction

Our third research question focuses on the interplay between tradition and innovation at a local level. In the past it was always assumed that the adoption process was a one-way track, everyone wanted to adopt the Bell Beaker phenomenon and all communities adopted it, as we have discussed in chapter 1. However, only by looking at the distribution of the Bell Beaker phenomenon, we come to different conclusions. How are we to explain these differences? Can we see regional differences in adopting innovation and holding on to tradition? In chapter 2 we have seen that this interplay between tradition and innovation is a well-understood research theme for anthropologists focusing on technologies and techniques. These studies use concepts that are well applicable to archaeology, such as the *chaîne opératoire* approach. We've decided in chapter 2 to focus on specifically two aspects of practices related to innovation, the pottery forming stage in the production process and the skill and creativity involved in producing pottery. By analysing this stage and these concepts we will be able to see tradition and innovation play out, we will be able to study the specific reinvention stage of the innovation process on a local, settlement-based, level. The current hypothesis, every community adopted the Bell Beaker phenomenon and all communities (and likewise: potters) did so in the same way, will thus be tested. If we see differences between research areas, or even between settlements (in terms of pottery forming, the skills involved in adopting the innovation or creativity in the

Fig. 3.2 Artist impression of Common Ware pottery. A Potbeker pottery vessel from Emst – Hanendorp, the Netherlands (painting by M. Mak-Kalkman).

expression of the innovation) we will be able to dismantle this uniformist approach and construct a different, more variable, narrative.

3.4.2 Changing forming traditions

The study of changing pottery practices, in relation to the adoption of the Bell Beaker phenomenon follows two paths. The first path studies the changing traditions in pottery forming (see figure 3.2). The study of pottery forming is well suited for such an analysis, as it shows how traditional practices and their motor habits, change over time (*cf.* Gosselain 2000; Wallaert-Petre 2001).

In this analysis, a selection of Common Ware pottery vessel shapes will be analysed in spatial and chronological ways in order to study the ways in which the adoption of the Bell Beaker phenomenon had influences and/or impact on local traditional pottery production process, through changes in the motor habits of potters.

Methodically, the work of Beckerman/Raemaekers (2009) is followed. Beckerman/Raemaekers (2009) studied pottery shapes of the Vlaardingen-group, basing their methods on the work of Graner (2003) and Koch (1998). However, in this study we will calculate certain variables and ratios differently. These different choices will be outlined here. Koch (1998) and Graner (2003) focused on the shape of vessels, but did so irrespective of the vessel size. Beckerman/Raemaekers (2009) changed this for their analysis by taking specific measurements for rim width and minimum and maximum shoulder width, rim, shoulder and vessel height and rim and shoulder angles (see figure 3.3).

However, methodologically, two things in that study are up to debate and executed differently in this study. Firstly, Beckerman and Raemaekers' final cate-

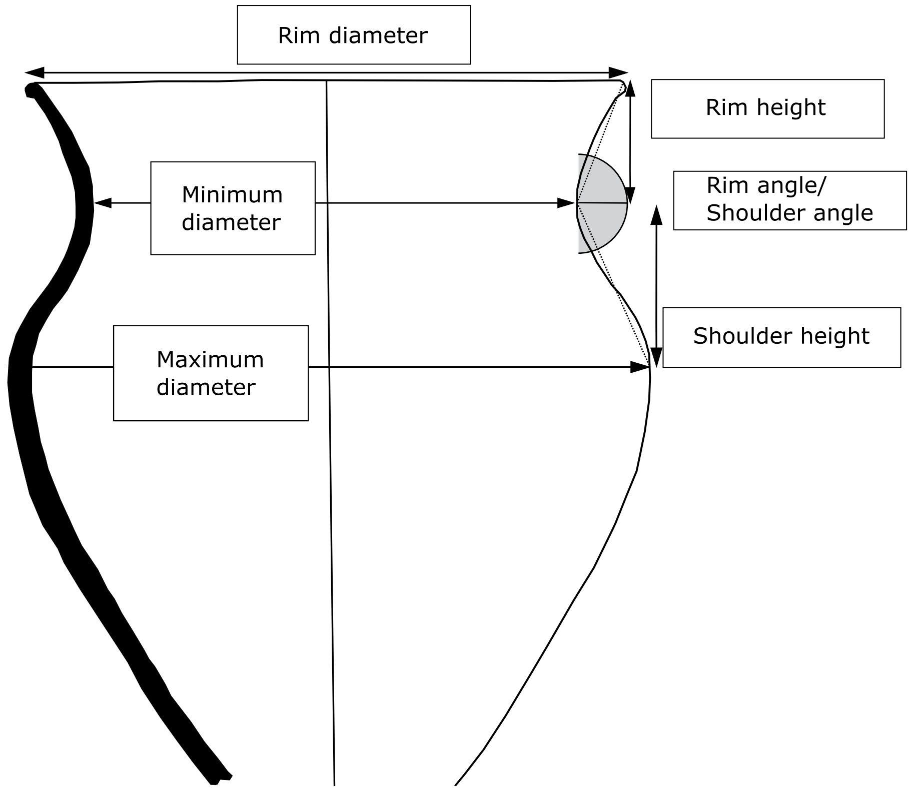


Fig. 3.3 Methods of this study (modified after Beckerman/ Raemaekers 2009).

gorisation of vessel types uses a subjective way, based on the predefined categories. Secondly their method of calculating the shoulder and rim angles of vessels was altered. A different approach to angles is to calculate it on the basis of the measured rim and shoulder heights and widths respectively, using Pythagoras' law ("A^2 x B^2 = C^2 in a right-angled triangle") and the Law of cosines ("$c^2 = a^2 + b^2 - 2ab \cos \gamma$"), making it possible to calculate any angle or side of a triangle when 2 variables (in this case rim or shoulder height and the difference between minimum diameter and rim or maximum diameter respectively) are known.

In the present research the dimensions of a large number of Potbeker, Common Ware and Barbed Wire Beaker vessels, primarily from North Western and Central Europe, are recorded. As comparison, several Artenac vessels are also added as a reference. Cormenier (2009) has already studied the development of vessel shapes from Artenac to Bell Beaker in Western Central France, and this will be a way to test her hypotheses. Similarly, the dataset gathered by Beckerman/Raemaekers (2009) was also added for Late Neolithic comparison.[10]

Recorded variables are a vessel's height, rim diameter, minimum diameter, maximum diameter, rim height, shoulder height. Calculated on the basis of this dataset are the shoulder and rim angles. Additionally, decorative elements were recorded, the presence or absence of (semi-)perforated holes beneath the rim, temper (when known), presence and type of handles (horizontal, vertical, perforated, horseshoe-shaped) and the shape of the base (flat, lens, hollow, protruding). Finally, a typological characterisation was made based on the site report expert judgement and consensus.

Analysis consists of a Principal Component Analysis, carried out in PAST (Hammer *et al.* 2001), and additional analysis using SPSS.

10 Many thanks to Dr. S.M. Beckerman who provided the original dataset.

3.4.3 Skill and creativity

Aside from the changes in tradition, in the motor-habits learned by young potters, as a notable element in the adoption of an innovation, the adoption of innovations is surrounded by the acquisition of new skills and processes of creativity. Studying these skills and elements of creativity, we can further refine our understanding of the local environment in which potters had to operate with the adoption of the Bell Beaker phenomenon.

3.4.3.1 Skill

Skill forms an intricate part of all the aspects of the production sequence, and all the variables are affected by certain choices made by the potter. In particular the shaping of the vessel can be a way to study skill more specifically, as was already demonstrated for wheel-thrown pottery by Roux (1990), among others. Experiments in the production of Bell Beaker pottery (Van Der Leeuw 1976; Hammersmith 2010) have presented a good overview and assessment of the skills and choices a potter has. Here, we can relate to this aspect of skill with answering a number of questions: how good was the potter in rolling thin coils, attaching the coils to one another and building thin walls (the effect of 'poor binding' mentioned by Hammersmith 2010, 125), without the vessel to collapse or break? How much care and effort were put in smoothing or roughening the surface of the vessel? Next to vessel forming, skill plays a part in the decorating of a vessel. How much care was put into following the familiar Bell Beaker motifs? Is there a difference in the way these motifs are executed?

3.4.3.2 Creativity

Creativity reflects the personal choices a potter makes within the production process, the 'bandwidth' a potter has and exploits acting within the predefined structures. This bandwidth is not the same everywhere, and thus expressions of creativity vary. Creativity is generally low in parts of the production sequence where visibility plays an important role such as decorating pottery (Barley 1994, 120). This leads us to expect low degrees of variability within ceramic decorative schemes themselves, however the variability within the *expression* of these schemes can be a creative enterprise.

A detailed analysis of various steps in the *chaîne opératoire* from several settlements, focusing on the aspects mentioned above (wall thickness, coiling technique, variability and execution of decoration motifs) will provide an insight in the potters' choices, skills and levels of creativity in adopting the Bell Beaker phenomenon. Low levels of skill and a lack of creativity will probably result in the diminishing of an innovation, a low level of sustainability. Thus, this inquiry will also show us in what way this Bell Beaker innovation was sustainable or not on this settlement and within this research area.

3.5 A note on settlement sites

As said, the basis for this work lies with the analysis of Bell Beaker settlements. Understanding both the material culture and remains of subsistence found on settlements will prove insight into the daily lives of communities across Europe and their adoption of the Bell Beaker phenomenon. The settlements gathered for this study are all *excavated* archaeological sites, dating between 2900 and 1900 BC. Their chronological attribution is based on a variety of evidence (pottery, flint, stratigraphy and/or absolute dating). Within this study a settlement is not limited to structural evidence, but can range from several types. In this study we define single features (type A), to a cultural layer (type B), structural remains (type C), a filled up natural deposit (type D) or a cumulative palimpsest situation (type E). These different categories, which will be discussed in more detail below, are discerned because there might be a relationship between the nature of the habitation and the material culture present (both frequencies and assemblages).[11]

A. A single feature is any man-made negative disturbance of the soil, which can be a pit or a ditch, or positive build-up of soil or stone.
B. A cultural layer can be defined as an accumulation of soil material and debris on the former land surface, sometimes accompanied by features such as ploughmarks or cattle hoof imprints.
C. Structural remains are defined as any pattern in features that could have been part of a walled and roofed structure. This can be both irregular spaced features, such as at several Late Neolithic settlements in Germany and the Netherlands, or more regularly spaced features of houses in Denmark, Northern Germany or France. Also walled structures, such as the enclosed settlements of Spain and Portugal, fall within this category.
D. A filled up natural deposit can be a natural silted up gully or a three-throw hole, both cases in which material culture ends up in a naturally formed closed environment.
E. Finally, a cumulative palimpsest is a site where different occupations are both superimposed on each other and mixed in terms of the horizontal and vertical spatial distribution of finds (after Smit 2010, 150; Bailey 2007, 203-208).

3.6 Conclusion

The three different aspects of innovation addressed here (processes, mechanisms and practices), and their respective methods allow us to look at different aspects of the adoption of the Bell Beaker phenomenon across Europe.

We will start our analysis by studying the innovation processes, focusing on pottery percentages, settlement frequencies and the chronological modelling of occupation spans and intervals. The innovation mechanisms will be analysed by studying networks of communication and the exchange of ideas between settlements. Following this, we will study the ways in which tradition and innovation are played out at the hands of the potter and his or her motor habits. We will end our analysis by moving beyond the potter's hands into the potter's mind, the choices made, and the various actions involved in adopting the Bell Beaker phenomenon on a very local and almost private scale.

11 Settlements for which the type is unknown are labelled X in the database.

4 Sources and limitations: settlements and radiocarbon dates

4.1 Sources

In the previous two chapters, the theory and methodology to be able to answer the main research question, and the practical methods at our disposal to analyse our dataset, were discussed. Before we start this analysis in the next chapter, it is however first necessary to look at this dataset a bit closer. In this chapter the sources for the settlements dataset, the dataset on settlement assemblages and the radiocarbon dates will be outlined. Next to that, the origins, possible biases and limitations will be discussed in detail.

Most of the data used in this study is based on settlement evidence. While there has never been a comparison of Bell Beaker settlement evidence across Europe, and thus no clear-cut dataset to work with directly, there are various more general overviews of the Bell Beaker phenomenon, regional synthetic studies, Master and PhD theses, unpublished sources, and overview articles that give a first impression as to the nature of the evidence and the variability.

The most important starting point is the work of Vander Linden (2006) who relatively recently compiled an overview and synthesis of the Bell Beaker phenomenon, including the settlement evidence from all research areas. Additionally, the publications from several of the *Archéologie et Gobelets* meetings provide valuable overviews (Benz/Stadelbacher 1995; Benz/Van Willigen 1998; Nicolis 2001; Czebreszuk/Szmyt 2003; Rojo-Guerra *et al.* 2005; Baioni *et al.* 2008; Fokkens/Nicolis 2012; Prieto-Martinez/Salanova 2013; Besse 2014; Prieto-Martinez/Salanova 2015; Kleijne *et al.* 2018). Thirdly, the work of Besse (2003a) compiled many Bell Beaker settlements and pottery finds from all over Europe. The regional overviews from which data was gathered include a variety of sources. For Portugal, De Carvalho Amaro (2012) studied the Chalcolithic pottery technology development from the Estremadura and compiled a list of Chalcolithic sites including several Bell Beaker settlements. Additionally, the works of Spindler (1976), Spindler and Gallay (1973) and Harrison (1977) provided another overview of respectively Late Neolithic, Chalcolithic and Bell Beaker sites in Portugal. For Western France, the works of Burnez (1976) and Joussaume (1981, 1986b) and the more recent overview by Cormenier (2009) were used as primary sources for settlement data. For Northern France, the work of Blanchet (1984) remains the most important source. In the Lower Rhine Area, overviews of Bell Beaker settlement evidence are scarce, mainly the work of Louwe Kooijmans (1974) contextualising his Molenaarsgraaf excavations, the general overview on the Bell Beaker phenomenon by Lanting/Van Der Waals (1976a), papers by Drenth (2005) and together with Hogestijn (Drenth/Hogestijn 1999, 2001, 2006), Lanting (1973, 2008) and most recently the book by Fokkens and co-authors (2016). The Southern Scandinavian and Northern German evidence was mainly compiled based on the works of Simonsen (1983), Vandkilde (1996), Ethelberg *et al.* (2000), Liversage (2003) and Sarauw (2006a, 2006b, 2007, 2008) for Denmark and the works of Strahl (1990), Jacobs (1991), Struve (1955), Rassmann (1993) and Mertens (2003) among others for Northern Germany. Bell Beaker settlements in the Czech Republic (mainly Moravia) were mainly gathered from the work of Ondráček *et al.* (2005) and from Turek (1993, 1996) together with Peška (Turek/Peška 2001) and with Dvořak (Turek *et al.* 2003) and Peška alone (2011).

From these studies and several other works, a database of Bell Beaker settlements was compiled for the Portuguese Estremadura, the French Central West and North regions, the Lower Rhine Area, Southern Scandinavia and Northern Germany and Moravia. Of this total overview of settlements, the excavated ones were selected. From these excavated settlements the site reports were accessed, and counts were made of the finds that were reported there. Additionally, the published pottery descriptions and depictions were used to collect additional data concerning vessel shapes and types of decoration, of which the methods will be mentioned in detail in chapter 3. Finally, a number of settlements was selected for either a macroscopic analysis of the pottery production sequence (see chapter 7), and/or radiocarbon dating.

In total 380 excavated settlements on which Bell Beaker pottery was found, and 65 settlements otherwise dating to the Bell Beaker time period (associated with Gord, Deûle/Escaut or other types of ceramics) were collected. From 273 of these 380 settlements, quantitative data was obtained concerning pottery (see appendix A, table 2), 142 settlements have produced data on stone and flint artefacts (see appendix A, table 4), metal artefacts and production waste was recovered from 9 settlements (see appendix A, table 6) and data concerning the subsistence economy came from 71 settlements (see appendix A, table 7 and table 8). Common Ware ceramics were analysed from 149 settlements and additional contexts (see appendix C). And finally the production sequence of pottery was analysed for 13 settlements in total (see appendix D).

Next to these analyses of settlement assemblages, particular objects have been selected to serve as proxy for the analysis of exchange and communication networks at a large scale: bone plates and pendants (see appendix E) and copper Palmela points (see appendix F).

4.2 Radiocarbon (^{14}C) dates

For understanding the adoption of the Bell Beaker phenomenon, an understanding of regional chronology is essential. Not only for Bayesian modelling to assess the intervals between occupation phases and the spans of occupation phases themselves, but also for the calculation of pottery percentages through time and the reconstructions of regional s-curve models.

Radiocarbon determinations, dendrochronological dates and OSL measurements were gathered for all Late Neolithic sites in the research areas (see appendix A, table 9). There are several important points that need to be made with regard to ^{14}C dates. Recent discussions concerning the chronology of the Bell Beaker phenomenon focused on the importance of context and sample material (*e.g.* Beckerman 2012). While present-day radiocarbon studies mainly focus on samples of 'single entity' (Ashmore 1999), secure contexts (Waterbolk 1971) and samples with relatively low inbuilt age, this was not always the case. For this project many of the dates were not taken with the above guidelines in mind. Problems with using these older radiocarbon dates can be summarised as follows, for charcoal and bone specifically.

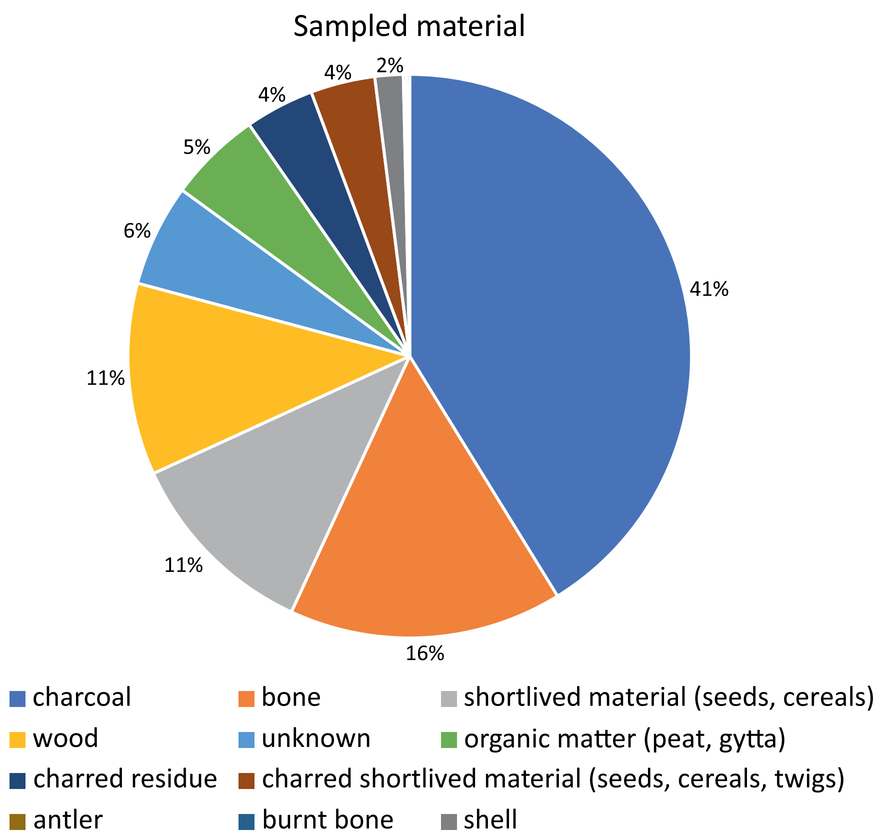


Fig. 4.1 Pie chart with all ^{14}C dates and their sample materials (totals and percentages).

Charcoal can be residual within contexts and can have an old-wood effect (when older tree-rings from a living tree are no longer in equilibrium with the environment and thus unable to take up carbon from the atmosphere). Bone can also be residual within contexts and can, in addition, be prone to a reservoir effect. This effect is related to the marine or riverine environments acting as a reservoir for carbon. Thus the carbon is diluted when it enters into the food chain of crustaceans, fish and eventually mammals. Therefore, organisms that are part of this food chain can have lower concentrations of ^{14}C and thus an apparent older age than their age of death.

In any ideal situation one would therefore choose only charred material that has a short lifespan (such as twigs or wood from specific species) or bones of herbivorous animals that are still in anatomical position.

However, when we would scrutinise our collection of radiocarbon dates based on the above points, we would end up with only 296 out of 692 dates related to Bell Beaker occupation. In fact 41% of the Bell Beaker associated ^{14}C dates are based on charcoal samples, 24% based on human or animal bone (burnt and unburnt) and antler, 11% based on unburnt wood and 24% based on other sample materials such as seeds/charred seeds, shells, food crusts or bulk organic matter. For 6% the sample material is unknown (see fig. 4.1).

Therefore a more loose strategy was adopted, taking all radiocarbon dates into consideration and on a case-by-case basis deciding for the credibility and usability of this date. When doing this, we take the abovementioned aspects of context, sample type and own-age into consideration.

Radiocarbon determinations are based on a survey of published literature. For radiocarbon dates the lab-code, BP measurement and standard deviation, where possible also $\delta^{13}C$, $\delta^{15}N$ and C%, and sampled material and context were noted. Calibrations are made by using OxCal 4.2 (Bronk Ramsey 2009) and INTCAL14 (Reimer

Country	Toponym	Literature	samples	Sample material	Context	Lab code	BP	Sigma	Remarks
Netherlands	Rhenen N225	Schute 2009	2	seed *Triticum dicoccon*	layer 0	Poz-79221	1030	30	too young
				charcoal *Quercus*	content vessel 3a/3b	Poz-80907	3865	35	
Netherlands	Deventer Skibaan	Hermsen 2007	1	charred seed *Quercus* (acorn)	pit	Poz-79902	4070	30	
Netherlands	Wijchen Oosterweg	De Koning 2010	1	charcoal	s9.21	Poz-75197	3875	35	
Germany	Süttorf fpl 18	Cosack 1996	1	charcoal *Pinus*	Fundnummer 4	Poz-82899	8830	50	too old
Czech Republic	Tesetice III	Ondracek *et al* 2005	1	charcoal *Quercus*		Poz-86635	1410	30	too young

Table 4.1 New radiocarbon determinations commissioned as part of this study.

et al. 2015). With regard to dates that have been modelled using Bayesian statistics (*cf.* Bronk Ramsey 2009), results are given in *italics* (*cf.* Millard 2014). Next to radiocarbon determinations, the database features several Optically Stimulated Luminescence (OSL), Thermo-Luminescence (TL) and dendrochronological dates. For these measurements we recorded the lab code, measurements and context details.

From several settlements in the Netherlands, Germany and the Czech Republic is was possible to take samples for additional radiocarbon measurements.[12] Unfortunately, half of these samples turned out to be residual from different periods, providing far too old or far too young dates (see table 4.1).

4.3 Limitations

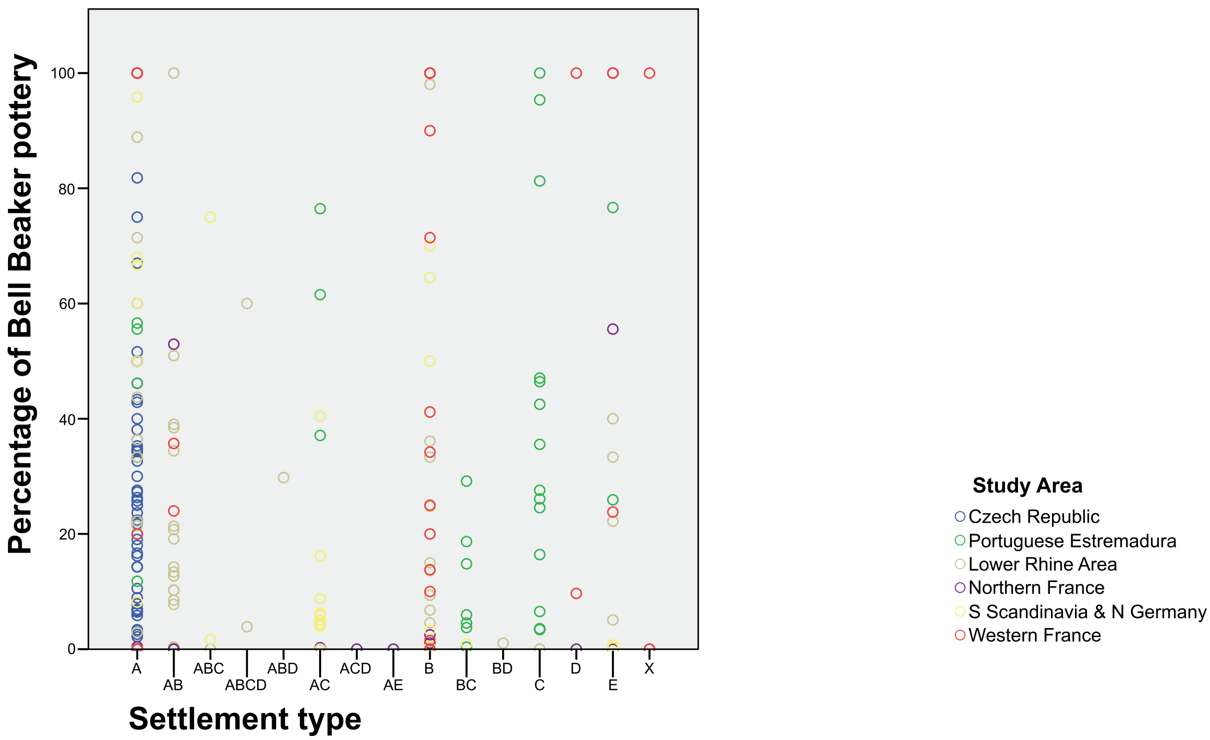
While this dataset of settlements and their respective settlement assemblages was compiled in a thoroughly fashion, it is not devoid of several choices made in the process.

First note that must be made concerns the methods of analysis. I will study only the published material from only excavated settlements on which Bell Beaker pottery was found or otherwise datable to the Bell Beaker period. Settlements are defined in the broadest sense possible, taking into account the variation ranging from single pits or other features to house plans and cultural layers, as explained in paragraph 3.5. While all these different types of settlements probably have a different interpretation in terms of site history and human activity, they can still be compared to each other on their specific assemblages. An analysis of the different site types and their specific assemblages shows that there is no association between different types of settlements and the frequencies of Bell Beaker pottery found on these settlements (see fig. 4.2). When the different settlement types and their Bell Beaker percentages are shown in a graph and in a boxplot, no association between any of the two elements can be seen.

Secondly, the way settlements have been studied in the past varies from region to region. Some regions have a long tradition of professional large scale excavations, while in other regions this tradition during the 20th century has been more episodically and related to foreign interests. The way the specific settlement assemblages are published also influences the outcome of this research. Therefore, settlements and their finds assemblages are not compared across different regions, but solely within their specific region, and thus within their specific research history and publishing traditions.

---

12 The charcoal determinations were made by Yasmin Dannath (GS), in close cooperation with the author. The charcoal from Wijchen was sent to the laboratory in Poznan before wood species could be determined.



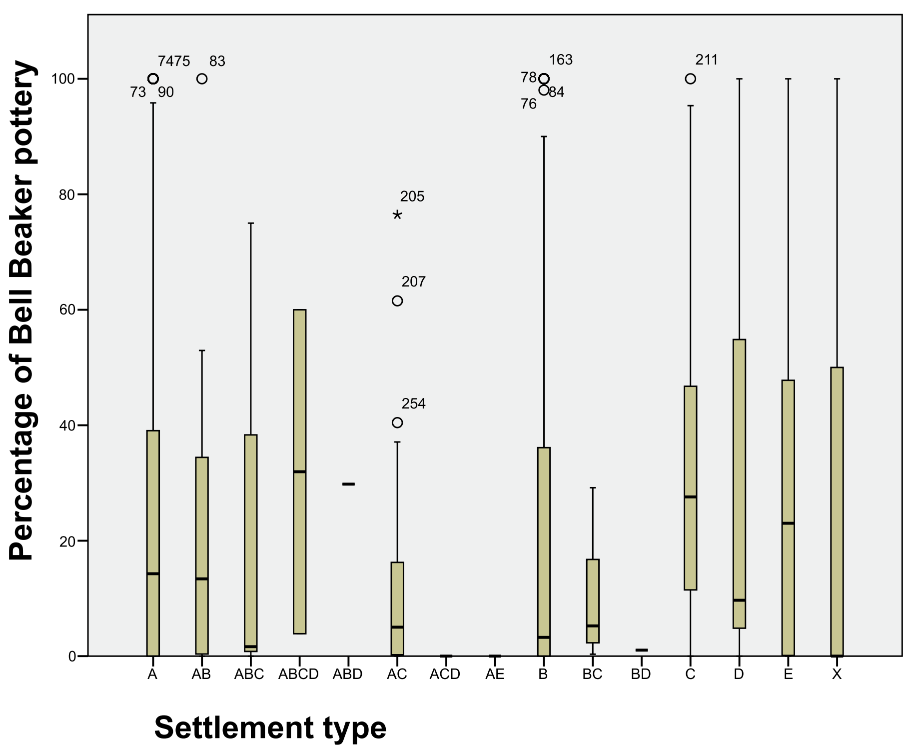


Fig. 4.2 Distribution and boxplot showing settlement type and Bell Beaker percentages.

Thirdly, the amount of settlement sites per region and within regions, depends also heavily on the intensity of research, and, since the Valetta-convention, on the pressure on the land for more mundane developments, such as construction work and gravel quarrying. Second point here is that commercial excavations do not always leave a published or accessible report. Especially from areas with a high economic intensity, Northern France and Southern Scandinavia, this proved to be a problem. Here most of the results are taken from the few accessible grey literature reports and published overview articles that do exist. A completely contrary development is the 'Valetta Harvest' programme in the Netherlands, where Fokkens *et al.* (2016) published a synthesis of the scientific results from all excavations where Late Neolithic and Early to Middle Bronze Age finds were recovered from 2001 onwards (see also Kleijne 2018). Next to this programme, the presence of a digital repository (DANS) and published excavation reports, makes the Netherlands a research area for which high quality data could be obtained.

Table 5.1 Representation of the structure of the analysis.

Chapter	Paragraph	Data and methods	Result
Chapter 5 Innovation processes	Pottery and site frequencies	Pottery frequencies: overview	Overview, cleanness
		Pottery frequencies: time	Phasing in adoption process
		Pottery frequencies: sites	Impact, timing and sustainability
	Bayesian analysis	Model radiocarbon dates and stratigraphy	Intervals and span shows pace, sustainability and timing
Chapter 6 Innovation mechanisms	Practices	Pottery information exchange, flint technology, metallurgy, subsistence practices and domestication	Practices that constitute the networks
	Communication networks	Pottery decoration network	Communication networks
		Complete network	Cliques and clusters
		Regional networks and chronology	Regional variability in link strength, node centrality and the formation of cliques
	Exchange of ideas	Bone pendants, bone plates, Palmela points	Exchange of ideas and objects, across regions and time periods
	Pottery exchange	Overview and review of analyses	Exchange networks
	Mobility of people	overview of aDNA and isotope research, review of interpretations	Mobility patterns and interpretation
Chapter 7 Innovation practices	Changing habits	Metric data	Continuity or change in pottery forming practice
	Skill and creativity	*Chaîne opératoire*	Skill and creativity in pottery production

5 Analysis: Innovation processes

5.1 Introduction

The first analysis that is carried out relates to the first research question that was proposed in chapter 1. "How did the adoption process of the Bell Beaker phenomenon take place in temporal terms?" The temporal terms in this question are being addressed in this chapter in three different ways, focusing on the phasing of innovation, the impact and sustainability of innovation, and pace and timing of this innovation. Together, these aspects allow us to understand the processes of innovation and phasing the adoption through time for each research area.

Firstly, we focus on pottery percentages. Overviews are given of the obtained pottery percentages, together with this simple introduction to the dataset, the degree of 'cleanness' of settlements is assessed. After this first overview, the data is ordered chronologically. The phasing of the adoption process of the Bell Beaker phenomenon in the different regions is addressed here. As discussed before, the development of pottery percentages through time shows us the phasing of the innovation process within the availability model (Availability phase, Substitution phase, Consolidation phase).

Our second analysis focuses on the frequency of settlements having a particular percentage of Bell Beaker pottery was calculated. The number of settlements with either a low or high percentage of Bell Beaker pottery shows us the impact and sustainability of the innovation through time.

Finally, for several settlements a Bayesian model is constructed. With this method settlement histories are reconstructed. The modelled occupation spans and habitation intervals are proxies for the pace and the sustainability of the adoption within a region. Next to that, this method provides a qualitative test for the currently favourable quantitative models of Bell Beaker diffusion through Europe.

5.2 Pottery frequencies: an overview

5.2.1 Introduction

For this first analysis, pottery frequencies were gathered from the literature and unpublished sources, both textually (by using reported frequencies) and visually (by counting sherds or vessels from images and from various catalogues). These frequencies will be used in our analysis of adoption processes. Thus we will use frequency data to test the hypothesis of Zvelebil's Availability model for the adoption of the Bell Beaker phenomenon across Europe.

Between the different research areas, the amount of settlements in general and especially the amount of ^{14}C dated settlements varies greatly. Also, an overview of settlements and the different types of pottery found on these settlements shows considerable variability. In general, some research areas have a lot of settlements with low percentages of Bell Beakers and a low amount of settlements with a large percentage of Bell Beakers, while other regions have less settlements with lower percentages of Bell Beakers and more settlements with higher percentages. In the following paragraph the research areas and their respective pottery frequency data will be introduced.

5.2.2 Results

For the Czech Republic (see figure 5.1), 75 sites provided frequency data. 18 sites of which have no Bell Beaker pottery at all, and three sites having only Bell Beaker pottery. Also noteworthy is the relative cleanness of the Bell Beaker settlements in the Czech Republic. Only 9 sites have other types of pottery than Bell Beaker or Common Ware. These intrusive elements can be ascribed to Corded Ware (1), earlier Neolithic (6) or unknown phenomena.

The Lower Rhine Area (see figure 5.2) has given us 81 settlements with frequency data. 26 of the sites in this region have no Bell Beaker pottery at all and are ascribed to this period based on Common Ware and Potbeker pottery or the Gord and Deûle/Escaut phenomena. On the contrary, 9 Bell Beaker settlements have produced only Bell Beaker pottery. In this area, many settlements that have Bell Beaker and/or Common Ware pottery, also provide pottery from other phenomena such as Barbed Wire (25), but also Corded Ware (6), Funnel Beaker (3) and other earlier Neolithic phenomena.

In Northern France (see figure 5.3) 37 settlement sites can be dated to the second half of the 3rd millennium BC. Most of the sites in Northern France have pottery that can be ascribed to the Gord (15) or Deûle/Escaut (10) or Seine-Oise-Marne (3) phenomena. Settlements with Bell Beaker or Common Ware pottery mount to a total of 13. 2 sites have only Bell Beaker pottery and 2 other sites have only Common Ware pottery. Of the other 9 sites, only 2 have a combination of Common Ware and Bell Beaker pottery. The other 7 sites have either Bell Beaker or Common Ware pottery associated with other later 3rd millennium groups (2 with Gord, 2 with Deûle/Escaut) or earlier Neolithic pottery (2 with Corded Ware, 1 with Seine-Oise-Marne).

In the Portuguese Estremadura (see figure 5.4) 31 Bell Beaker settlements were found with data regarding pottery frequencies. All of these settlements have provided Bell Beaker pottery, in different quantities. One of the settlements consists of only Bell Beaker pottery, and thus 30 settlements have some sort of intrusive elements accompanying the Bell Beaker assemblage. These intrusive pottery assemblages can be ascribed to the earlier Chalcolithic Channelled ware, Kerbblatt/Acacia ware and Late Neolithic wares. Only on 2 settlements evidence for the existence of some sort of Common Ware was found.

The Southern Scandinavia and Northern Germany (see figure 5.5) research area has provided us with 36 Bell Beaker settlements. Of these settlements, 11 have produced no Bell Beaker pottery and there are none with only Bell Beaker pottery present. Remarkably, 6 sites consist of only Common Ware pottery. Additionally, the amount of intrusion on settlements in this area is relatively low with 12 settlements having either Barbed Wire (8), Corded Ware (7), Schönfeld (1) or Funnel Beaker (3) pottery present.

From Western France (see figure 5.6), 26 Bell Beaker settlements were recorded. Of these settlements, 3 have no Bell Beaker pottery at all, while 8 settlements only have Bell Beaker pottery. 4 sites have intrusive elements in the form of Artenac pottery (4) and earlier Neolithic pottery (2). Other elements include cord-decorated pottery on 1 settlement and Artenac Tardif pottery on 4 settlements.

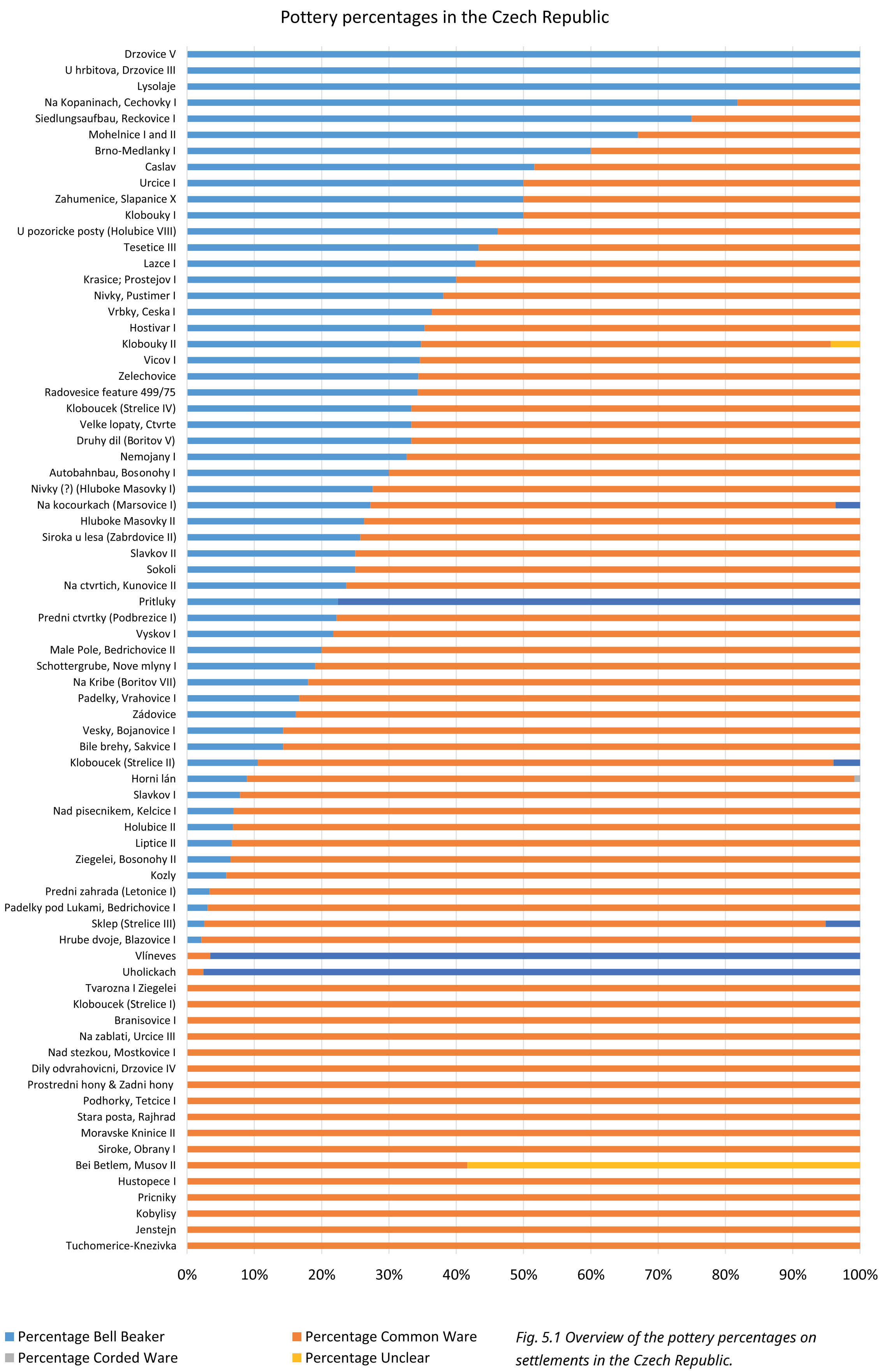


Fig. 5.1 Overview of the pottery percentages on settlements in the Czech Republic.

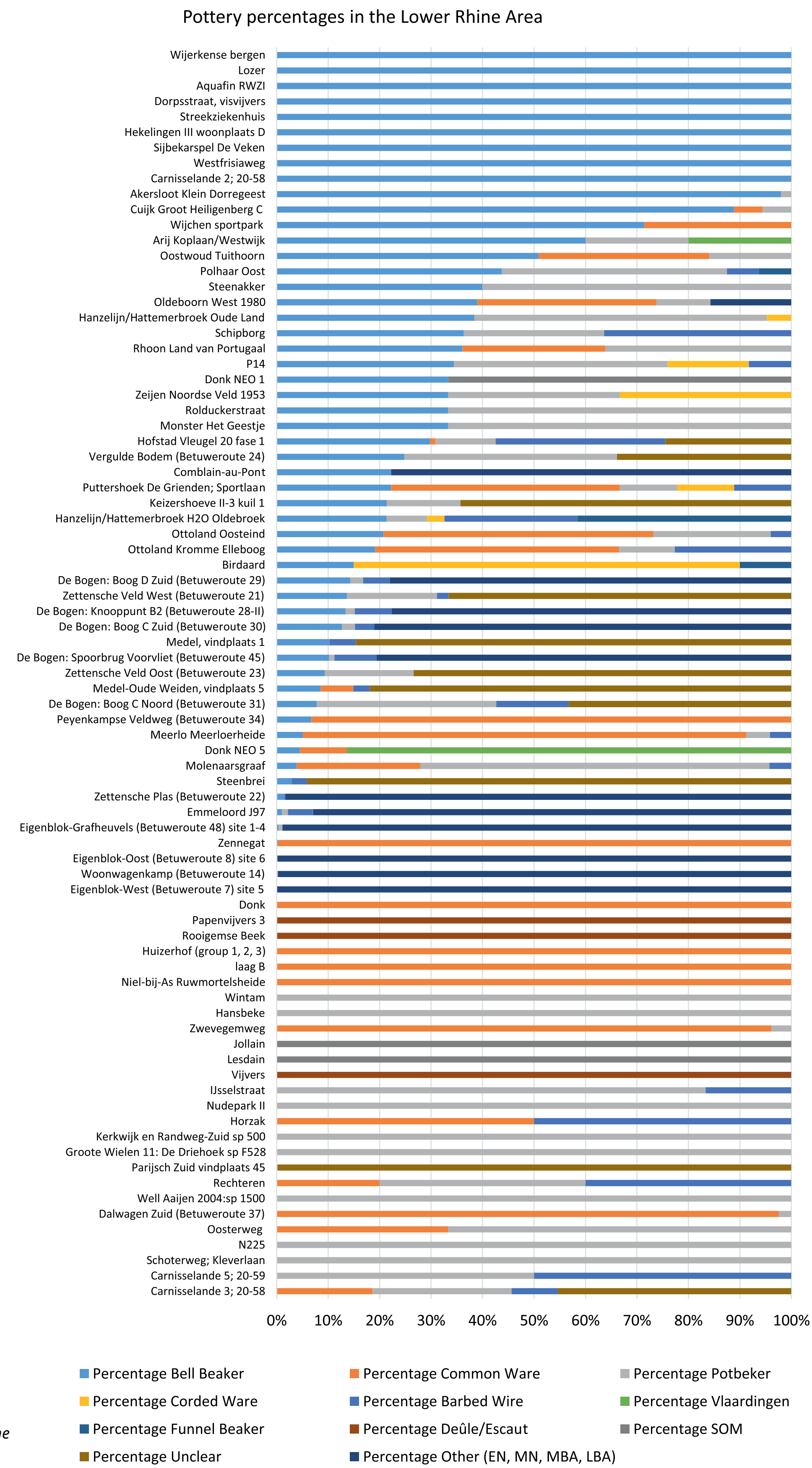


Fig. 5.2 Overview of the pottery percentages on settlements in the Lower Rhine Area.

5.2.3 Recapitulation

Summarizing, these graphs show us already three things: Firstly, there is a wide variety in the percentages of Bell Beaker pottery present, both within and between research areas. Secondly, the intrusion or 'cleanness' of settlements varies considerably between different regions. And thirdly, different types of pottery exist that are largely contemporaneous to Bell Beakers. However, this does not yet allow us to make inferences about the process of adoption. These graphs show us all the Bell

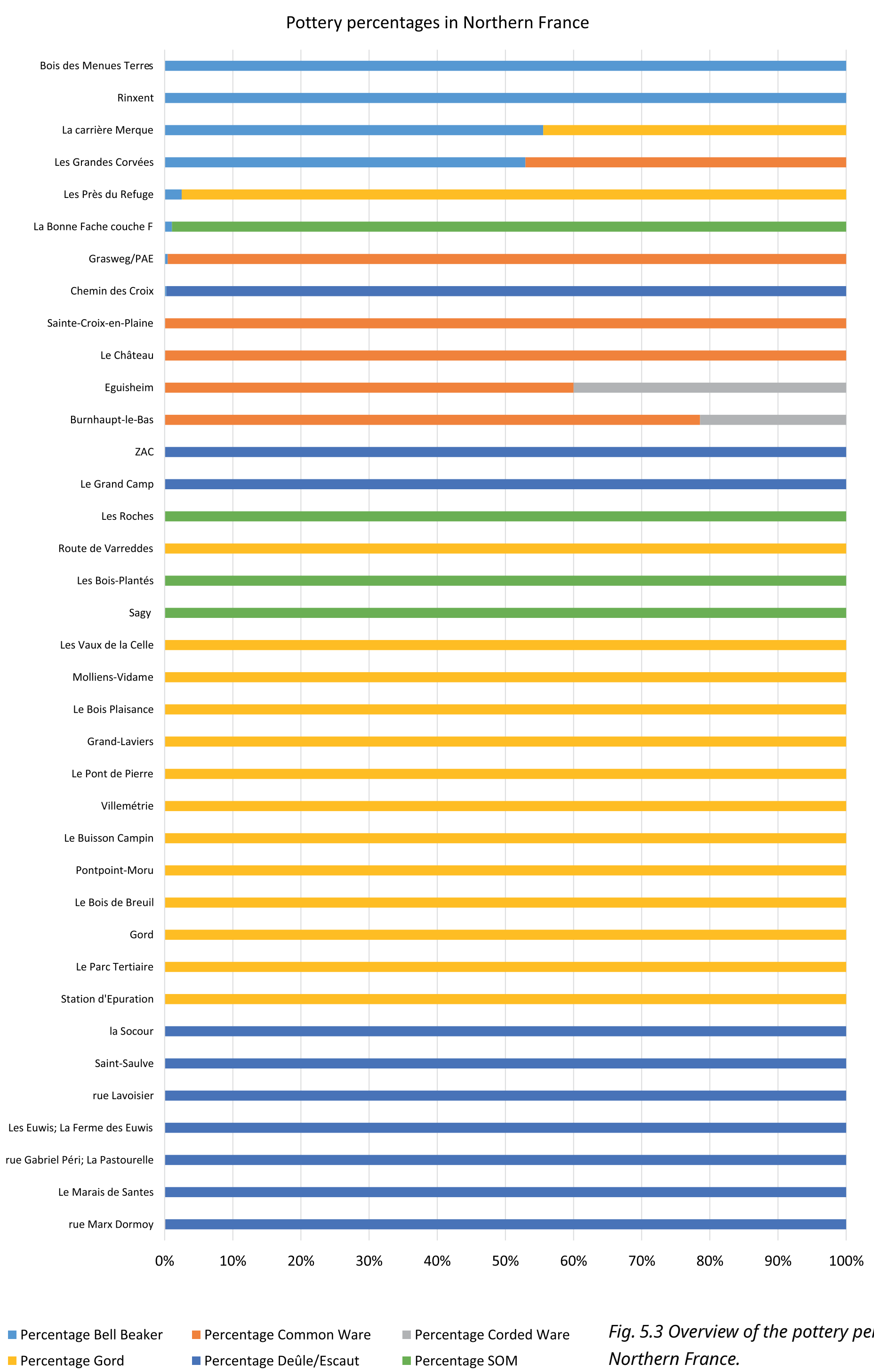


Fig. 5.3 Overview of the pottery percentages on settlements in Northern France.

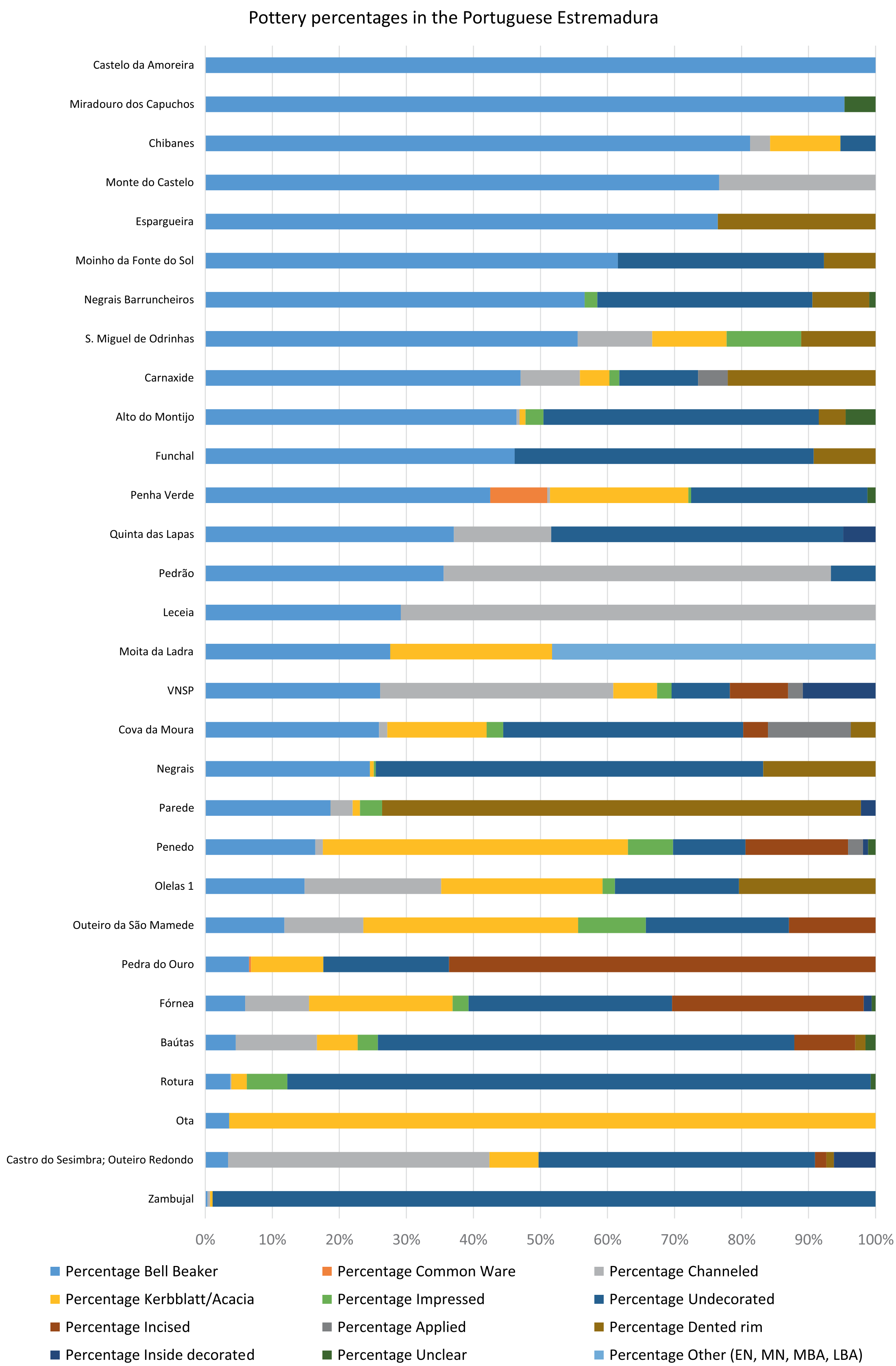


Fig. 5.4 Overview of the pottery percentages on settlements in the Portuguese Estremadura.

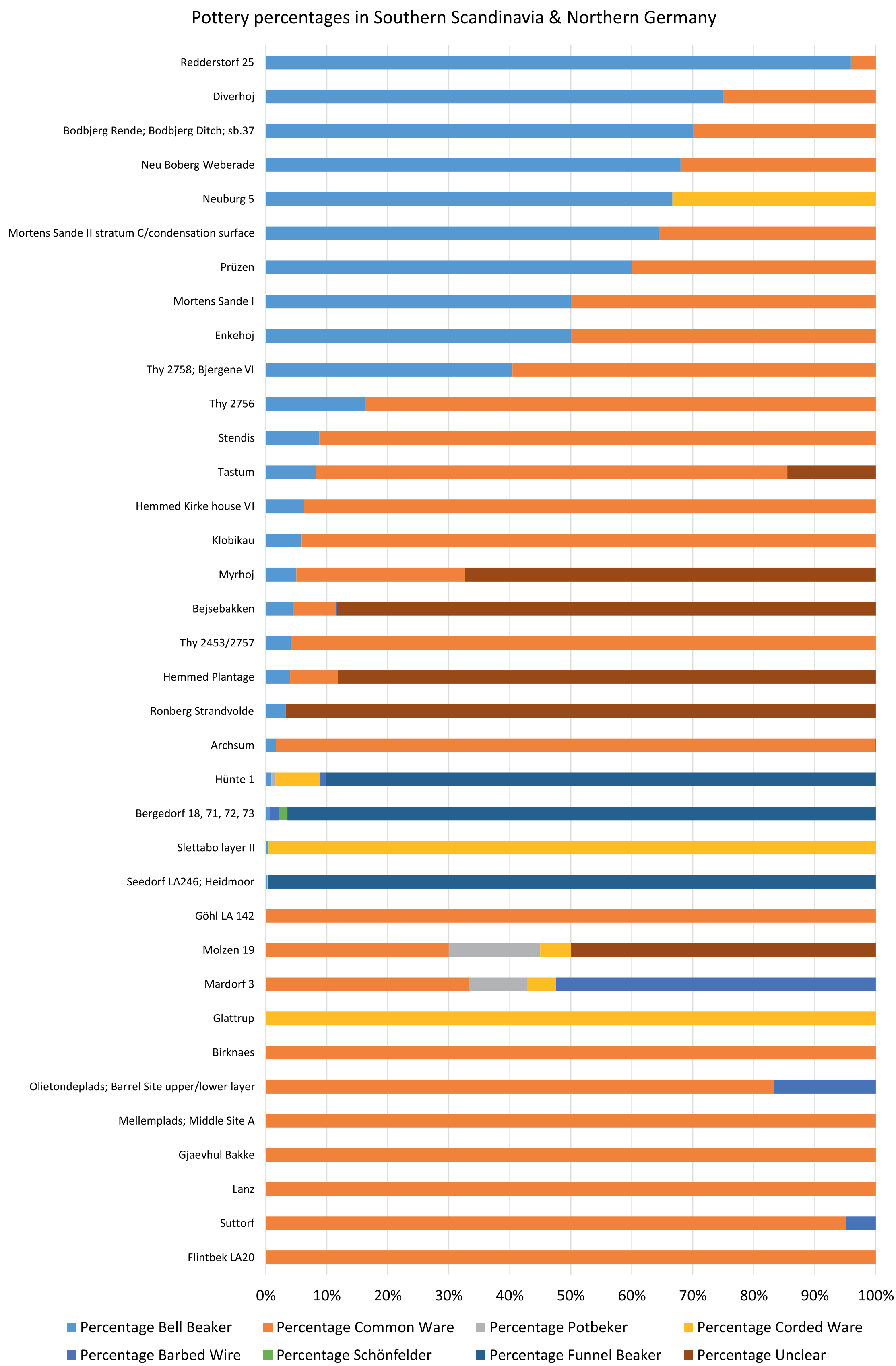


Fig. 5.5 Overview of the pottery percentages on settlements in Southern Scandinavia & Northern Germany.

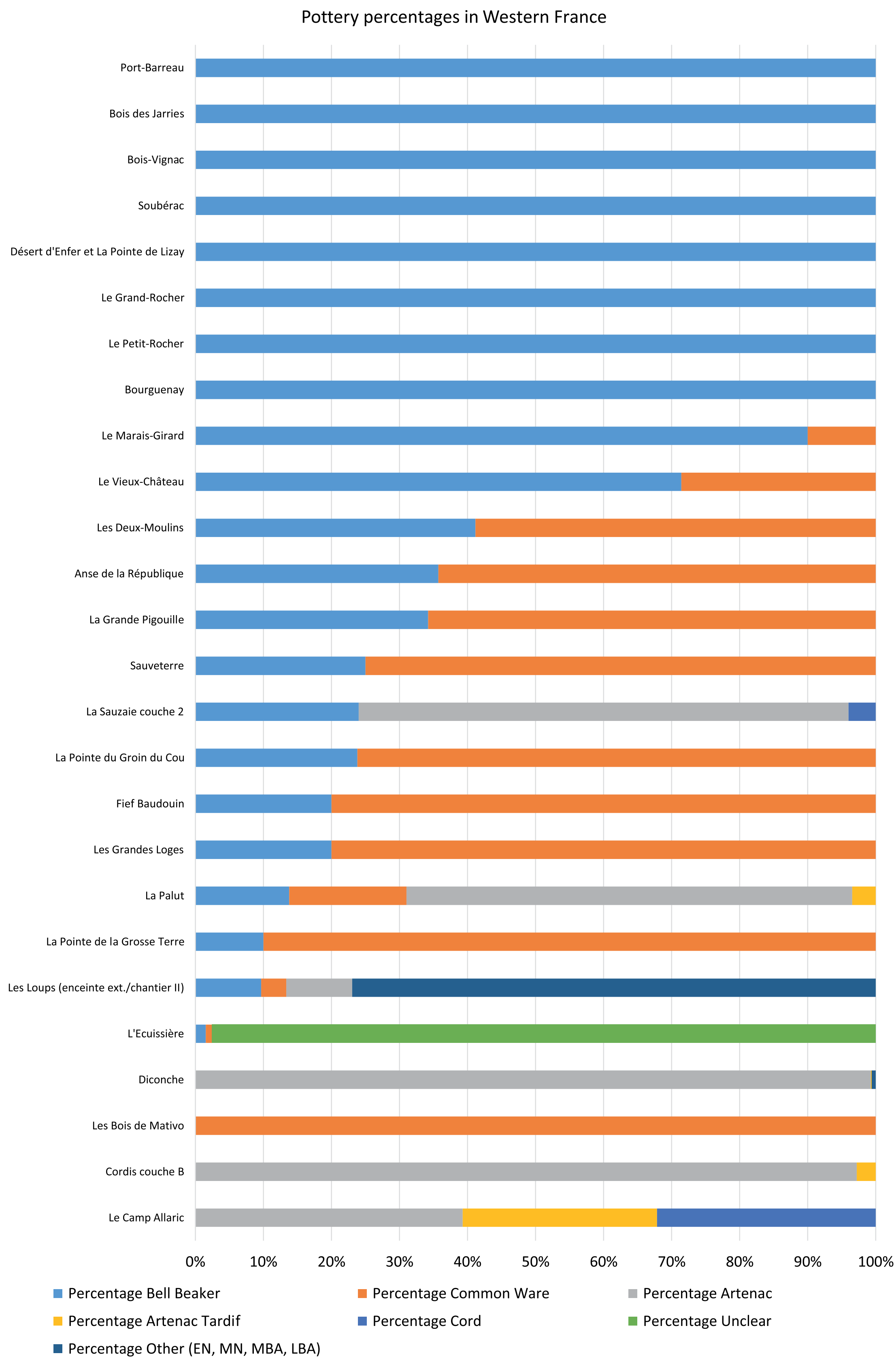


Fig. 5.6 Overview of the pottery percentages on settlements in Western France.

Beaker settlements for which frequency data is available without taking chronology into consideration. If we want to address the temporal process of adoption, we need to get a better grip at chronology, by using only the radiocarbon dated settlement phases. This is done in the forthcoming paragraph.

5.3 Pottery frequencies: time and chronology

5.3.1 Introduction

In order to understand the phasing of the Bell Beaker innovation, we combine the pottery frequency data with chronological data. By doing this, the hypothesis of a rapid transition and consistent high impact of the Bell Beaker phenomenon across Europe can be tested. For analysing this combined dataset, and for sorting radiocarbon dates chronologically, there are two relatively straightforward methods available: the median and the aoristic method.

For the median method, we use all the available ^{14}C data that is specifically associated with Bell Beaker phases of occupation on the Bell Beaker settlements. From this collection of ^{14}C dates we take the median value per site. These median values serve to sort the settlements and their specific Bell Beaker pottery percentages accordingly.

For the aoristic method, the same dataset is used. However here, each settlement's ^{14}C dates are calibrated and the results are plotted as probabilities on a 100-year interval between 2800 and 1800 BC. These ^{14}C probabilities are accumulated to create a cumulative probability distribution for the occupation of a particular settlement. These probability distributions can then be used to chronologically order settlements. A benefit of this particular method is that it, in contrast to the median, takes the calibration and the standard deviation of a radiocarbon date into consideration (*cf.* Crema 2011).

Together with a treatment of the results, an illustrated overview is given below per research area in the form of a Median ordered frequency graph and an Aoristic ordered frequency graph. In table 5.2 it can be seen that a large variety exists between research areas and the number of ^{14}C dated settlements and their respective Bell Beaker phases.

5.3.2 Results

Portuguese Estremadura (see figure 5.7)

The Portuguese Estremadura might be a well-known area for Chalcolithic occupation, the amount of excavated settlements totals to only 48. And unfortunately, of these 48 settlements, only 8 settlements have produced radiocarbon dates, adding

Table 5.2 The number of ^{14}C dated settlements and corresponding Bell Beaker phases per region.

Study Area	Number of dated settlements	Number of dated Bell Beaker phases
Lower Rhine Area	50	31
Northern France	16	15
Western France	8	6
Portuguese Estremadura	8	4
Czech Republic	3	2
Southern Scandinavia & Northern Germany	30	19

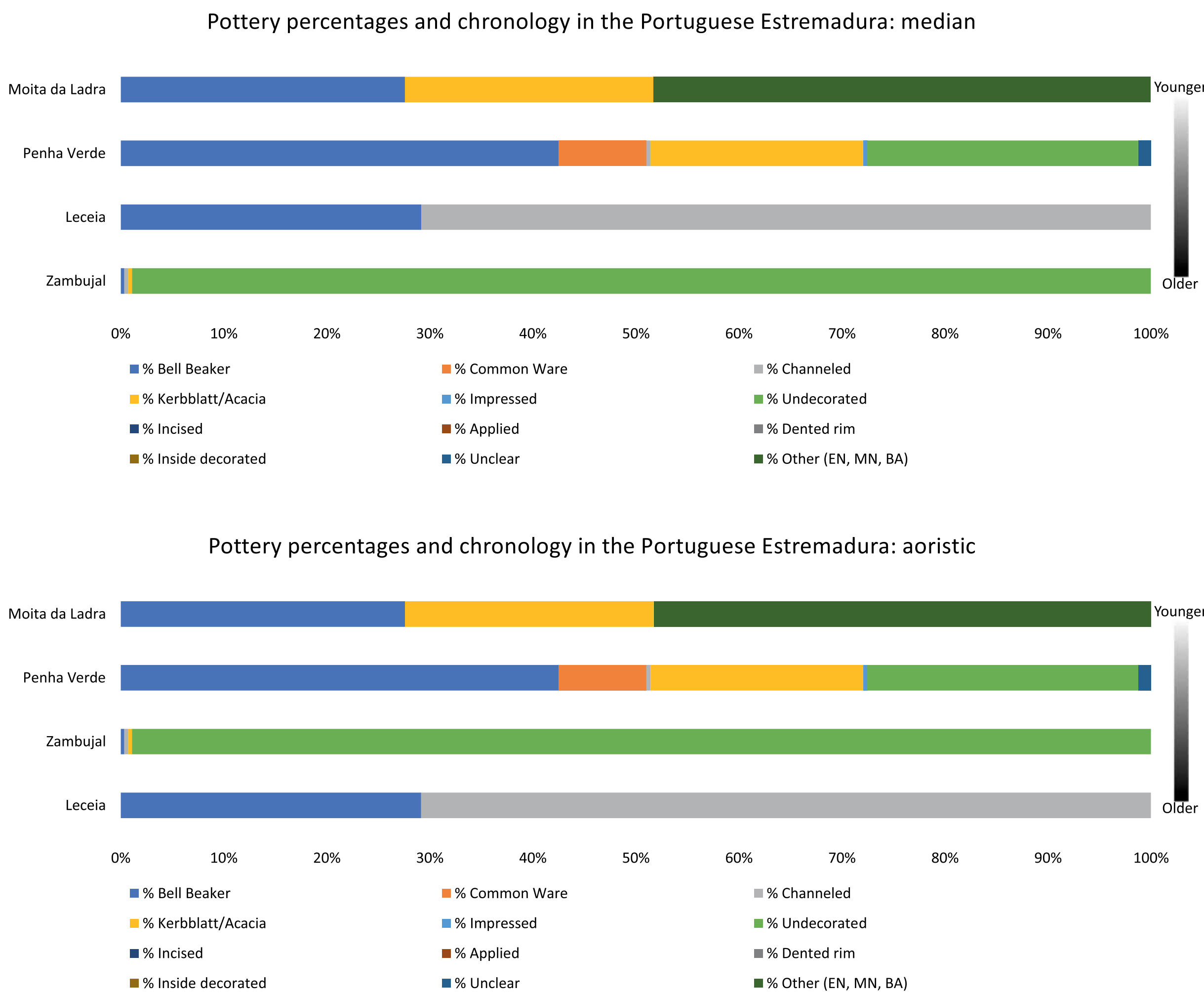


Fig. 5.7 Pottery percentages Portuguese Estremadura.

up to a total of 110 dates. Particularly the settlements of Zambujal and Leceia with their respective numbers of 43 and 41 radiocarbon dates contribute high to this totality. When we limit ourselves to the radiocarbon dates specifically focusing on the Bell Beaker phase of occupation, only 5 settlements remain. From these 5 settlements, pottery frequencies are known for only 4. For these 4 settlements the pottery frequencies and chronological data is compared in figure 5.7.

In the Portuguese Estremadura the percentage of Bell Beaker pottery on settlements is relatively high in general. Only the settlement of Zambujal has a very low percentage of Bell Beaker pottery. One might argue that this is because of the intense longevity of the site, spanning almost a millennium (see also paragraph 5.5.2), but when we take into consideration the Bell Beaker phases of occupation at the site and the specific percentage of Bell Beaker pottery within only these phases, the percentage stays very low. Other pottery on Bell Beaker settlements in the Estremadura includes Channelled Ware (also known as *Copos Cañelados*), Acacia-leaf/Kerbblatt and various Late Neolithic pottery types (inside decorated and dented rims). The absence of Common Ware pottery from most settlements (apart from Penha Verde) can possibly be explained by the large presence of undecorated coarse pottery and the various other decorated wares (incised, impressed, applied) for which no secure chronological ranges are available. Despite the lack of radiocarbon dated settlements, there might be some trends visible. The percentage of Bell Beaker pottery remains relatively constant throughout the time period under study, except for the site of Zambujal where undecorated pottery prevails.

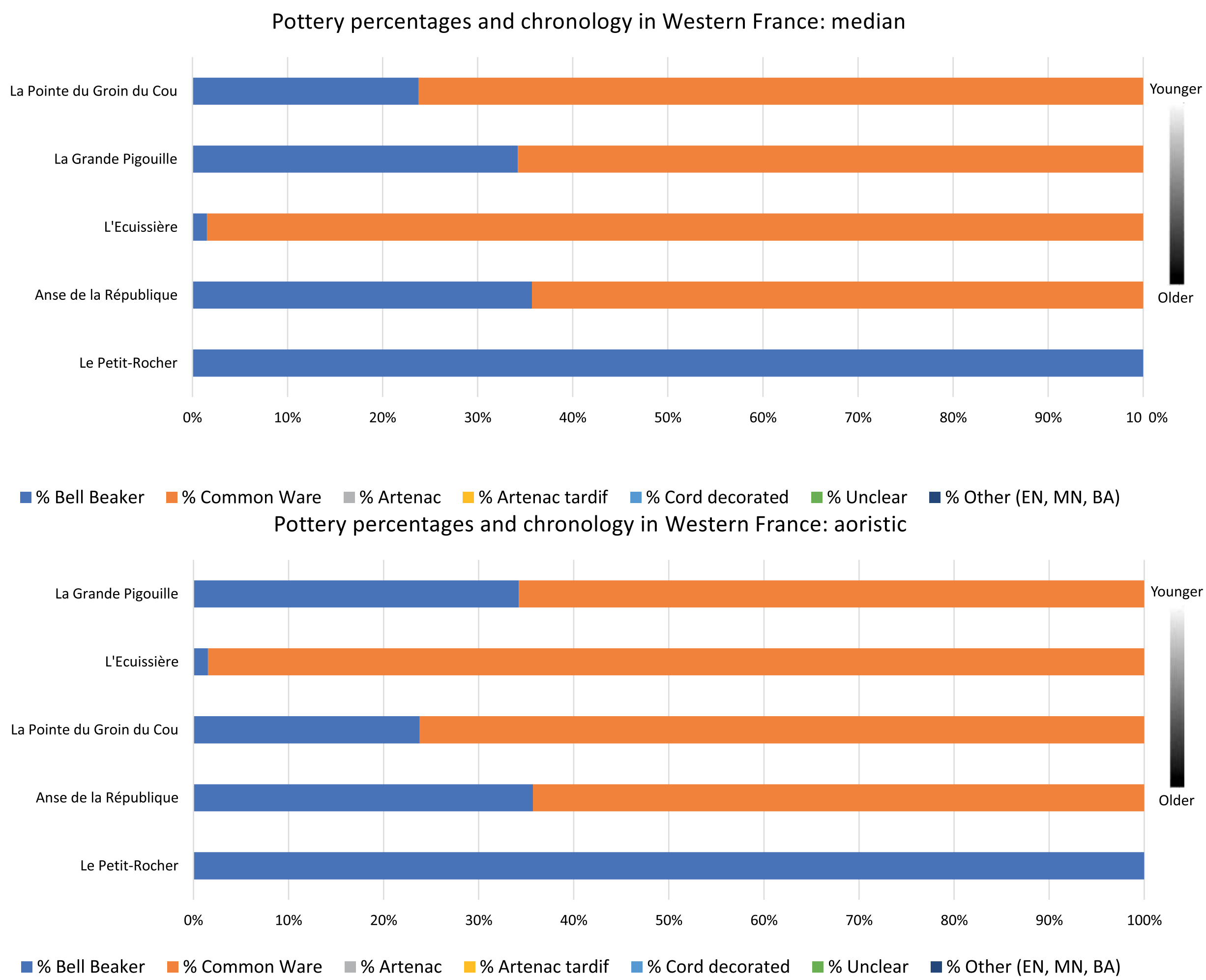


Fig. 5.8 Pottery percentages Western France.

Western France (see figure 5.8)

The Bell Beaker settlements in Western France are 38 in total. From these 38 settlements, only 8 have produced radiocarbon dates. When we only take the radiocarbon measurements that are associated with Bell Beaker phases of occupation on these settlements specifically, we end up with only 5 settlements having pottery frequency data available and for which at the same time a median value could be obtained from 10 radiocarbon measurements in total.

When assessing the results for Western France, we see that also here is no real trend visible. Some settlements have both Bell Beaker and Common Ware pottery in comparable quantities, while another settlement, Le Petit-Rocher, has only Bell Beaker pottery, and again another settlement, L'Ecuissière, has almost no Bell Beaker pottery. This can be explained by recovery and publication methods: while the former is an old excavation, the latter was only recently studied and published. For the other three Bell Beaker settlements, the percentage of Bell Beaker pottery is between 20-40%. Interestingly, from all the settlements with radiocarbon dated Bell Beaker phases, not a single settlement has produced evidence for Artenac or earlier Neolithic occupation. Similarly, no Artenac settlement has a radiocarbon dated Bell Beaker phase. So, in Western France, at the moment, no trends are visible.

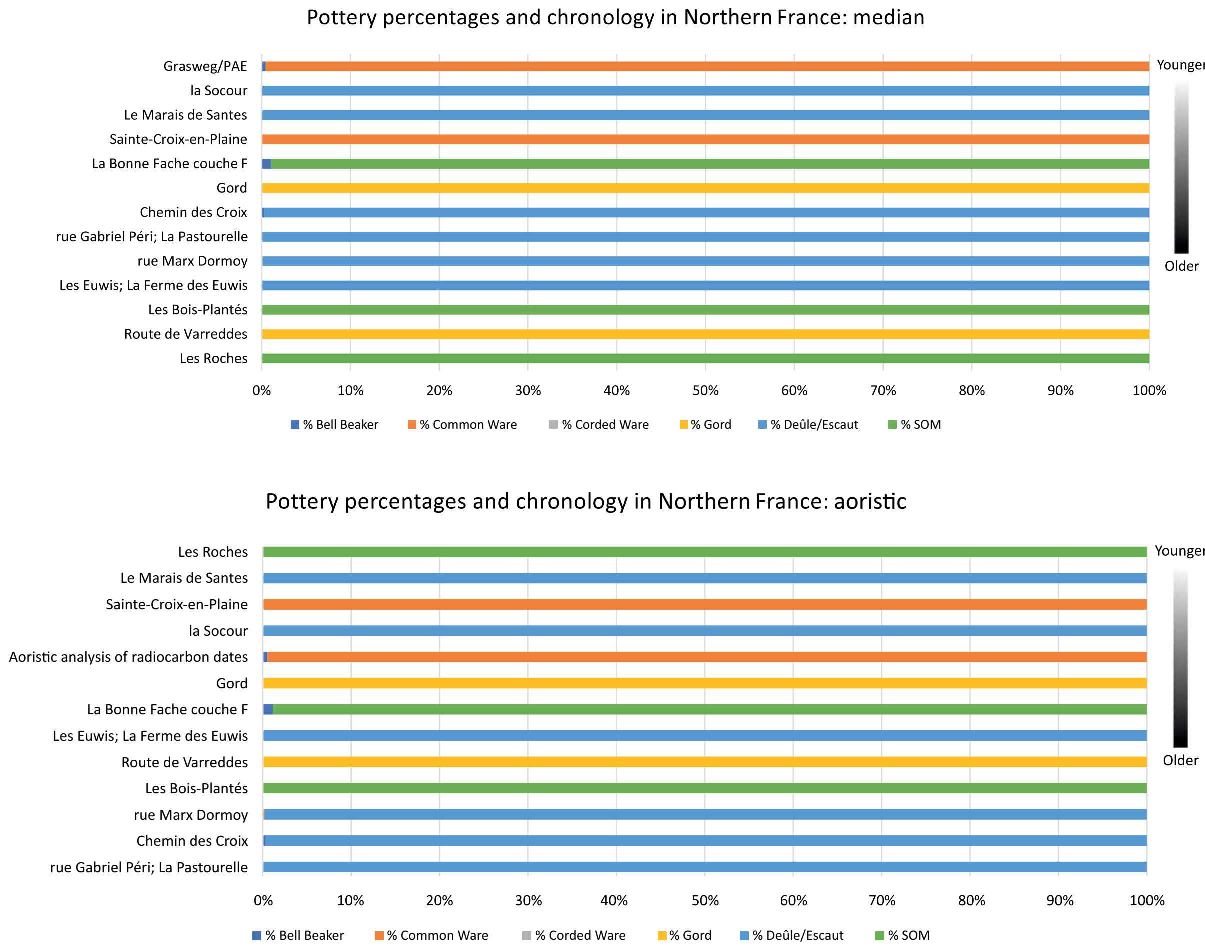


Fig. 5.9 Pottery percentages Northern France.

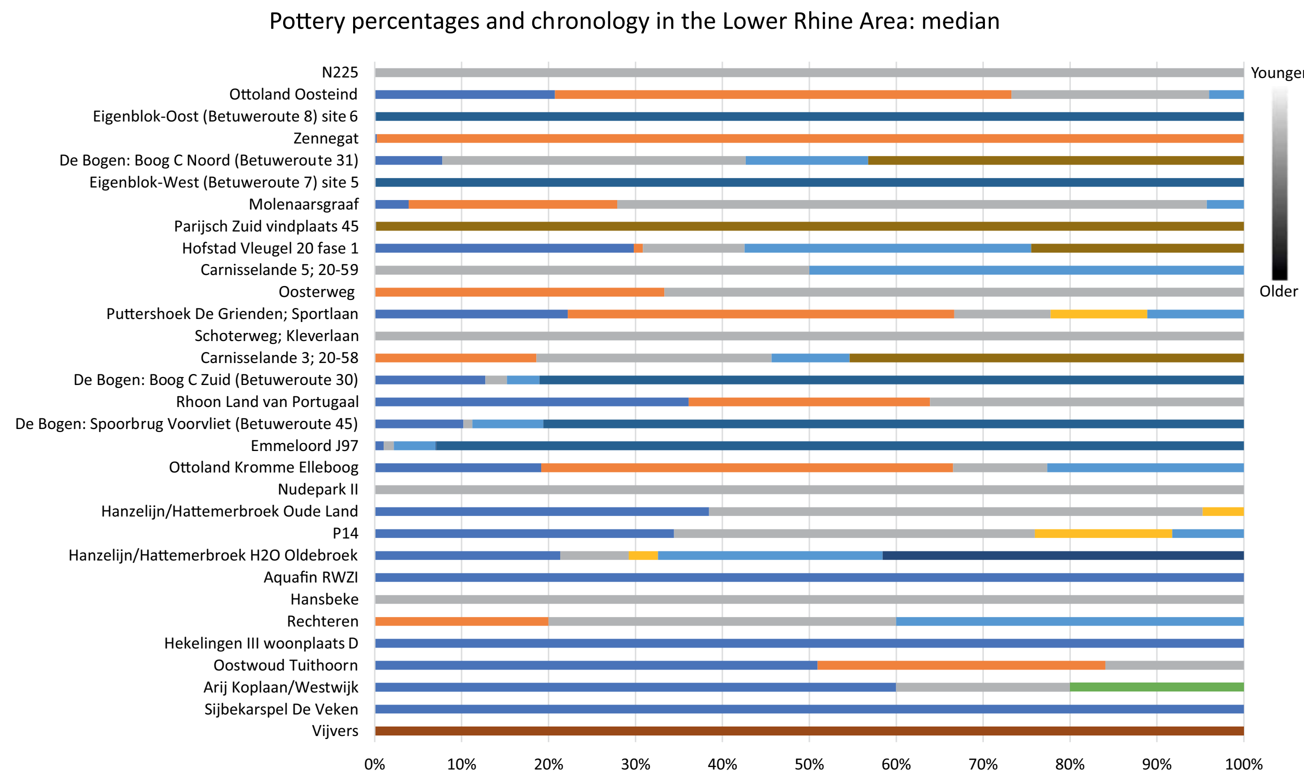
Northern France (see figure 5.9)

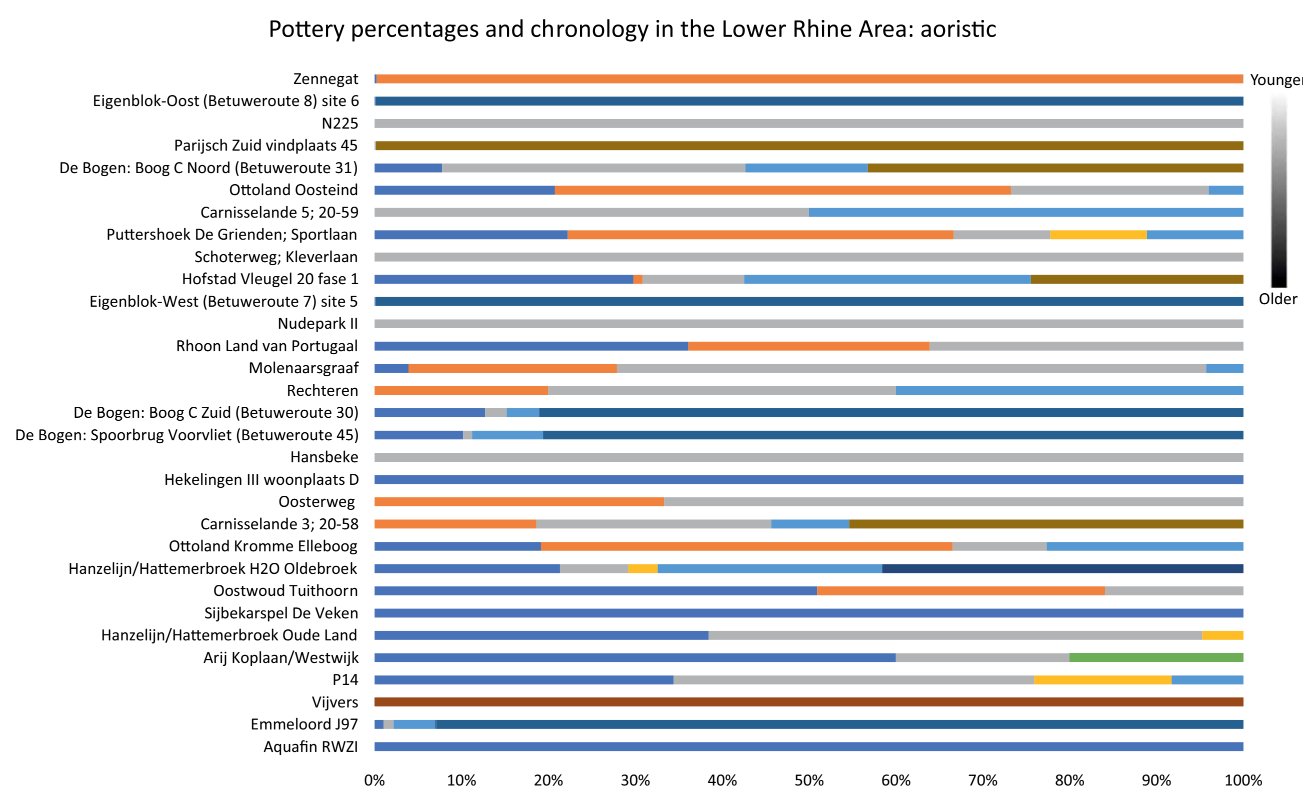
For Northern France 68 settlements are known from the second half of the 3rd millennium BC. Only 21 of these settlements have produced radiocarbon dates, 91 in total. Specifically dealing with the Bell Beaker occupation, or occupation contemporaneous with the Bell Beaker phenomenon, are 13 sites. These 13 sites have 68 radiocarbon dates in total. Again, the median of the radiocarbon dates was calculated for each of these 13 settlements, and compared with the percentages of Bell Beaker pottery on these settlements. The results are shown in figure 5.9.

In Northern France the percentage of Bell Beaker pottery on contemporaneous settlements is extremely low. Only three settlements have a tiny amount of Bell Beaker pottery present (Chemin des Croix, La Bonne Faché and Grasweg/PAE). The first two of these three settlements are dominated by Seine-Oise-Marne and Deûle/Escaut ceramics. The third site with Bell Beaker pottery is dominated by Common Ware. Further Common Ware pottery is present on two other sites (rue Marx Domoy and Sainte-Croix-en-Plaine). In general, Northern France shows a notably uniform and 'clean' picture. The Gord, Deûle/Escaut and late Seine-Oise-Marne phenomena are ubiquitous across the region and an almost complete separation between Bell Beaker and Gord and Deûle/Escaut settlements is visible with respect to pottery.

Lower Rhine Area (see figure 5.10)

For the Lower Rhine Area, 290 radiocarbon dates are known from 50 Bell Beaker settlements or other settlements from this timeframe. From 41 out of these 50 Bell





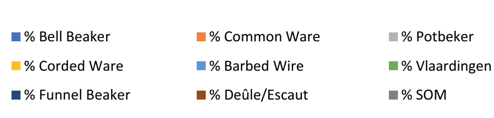


Fig. 5.10 Pottery percentages Lower Rhine Area.

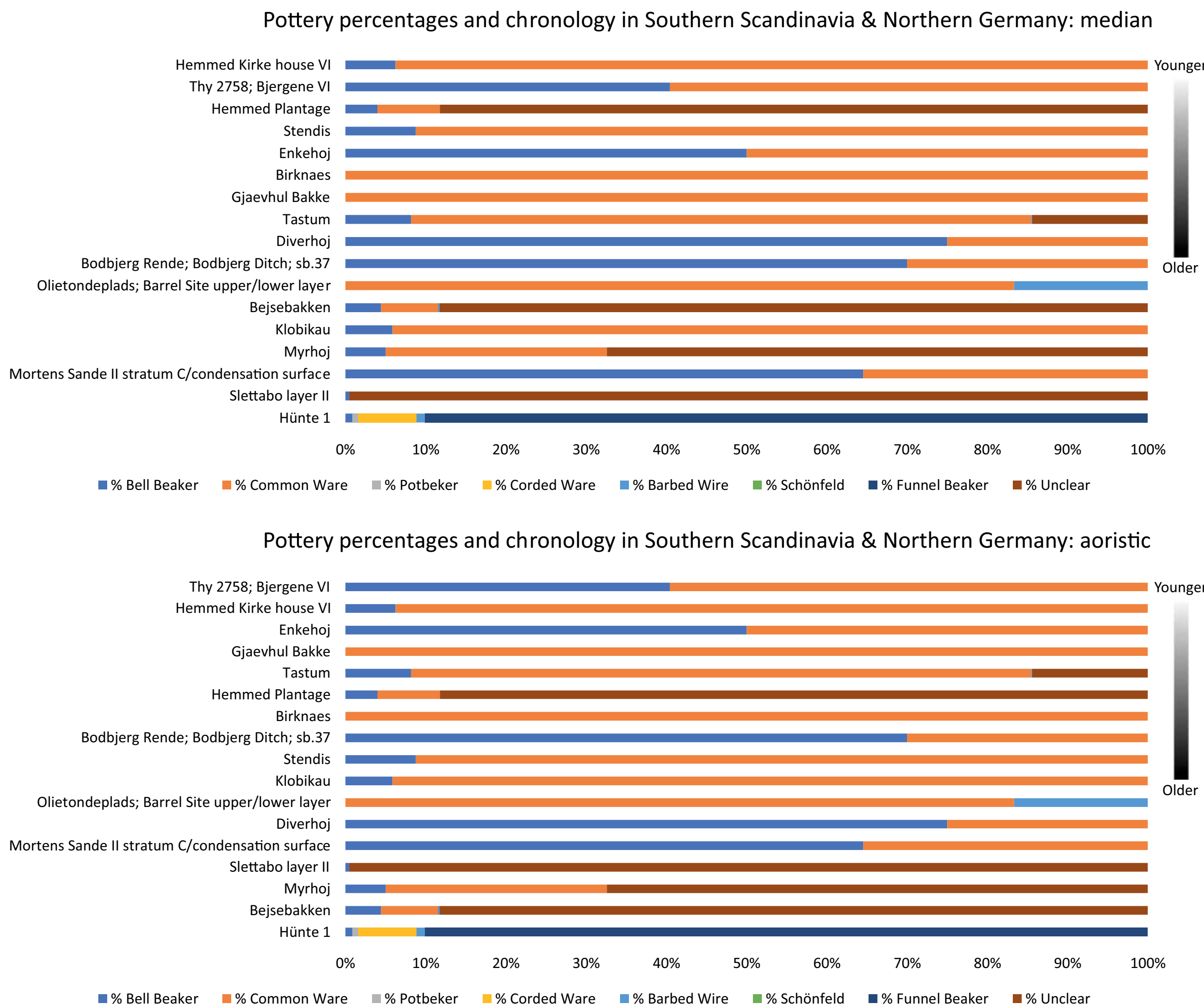


Fig. 5.11 Pottery percentages Southern Scandinavia & Northern Germany.

Beaker settlements the pottery frequencies are known. From these 41 Bell Beaker settlements with radiocarbon dates, 31 settlements have a total of 91 radiocarbon dates specifically targeting the Bell Beaker phase of occupation. Again, the median of these radiocarbon dates is calculated for each settlement, and compared with the percentages of Bell Beaker pottery on these settlements. The results are shown in figure 5.10.

In the Lower Rhine Area, the percentage of Bell Beaker pottery on settlements is increasing at first reaching high levels (50-100%), but later decreasing over time. This trend is more clearly visible when using the aoristic method. During the later phases of the Bell Beaker phenomenon, also Barbed Wire decorated ceramics start appearing. The pottery assemblage in the Lower Rhine Area is characterised by a relatively high degree of intrusion. Aside from this, a relative constant presence of Common Ware and Potbeker pottery is noted, along with the introduction of Barbed Wire pottery and the decrease in Bell Beaker pottery.

Southern Scandinavia & Northern Germany (see figure 5.11)

From Southern Scandinavia (Denmark and Norway) and Northern Germany 30 excavated Bell Beaker settlements with radiocarbon dates have been recorded. In total, these 30 settlements provide us with 195 radiocarbon measurements. With regard to specifically Bell Beaker occupation phases, a total of 122 radiocarbon dates could be obtained from 18 settlements. 17 out of these 18 settlements provide pottery

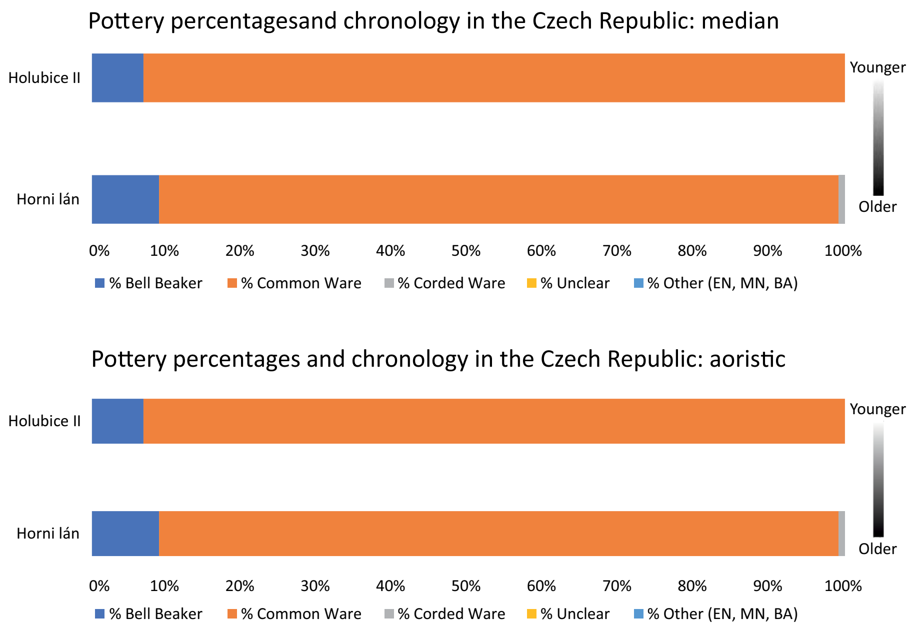


Fig. 5.12 Pottery percentages Czech Republic.

frequency data. The median radiocarbon date is calculated for these 17 settlements and the result is shown in figure 5.11.

For Southern Scandinavia and Northern Germany, the percentages of Bell Beaker pottery are very low, apart from some exceptional cases, creating some sort of alternating pattern. Important here is the Common Ware pottery, which is well represented almost everywhere. Other types of pottery such as Corded Ware, Schönfeld, Barbed Wire and Funnel Beaker, are very seldom present. From this we can state that there is not really a trend visible chronologically.

Czech Republic (see figure 5.12)

For the Czech Republic only three Bell Beaker settlements have produced ^{14}C dates, 19 in total. Two of these settlements have dates that can be associated with the Bell Beaker phase of occupation (with 2 and 6 dates respectively), while one date is clearly dating earlier occupation of that particular settlement.

As only two settlements remain in this analysis, both the aoristic and median method give the same result. It can be noted that the older settlement, Horni Ián, has low percentage of Bell Beaker pottery, and next to a large percentage of Common Ware, a minor percentage of intrusive Corded Ware pottery. The second, younger settlement is Holubice II, where there's no Corded Ware pottery and an even lower percentage of Bell Beaker pottery. However, it is impossible to identify this as a decreasing trend when comparing only two settlements.

5.3.3 Recapitulation

When we compare the results of this analysis for the different region, a relative uniform picture emerges. For the Portuguese Estremadura and Western France regions, Bell Beaker percentages remain at a continuous level of between 20 and 40%. Continuous low levels are visible in the Czech Republic, while an alternation of low and high percentages can be identified in Southern Scandinavia/Northern Germany. In Northern France there really seems to be no significant presence of Bell Beakers, based on low Bell Beaker pottery percentages compared to Gord and Deûle/Escaut ceramics. Finally, only in the Lower Rhine Area it is possible to see a decreasing trend in the percentage of Bell Beaker pottery on settlements. This final statement mirrors the conclusion drawn by Fokkens *et al.* (2016) who state that Late Bell Beaker settlements and Early Barbed Wire settlements in the Netherlands still have some Bell Beaker elements present. Furthermore, the hypothesis that there is a decrease in the percentage of Bell Beaker pottery on settlements in the Czech Republic (as stated by Heyd 2000 and Hájek 1968), is not (yet) supported by this absolute dating evidence.

Interestingly, none of the research areas show signs of the famous S-curve, which was expected based on sociological studies on innovation. As said before, the earliest stages of the adoption process are archaeologically invisible, until a critical mass is reached. But when the critical mass is reached, and we see Bell Beaker pottery appearing in settlements across Europe, there is no development visible from this Availability phase to the subsequent Sustainability or Consolidation phases. The Bell Beaker phenomenon in Northern France even only shows an initial development, but also a quick demise indicating an active rejection by the local population. Across the other parts of Europe, communities specifically chose to not produce all their pottery in the Bell Beaker fashion, but only a selected few vessels. This was done despite the fact that knowledge and technology was abundant. The adoption of the Bell Beaker pottery vessel by local communities across can thus be seen as a continuous Availability stage throughout the later 3rd millennium BC within Zvelebil's model. This also shows that the impact of the Bell Beaker innovation was limited, and thereby we can reject the hypothesis stated at the start of this paragraph. The Bell Beaker innovation was confined to the availability phase, and not an impactful and rapid event as had always been assumed.

5.4 Pottery frequencies: sites

5.4.1 Introduction

A further element in understanding the temporality of the adoption of the Bell Beaker innovation, comes from the analysis of settlement frequencies relative to the percentages of Bell Beaker pottery found on these settlements. By analysing this relationship, we can better understand the impact and sustainability of the Bell Beaker innovation. In this paragraph, results of this analysis from the different research areas are presented. The frequency of sites with a low percentage (0-20%), middle percentages (21-40%, 41-60%) or high (61-80%, 81-100%) percentages of Bell Beaker are presented here.

5.4.2 Results

Portuguese Estremadura (see figure 5.13)

The Portuguese Estremadura research area has a relatively large number of sites with low percentages of Bell Beaker pottery and a lower, but still fairly high number of sites with medium and high percentages.

Western France (see figure 5.14)

The Western France research area has a relatively large number of sites with low percentages of Bell Beaker pottery and a large number of sites with high percentages of Bell Beaker pottery. Especially the medium percentages of Bell Beaker pottery are not well represented here.

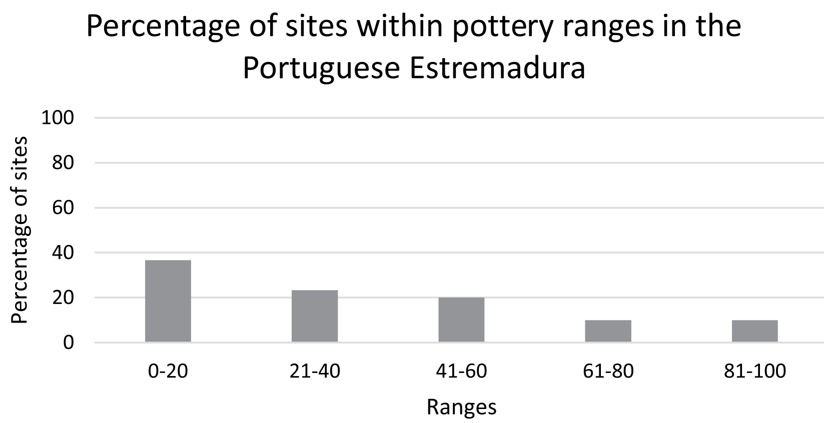


Fig. 5.13 Frequency sites Portuguese Estremadura.

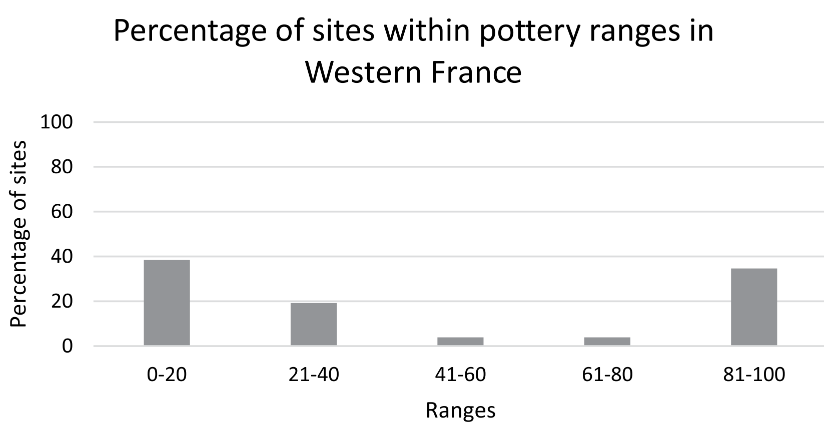


Fig. 5.14 Frequency sites Western France.

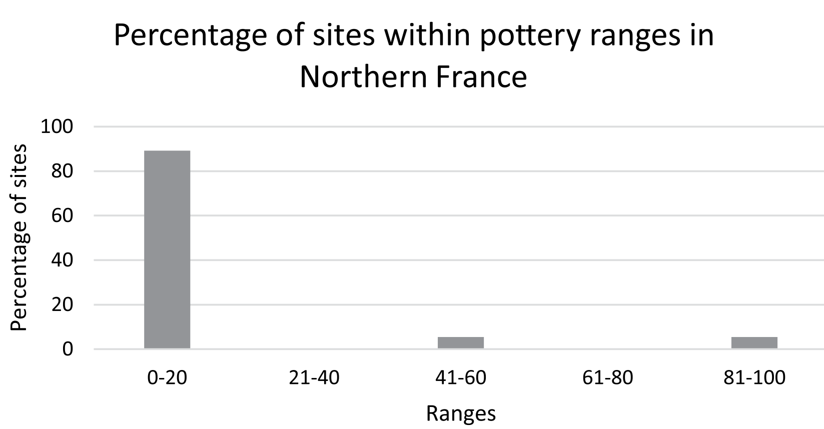


Fig. 5.15 Frequency sites Northern France.

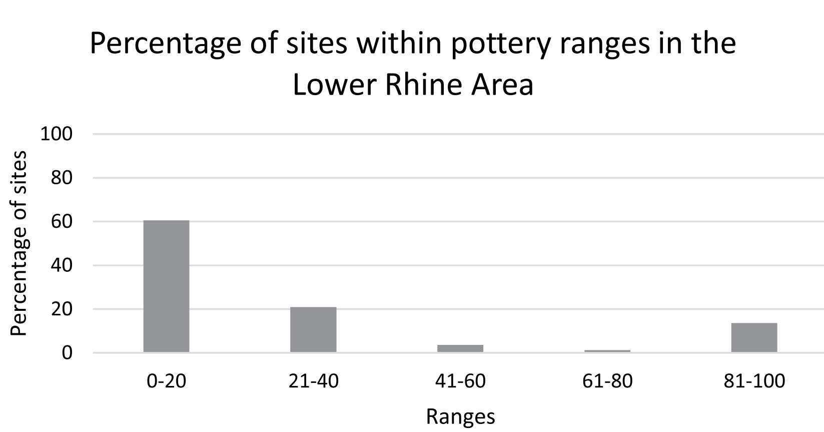


Fig. 5.16 Frequency sites Lower Rhine Area.

Northern France (see figure 5.15)

The Northern France research area has a relatively large number of sites with no Bell Beaker pottery, hidden in the 0-20 range. The number of sites with higher percentages of Bell Beaker pottery can be characterised as very low. These two sites are old finds where probably only Bell Beaker pottery was collected.

Lower Rhine Area (see figure 5.16)

The Lower Rhine Area research area has a relatively large number of sites with low percentages of Bell Beaker pottery and a medium number of sites with high percentages of Bell Beaker pottery. The middle range percentages of Bell Beaker pottery are also not well represented here.

Southern Scandinavia & Northern Germany (see figure 5.17)

The Southern Scandinavia and Northern Germany research area also has a relatively large number of sites with low percentages of Bell Beaker pottery. It has a low number of sites with medium or high percentages of Bell Beaker pottery.

Czech Republic (see figure 5.18)

The Czech Republic research area also has a relatively large number of sites with low percentages of Bell Beaker pottery. Here again the sites with a high percentage of Bell Beaker pottery are low, while the medium ranges are more frequently encountered.

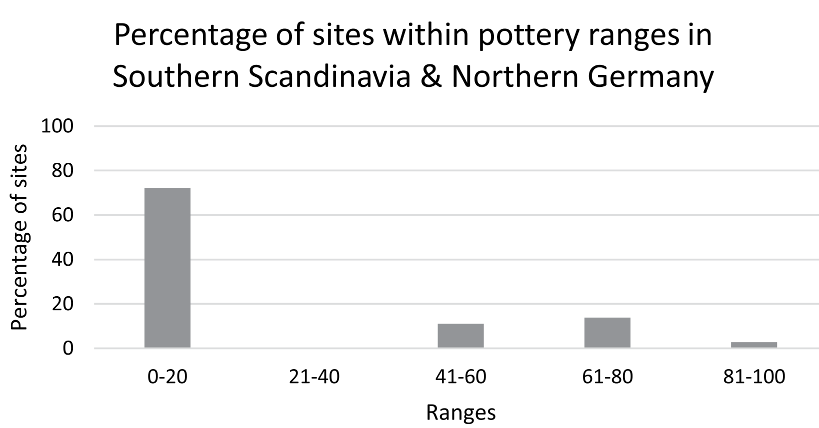


Fig. 5.17 Frequency sites Southern Scandinavia & Northern Germany.

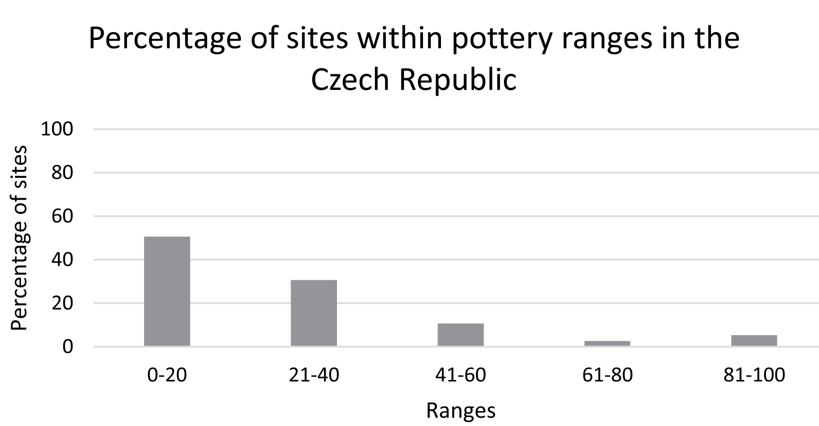


Fig. 5.18 Frequency sites Czech Republic.

Study areas	Low range	Medium range	High range	Impact	Sustainability
Portuguese Estremadura	high	high	medium	high	high
Western France	high	low	high	high	high
Northern France	high*	none	low	low	low
Lower Rhine Area	high	low	medium	high	high
Southern Scandinavia & Northern Germany	high	low	low	high	low
Czech Republic	high	high	low	high	low

Table 5.3 Summary of settlement frequency ranges (star denotes Northern France where most of the low range sites have no Bell Beaker pottery at all).

5.4.3 Recapitulation

How are we to understand these regional differences in the number of sites with different percentages of Bell Beaker pottery? In chapter 3 we've already discussed the underlying premises for this analysis, centring on the concepts of impact and sustainability of an innovation. Based on this, we can state that apart from Northern France, all our research areas present an initial adoption of the Bell Beaker phenomenon with a relatively high impact (see table 5.3).

In Northern France it appears as if the impact was either low or merely did not result in a substantial number of Bell Beaker settlements. Here most of the 0-20% Bell Beaker percentages actually fall on the 0% itself. Without these 0% settlements, the remaining settlements show a relatively modest range in terms of Bell Beaker pottery percentage. When moving towards the sustainability of the Bell Beaker phenomenon, this is clearly high in the research areas of the Portuguese Estremadura, Western France and the Lower Rhine Area, while it can be considered as low in Southern Scandinavia & Northern Germany and in the Czech Republic.

While this is only a preliminary result, based on a particular reading of the Bell Beaker settlements and percentages dataset. In paragraph 5.6 we will come back to understanding the processes of adoption in more elaborate terms, taking more strands of evidence into consideration.

5.5 Bayesian modelling of settlements

5.5.1 Introduction

An additional analysis that is carried out here, is the Bayesian modelling of several selected settlements. Bayesian models give an insight into three aspects of temporality and chronology: Firstly, the time interval between 'pre-Bell Beaker' and Bell Beaker occupation on these sites is of interest. Secondly, the duration of occupation can be modelled. The interval and occupation duration[13], albeit both indica-

13 Occupation duration is measured with the SPAN() function and can only be calculated when a phase has more than one ^{14}C date. Occupation interval is measured with the INTERVAL () function and only works when a model has double boundaries. Double boundaries allow for the possibility of elapsed time between the successive phases, i.e. hiatuses. This decreases the temporal resolution of the model, but increases its interpretive strength.

Settlement ID	Municipality	Toponym	Reference	Dates (used)	Sequences	Phases	Pre-Bell Beaker occupation	Post-Bell Beaker occupation
476	Torres Vedras	Zambujal	Kunst 1987, 1995, 2007; Kunst/Lutz 2008	53 (11)	1	7	Copos, Acacia-leaf	none
662	Slavonín	Horní Ian	Tkac 2012; Peska 2011	32 (31)	1	3	Globular Amphora, Corded Ware	Unetice
49	Vlaardingen	Arij Koplaan	Van Beek 1990; Amkreutz 2013	10 (5)	1	2	Vlaardingen	none
317	Grayan-l'Hopital	Lède du Gurp	Roussot-Larroque/Villes 1988; Roussot-Larroque 1995, 2002	21	2	7	Mesolithic, Early/Middle Neolithic, Artenac	Early Bronze Age
674	Mittelfranken	Ergersheim	Ullrich 2008	14	1	5	Corded Ware	Urnfield
399	Lodbjerg	Mortens Sande II	Liversage 1987, 1989, 2003	4	1	2	Corded Ware	none
40	Velsen	Noordzeekanaal	Zagwijn 1997; Vink/Bosman 2010; Kleijne 2016	9	2	4	none	Barbed Wire, Hilversum, Middle Bronze Age

Table 5.4 Settlement sites used in the Bayesian analysis.

tive in nature, can further elucidate the temporality of the adoption process in the research areas. Finally, these sites provide an indication for the diffusion of the Bell Beaker phenomenon. As said, earlier scholars, based on single radiocarbon dates, argued that the Iberian Peninsula was the place of origin. Recently several studies have however shown that, because of its many wiggles and plateaus in the 3rd millennium BC, the radiocarbon calibration curve does not allow any detailed differentiation on the precise origin of the Bell Beaker phenomenon (*cf.* Furholt 2001; Beckerman 2012; Fokkens *et al.* 2016). By using Bayesian models as proxies for the beginning of the Bell Beaker phenomenon in a particular research area, we can get a more fine-grained resolution, and possibly circumventing the radiocarbon calibration problem. This then allows us to provide new insights with regard to the origin and development of the Bell Beaker phenomenon at large. These seven settlements are selected on the basis of their published stratigraphy and distinct occupation phases (see table 5.4 and figure 5.19).

Results of the models are quantitative mathematical estimates of the duration and the span of particular occupation horizons. In order to understand these estimates in terms of their sustainability and impact of the Bell Beaker phenomenon, a qualitative framework is created. This framework is aimed at understanding outcomes such as "0-10" versus "0-400" years frequently encountered in Span and Interval calculations. While the first example is a relatively short period, a decade, the second example can be seen as a long time period.

5.5.2 Results

Zambujal

The settlement of Zambujal (see table 5.5 and figure 5.20) is a well-known and long studied example of a Bell Beaker enclosed settlement from the Portuguese Estremadura, located on a hillside overlooking the Sizandro valley (Sangmeister/Schubert 1972; Kunst 1987). The site, basically a settlement consisting of walls, features and

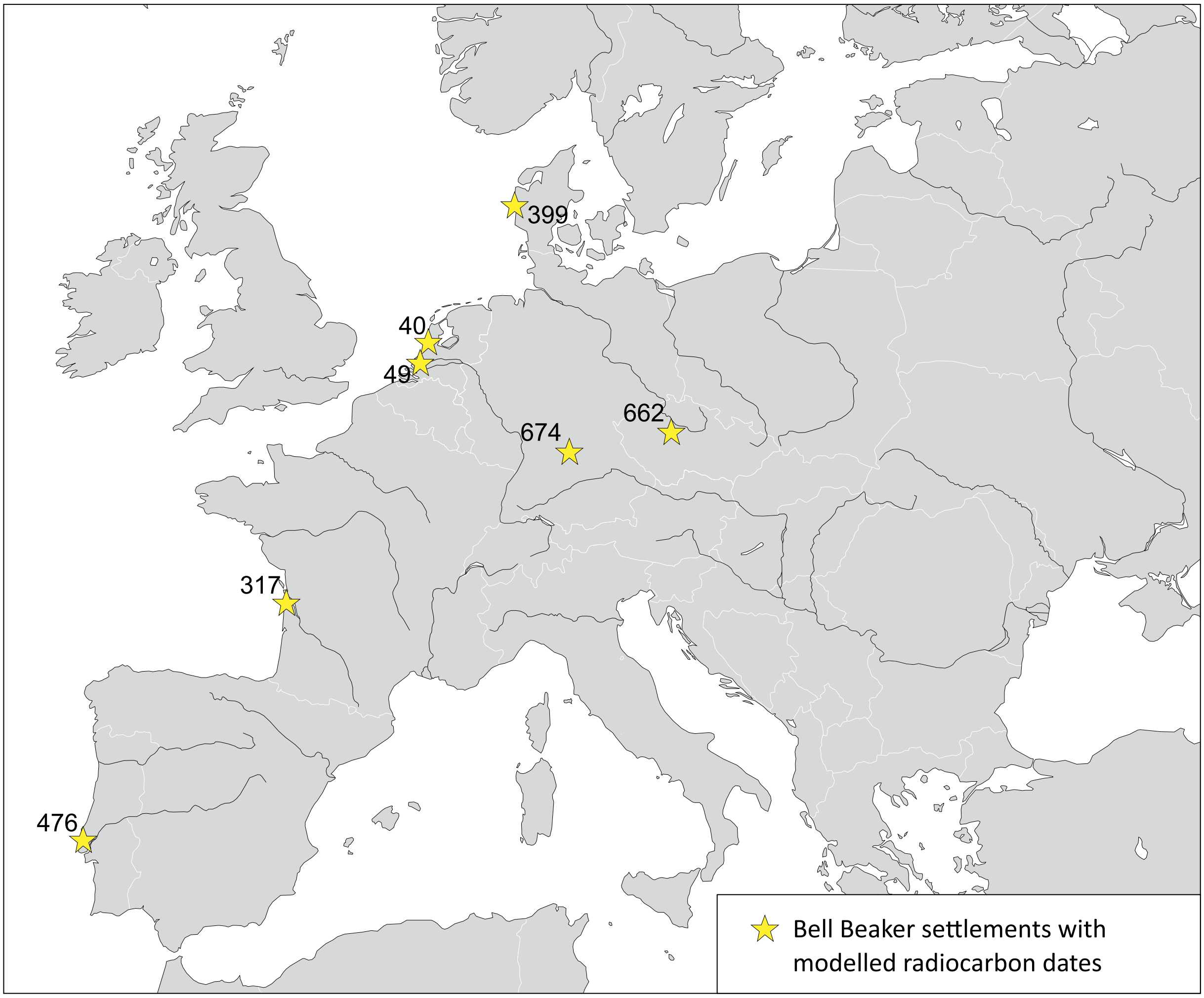


Fig. 5.19 The settlement sites used in the Bayesian analysis.

various cultural layers, is intensely occupied from the Earlier Chalcolithic until into the Bronze Age, as indicated by the presence of *Copos Cañelados*, Acacia-leaf pottery, Bell Beakers and later Bronze Age pottery (*idem*). While on the one hand it means that this site can be used to study the development from Early Chalcolithic to Late Chalcolithic, spanning more than a millennium of occupation, in practice this means that any model of its phasing is fraught with complex stratigraphy, erosion, reworked sediments, dug features and unclear contexts. In order to illustrate this complexity, the amount of Bell Beaker pottery from each phase was noted in table 5.5 (based on Kunst 2007, Abb. 23).

The settlement of Zambujal starts in phase 0 between *3086-2916 cal BC*, which ends between *2908-2763 cal BC*. This occupation lasts between *11-110 years (86.5% probability)*. Phase 1 starts between *2884-2677 cal BC* and ends between *2849-2626 cal BC*. The interval between phases 0 and 1 probably lasted between *0-169 years*. Phase 2 starts between *2779-2582 cal BC* and ends between *2667-2532 cal BC*. The interval between phases 1 and 2 probably lasted between *0-162 years*. Phase 3 starts between *2620-2488 cal BC* and ends between *2575-2459 cal BC*. The interval between phases 2 and 3 probably lasted between *0-102 years*. Phases 4 and 5 start between *2510-2359 cal BC* and end between *2492-2224 cal BC*. The interval between phases 3 and 4/5 probably lasted between *0-100 years*. When we consider the amount of Bell Beaker pottery found in each phase we can study the start of the Bell Beaker phenomenon at this settlement. Problem with Zambujal is to define the start of the Bell Beaker phenomenon. Low quantities of Bell Beaker pottery have been found in phase 1 and

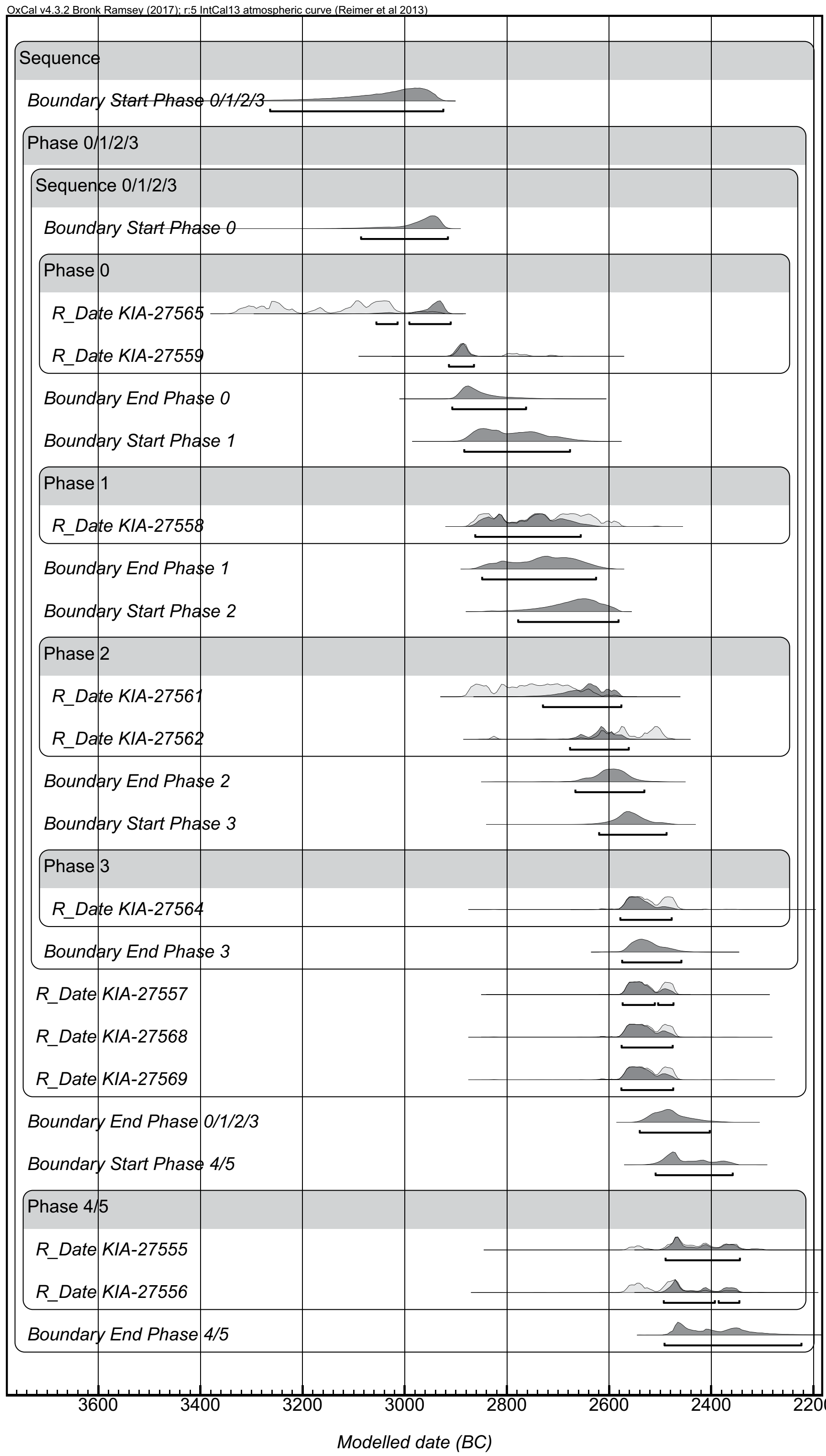


Fig. 5.20 Bayesian model of the Zambujal settlement.

Zambujal phase	Start cal BC	End cal BC	Interval	Span	BB pottery
0	3086-2916	2908-2763	0-169	11-110 (86.5%)	0
1	2884-2677	2849-2626	0-162	na	1
2	2779-2582	2667-2532	0-102	0-114	15
3	2620-2488	2575-2459	0-100	na	27
4	2510-2359	2492-2224		na	250

Table 5.5 Results of Bayesian analysis for Zambujal (interval and span in calendar years).

Horni Ian Phase	Start cal BC	End cal BC	Interval	Span
1	3725-2683	2843-2446	0-388	0-596
2	2566-2326	2105-1868	0-239	182-514
3	1959-1777	1416-1227		368-585

Table 5.6 Results of Bayesian analysis for Slavonín Horni-Ián (interval and span in calendar years).

phase 2, whereas higher quantities are known from phase 3 and especially phase 4. The intensive habitation at Zambujal, where rebuilding of structures, reworking and erosion of sediments took place, makes a secondary nature of these potentially early Bell Beaker sherds completely plausible (see also Kunst 2007). Thus, the start of the Bell Beaker occupation at Zambujal can be put at phase 3 of this enclosed settlement. The interval between the pre-Bell Beaker and Bell Beaker occupation is therefore between *0 and 102 years*.

Slavonín, Horni Ián

The settlement of Horni Ián (see table 5.6 and figure 5.21) is one of the few Bell Beaker settlements in the Czech Republic for which ^{14}C dates exist (Tkáč 2012, Peška 2011, 2013). The site consists of many dug features and several burials, associated with four phases of occupation: Globular Amphorae, Corded Ware, Bell Beaker and Únetiče.

It is at the moment impossible to distinguish between the Corded Ware and Bell Beaker associated features at the site of Horni Ián. Firstly, as ^{14}C dates are overlapping between Corded Ware and Bell Beaker associated features. And secondly as there is no chronological trend visible in the Common Ware pottery of the Corded Ware and Bell Beaker phenomena. Therefore, a model was created that combines both the data from the Corded Ware and Bell Beaker features, and only studies the intervals with the preceding Globular Amphorae and following Únětice phases.

The start of the Globular Amphora phase can be dated between *3725-2683 cal BC*. This phase ends between *2843-2446 cal BC*. The Globular Amphora occupation therefore can be modelled to between *0 and 596 years*. The start of the combined Corded Ware/Bell Beaker occupation phase can be dated to *2566-2326 cal BC*, while this phase ends between *2108-1837 cal BC*. An interval between the Globular Amphora and Corded Ware/Bell Beaker occupation phases lasted between *0-388 years*. The duration of the Corded Ware/Bell Beaker phase can therefore be modelled to between *182 and 514 years*. An interval with the subsequent Únětice lasts for *0-239 years*, as this final phase starts between *1959-1777 cal BC*.

This does not inform us about the span and interval of the Bell Beaker occupation in particular. On the other hand, the fact that Corded Ware and Bell Beaker are as of yet unseperable in terms of both ^{14}C dates and in terms of Common Ware

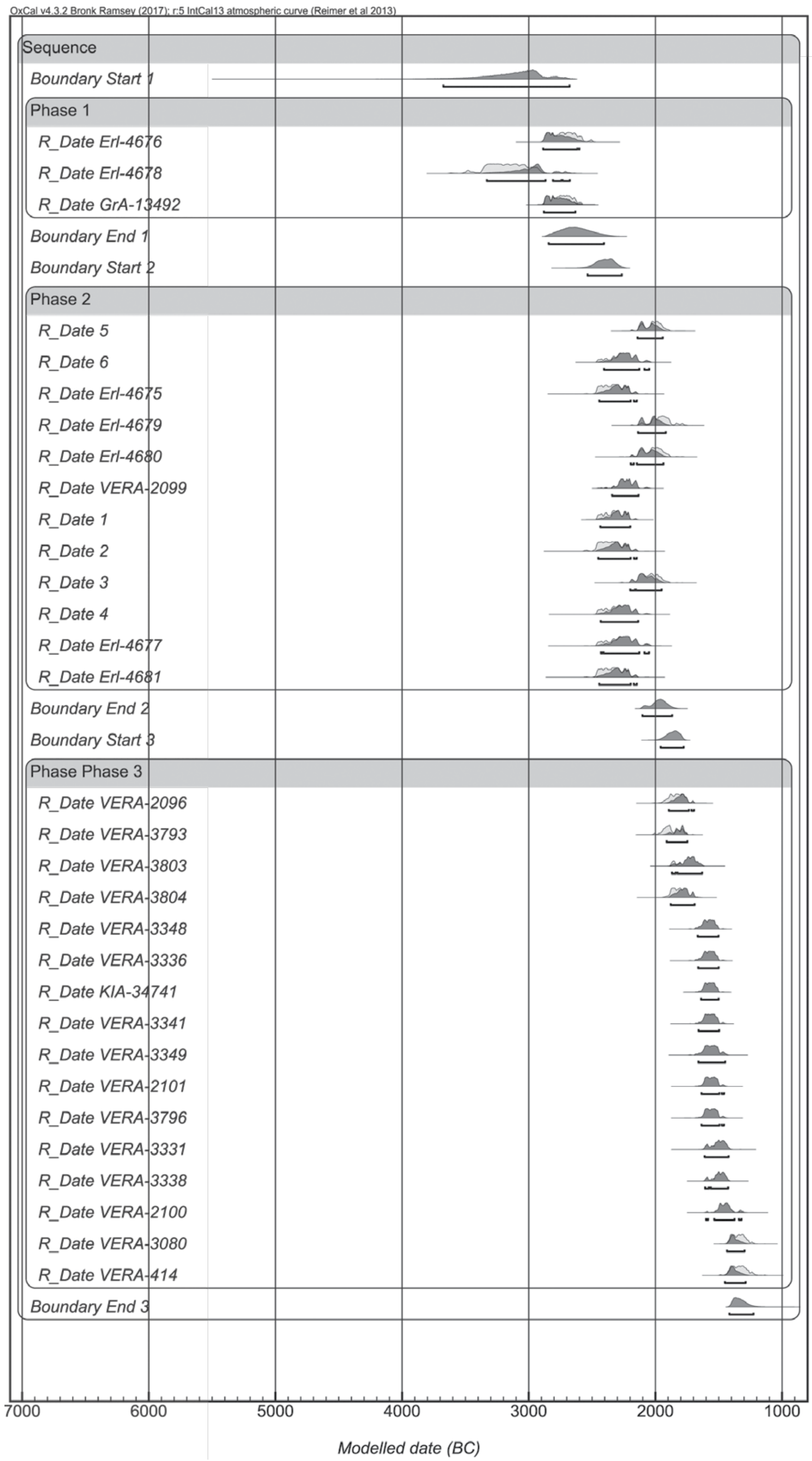


Fig. 5.21 Bayesian model of the Horni-Ián settlement.

pottery (see appendix B), might also highlight the short interval between these subsequent cultural phenomena.

Vlaardingen, Arij Koplaan

The settlement of Vlaardingen Arij Koplaan (see table 5.7 and figure 5.22) has produced many settlement traces dating to the Late Neolithic. A stratigraphic sequence could be observed at 'werkput 9'. Here, habitation ascribed to consecutively the Vlaardingen group and the Bell Beaker phenomenon was uncovered (Van Beek 1990). The sequence consists of cultural layers on the sandy clay levee of the gully of an estuarine system (Amkreutz 2013b, 250-256).

The start of the Vlaardingen group occupation can be dated between *3257-2486 cal BC (95.2% probability)*. This phase ends between *2852-2425 cal BC*. The start of the Bell Beaker occupation can be dated to *2588-2313 cal BC*, while this phase ends between *2462 and 2145* cal BC. This Bell Beaker phase lasted between *0 and 193 years*. A time interval between the Vlaardingen group and Bell Beaker occupation phases can be modelled to between *0 and 388 years*.

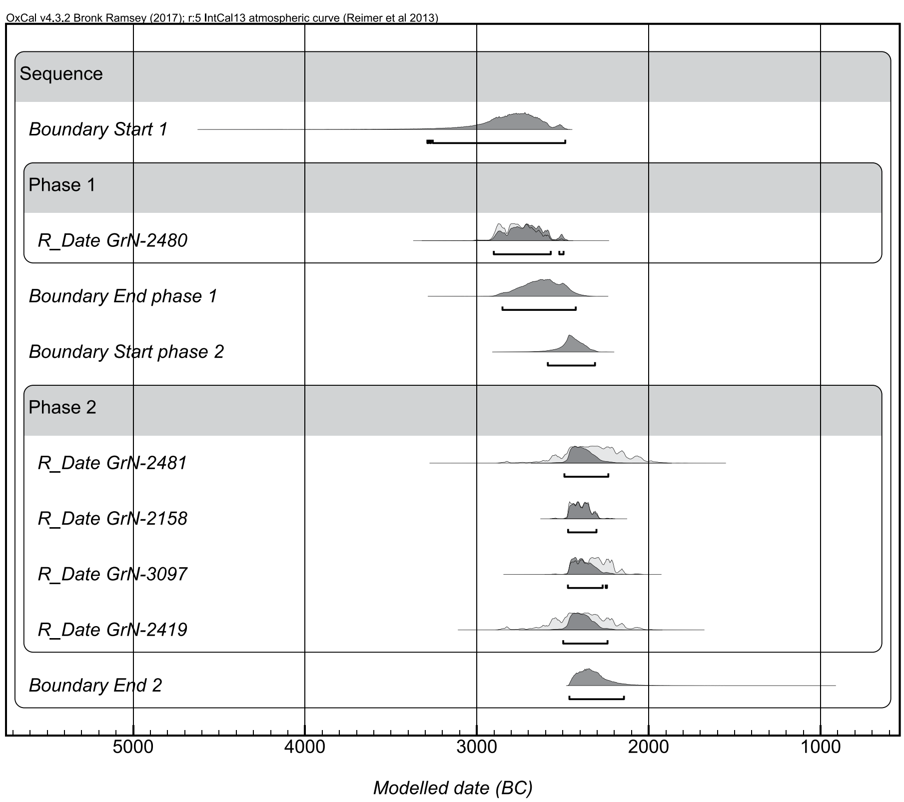


Fig. 5.22 Bayesian model of the Vlaardingen settlement.

Arij Koplaan Phase	Start cal BC	End cal BC	Interval	Span
1	3257-2486	2852-2425	0-388	Na
2	2588-2313	2462-2145		0-193

Table 5.7 Results of Bayesian analysis for Vlaardingen Arij Kpplaan (interval and span in calendar years).

Grayan-et-l'Hôpital, La Lède du Gurp

The settlement of La Lède du Gurp (see table 5.8 and figure 5.23), situated on the French Atlantic coast, has produced a stratigraphic sequence from the Late Mesolithic until the Bronze Age onwards (*cf.* Roussot-Larroque 1995, fig. 8).

The start of the Late Neolithic Artenac phase can be dated to *3777-3111 cal BC* and its end to *3372-2609 cal BC (95.2% probability)*. The start of the Bell Beaker phase can be dated to *2906-2486 cal BC* and its end to *2583-2314 cal BC*. The Bell Beaker

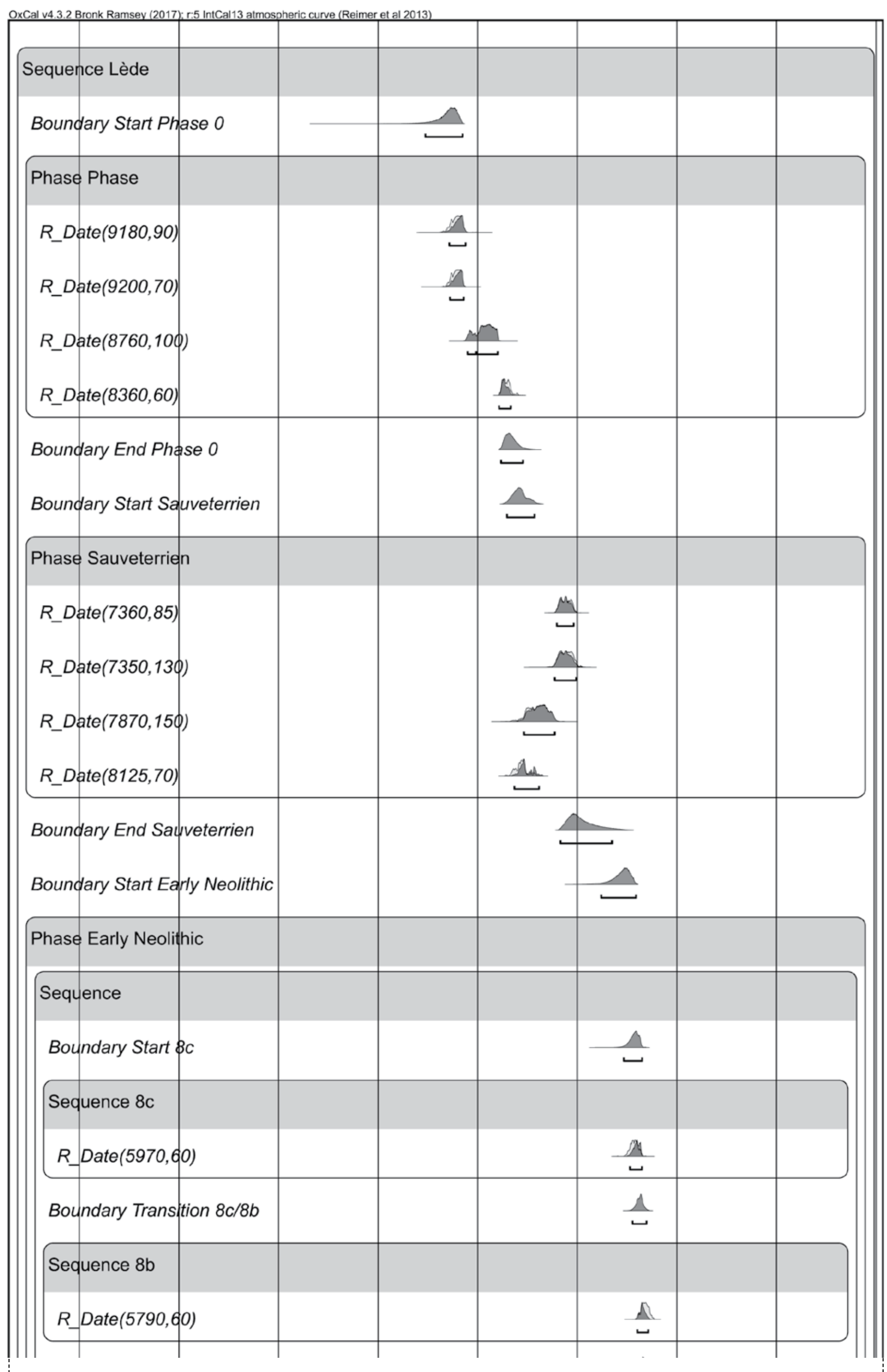


Fig. 5.23 Part of the Bayesian model of the La Lède du Gurp settlement.

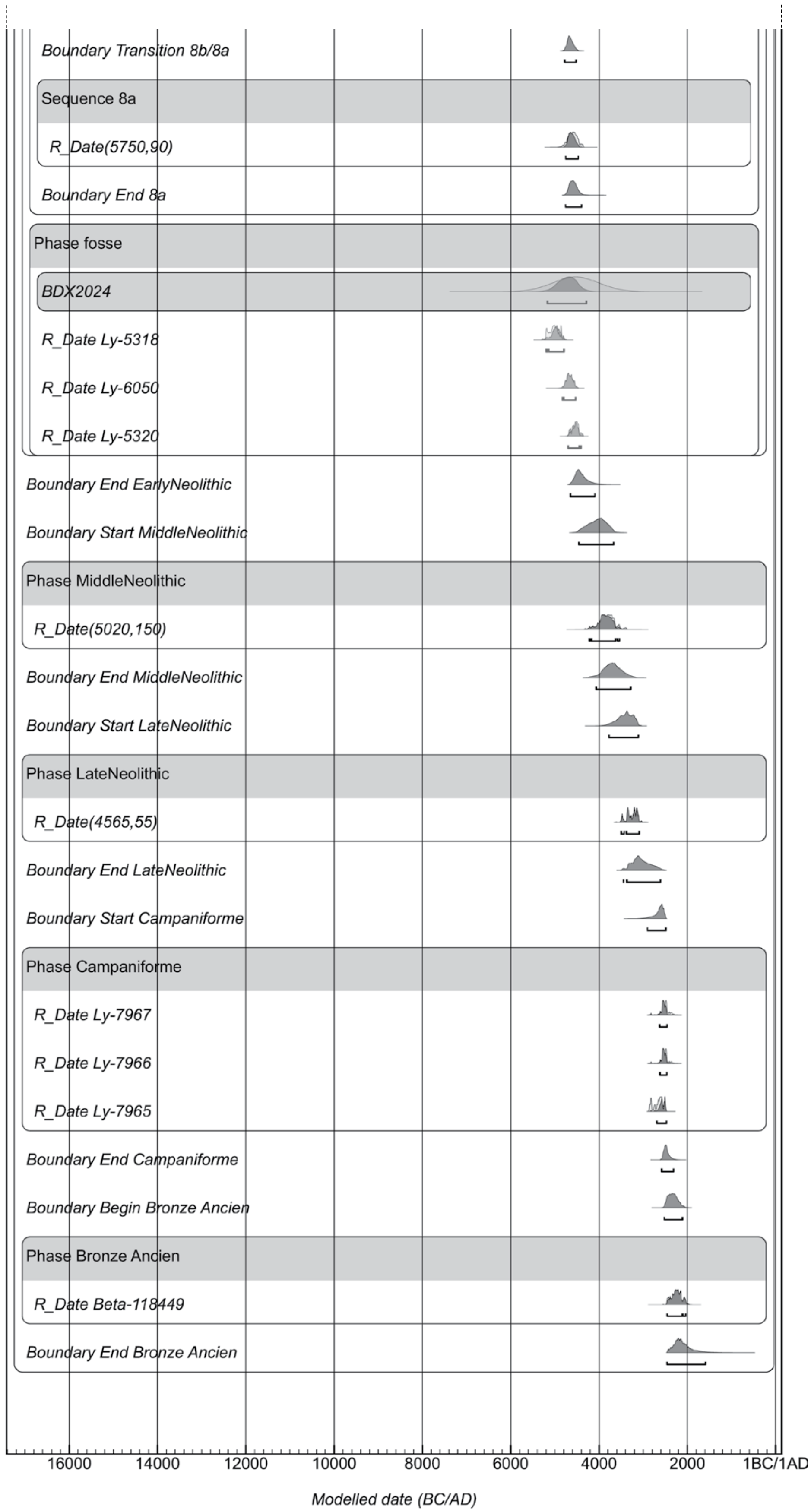


Fig. 5.23 (continued) Part of the Bayesian model of the La Lède du Gurp settlement.

occupation therefore can be modelled to *0 to 202 years*. An interval between the Artenac and Bell Beaker phases probably lasted between *0 and 751 years*. The start of the Early Bronze Age occupation can be dated to *2523-2118 cal BC (95.1% probability)* and its end to *2459-1587 cal BC*. An interval between Bell Beaker and Early Bronze Age phases probably lasted between *0 and 345 years*.

Mittelfranken, Ergersheim

The site of Ergersheim (see table 5.9 and figure 5.24), in Franconia, consists of a series of shallow sinkholes in which Neolithic and Bronze Age settlement material was deposited in a stratigraphic order (Ullrich 2008). The material is found in cultural layers, separated by layers of clay and silt without any evidence for human occupation.

The start of the Corded Ware phase can be dated to *3001-2301 cal BC* and its end to *2463-2177 cal BC*. The Corded Ware occupation phase therefore can be modelled to between *0-148 years*. The start of the Bell Beaker phase can be dated to *2361-2059 cal BC* and its end to *2178-1707 cal BC*. The Bell Beaker occupation therefore can be modelled to between *0-336 years*. An interval between Corded Ware and Bell Beaker phases probably lasted between *0 and 273 years*. The start of the Middle Bronze Age occupation can be dated to *1757-1463 cal BC* and its end to *1520-1301 cal BC*. The Middle Bronze Age occupation therefore can be modelled to between *0-200 years*. An interval between Bell Beaker and Middle Bronze Age phases probably lasted between *71 and 606 years*.

Lodbjerg, Mortens Sande II

The Late Neolithic settlement of Mortens Sande II (see table 5.10 and figure 5.25) is located in the coastal dune area of Western Denmark, where cultural layers formed between thick layers of dune sand, signifying aeolian sedimentation (Liversage 1987).

Because of this low amount of dates, a start of Corded Ware occupation cannot be narrowed down further than between *3345-2297 cal BC*, and ending between *2815-2259 cal BC*. The start of the first Bell Beaker occupation can be dated between *2576-2126 cal BC*, ending between *2427-1768 cal BC*. An interval between the Corded Ware and Bell Beaker occupation phases probably lasted between *0 and 444 years*. The Bell Beaker occupation lasted between *0 and 338 years*.

Velsen Noordzeekanaal

Late Neolithic and Bronze Age settlement traces were found during the widening of the North Sea channel between Amsterdam and Velsen (see table 5.11 and

La Lède du Gurp Phase	Start cal BC	End cal BC	Interval	Span
1	3777-3111	3372-2609	0-751	na
2	2906-2486	2583-2314	0-345	0-202
3	2523-2118	2459-1587		na

Table 5.8 Results of Bayesian analysis for Grayan-et-l'Hôpital La Lède du Gurp (interval and span in calendar years).

Ergersheim Phase	Start cal BC	End cal BC	Interval	Span
1	3001-2301	2463-2177	0-273	0-148
2	2361-2059	2178-1707	71-606	0-336
3	1757-1463	1520-1301		0-200

Table 5.9 Results of Bayesian analysis for Mittelfranken Ergersheim (interval and span in calendar years).

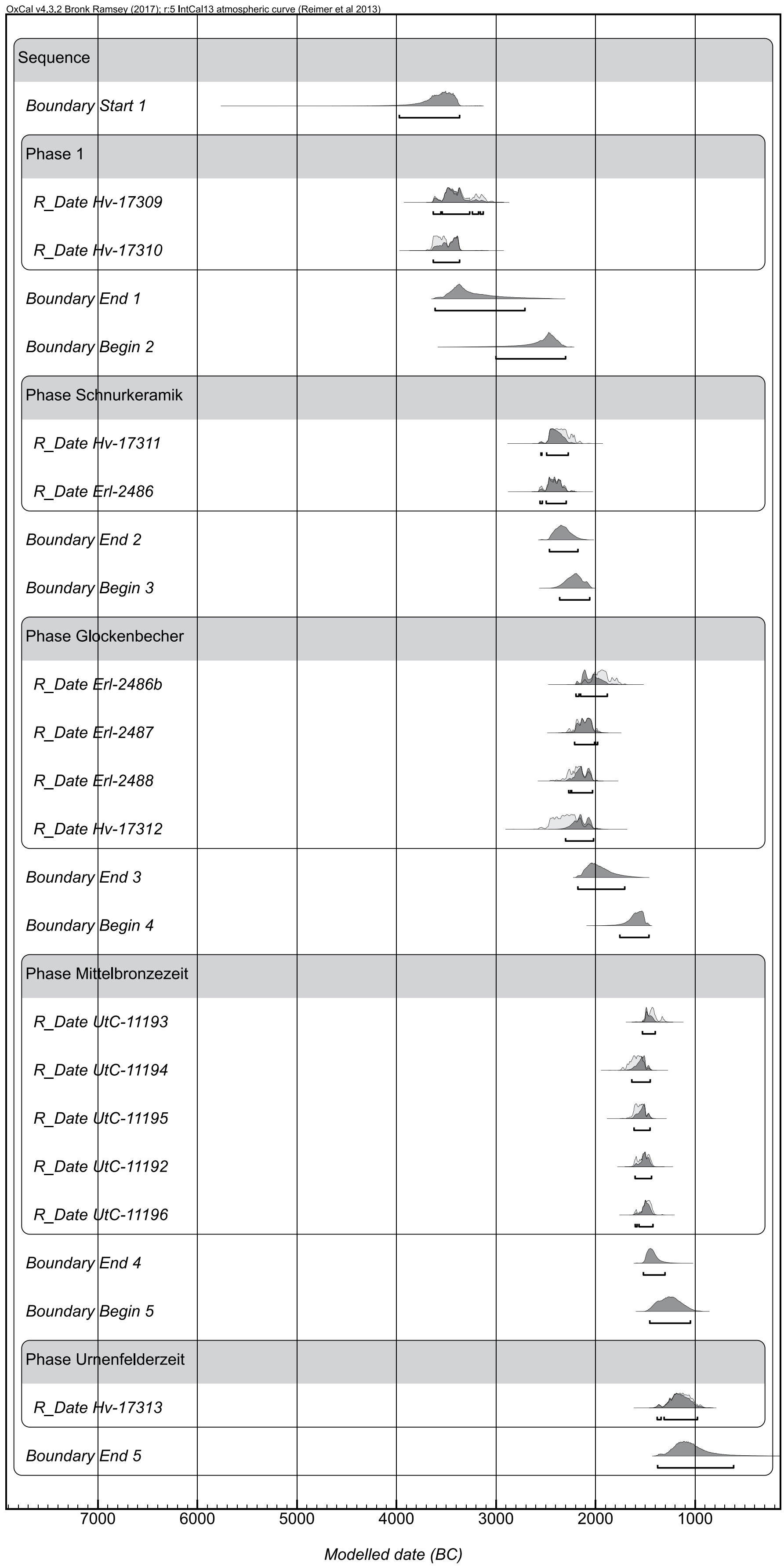


Fig. 5.24 Bayesian model of the Ergersheim settlement.

figure 5.26). For this settlement an age-depth model was created, as ^{14}C dates were taken from specific depths within the section of peat layers.

Just as at Ergersheim, only the Velsen Late Neolithic/Early Bronze Age and Middle Bronze Age occupation phases are taken into consideration here. The first habitation phase starts between *2041-1880 cal BC (95.3% probability)*. This is only *0-448 years* after the formation of the beach barrier in the Late Neolithic (which itself took place between *3184-1941 cal BC (94% probability))*. The Late Neolithic/ Early Bronze Age occupation ends between *1901-1736 cal BC*. This occupation phase lasted between *3-213 years*. Middle Bronze Age settlement started between *1833-1690 cal BC* and ended between *1767-1643 cal BC*. An interval between these Late Neolithic/Early Bronze Age and Middle Bronze Age occupation phases probably lasted between *0-148 years*.

Table 5.10 Results of Bayesian analysis for Ljodberg Mortens Sande II (interval and span in calendar years).

Mortens Sande II Phase	Start cal BC	End cal BC	Interval	Span
1	3345-2297	2815-2259	0-444	na
2	2576-2126	2427-1768		0-338

Table 5.11 Results of Bayesian analysis for Velsen Noordzeekanaal (interval and span in calendar years).

Noordzeekanaal Phase	Start cal BC	End cal BC	Interval	Span
0	3184-2216	2415-1941	0-448	na
1	2038-1881	1901-1736	0-149	3-213
2	1833-1690	1767-1643		0-87

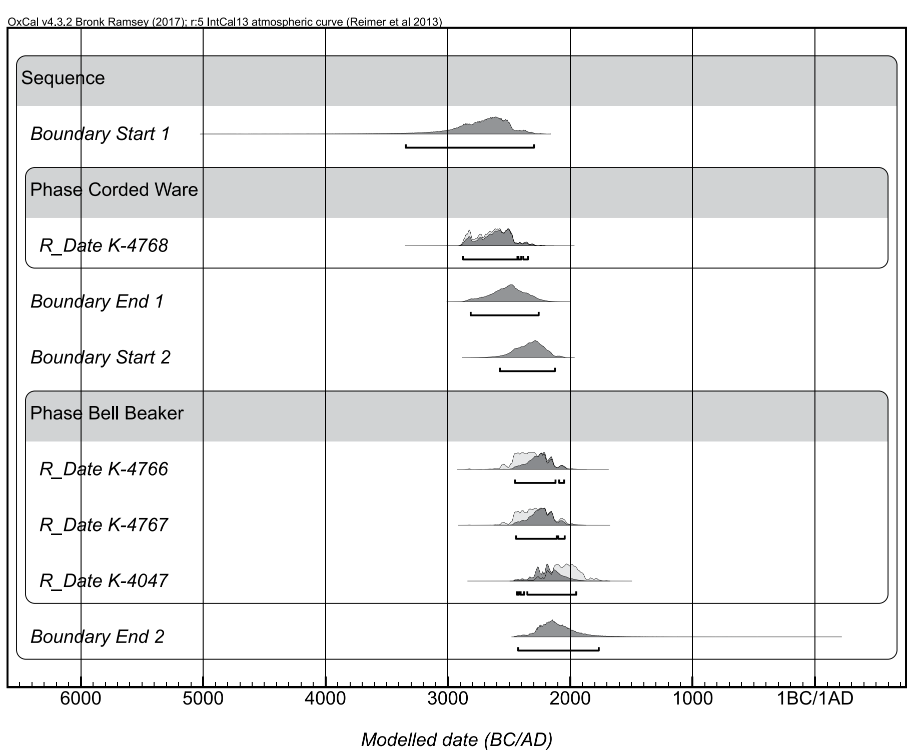


Fig. 5.25 Bayesian model of the Mortens Sande II settlement.

5.5.3 Bayesian analysis: intervals and spans

As argued in chapter 3, the Bayesian models created above can be used as an alternative perspective to understand the temporality of the Bell Beaker innovation on settlements. The length of the interval between a preceding phase and the Bell Beaker habitation is indicative of the fastness with which the Bell Beaker innova-

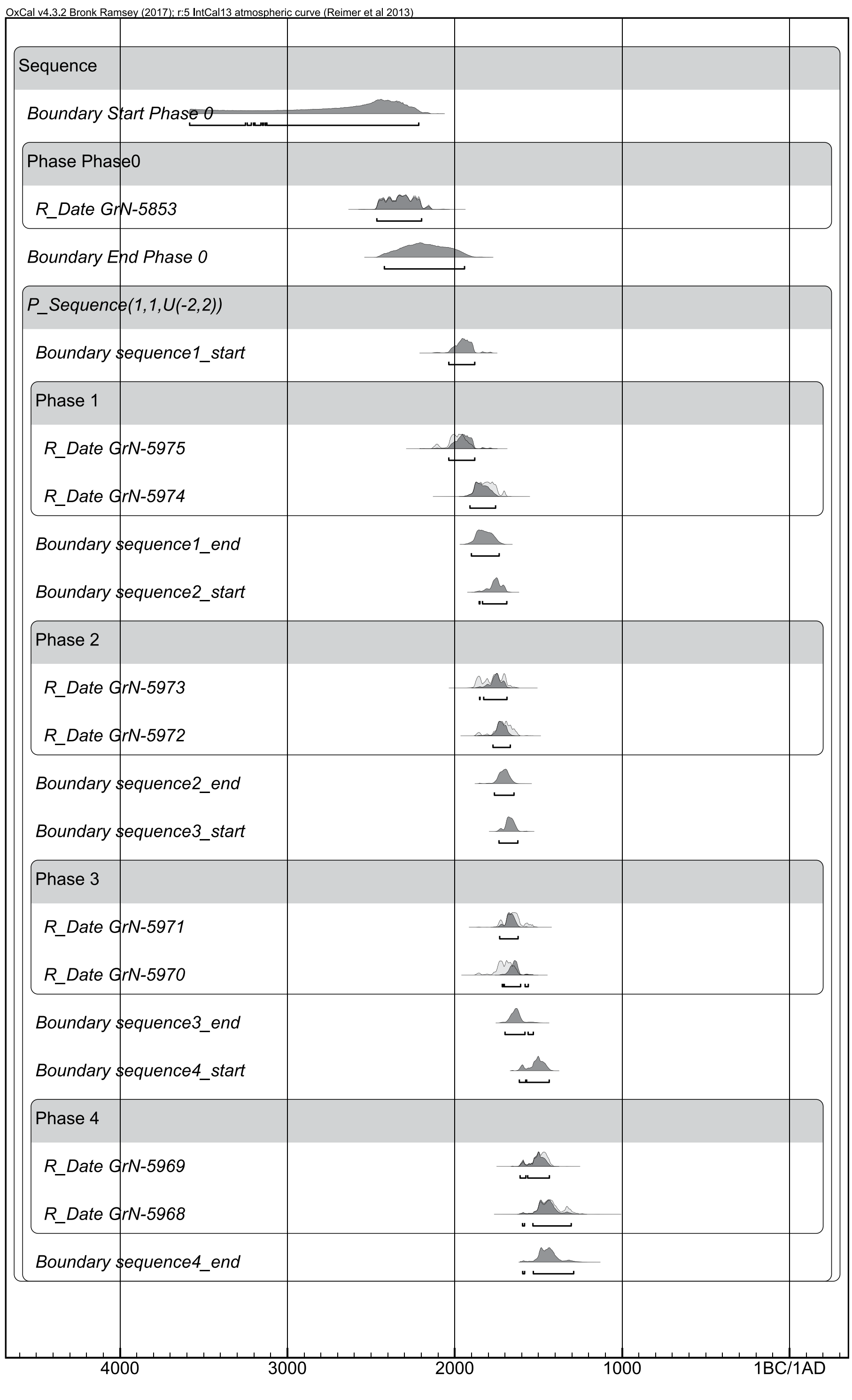


Fig. 5.26 Bayesian model of the Velsen settlement.

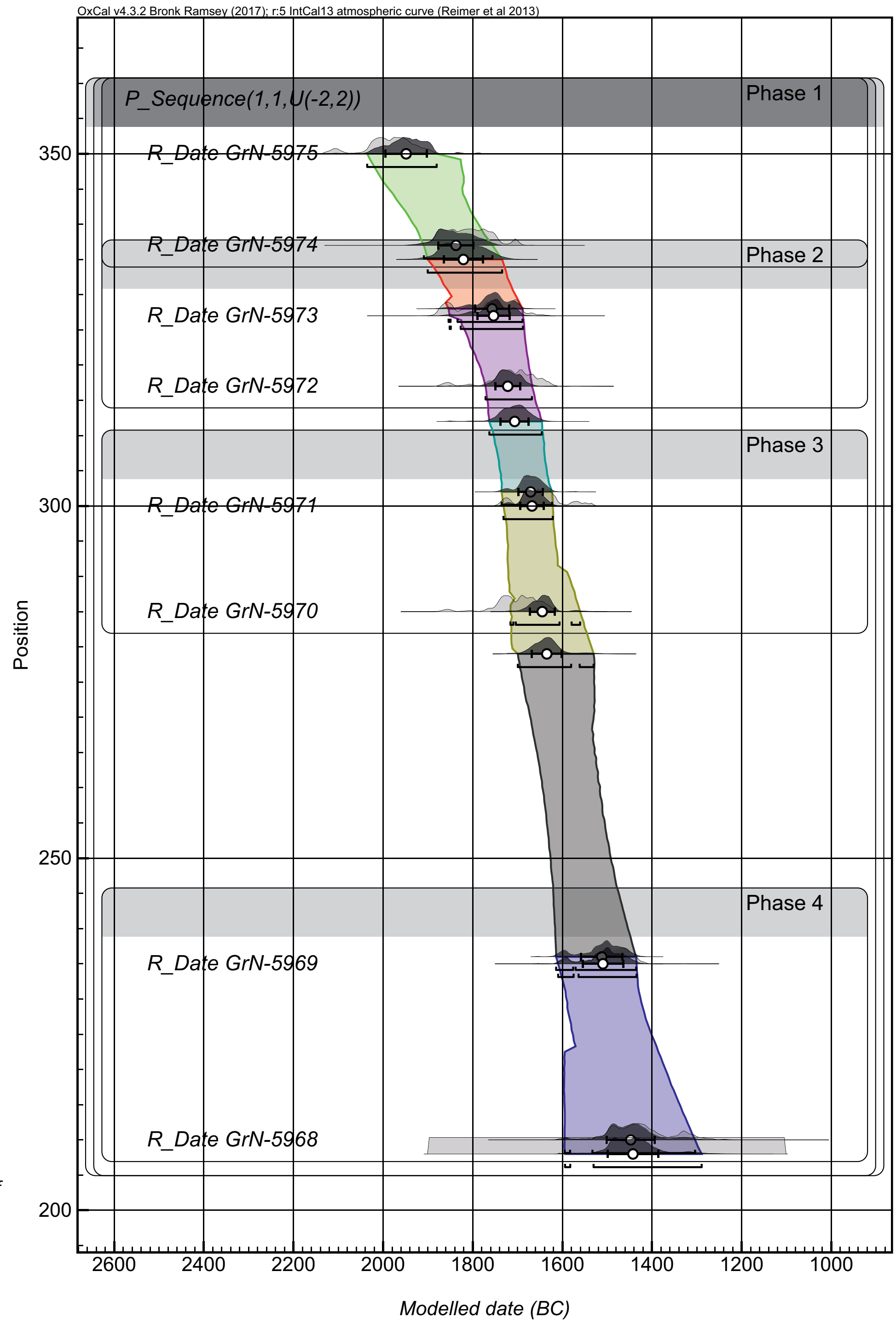


Fig. 5.27 Deposition model of the Velsen Noordzeekanaal habitation.

tion got adopted. Secondly, the span or duration of Bell Beaker occupation itself is indicative of the sustainability of this innovation. The six Bell Beaker settlements serve as proxies for understanding the temporality of innovation in their particular research areas.

When we take all the different time intervals between pre-Bell Beaker and Bell Beaker phases at the sites of Horni Ián, Ergersheim, Mortens Sande II, Vlaardingen, Zambujal and La Lède du Gurp and separately the Bell Beaker and post-Bell Beaker

Settlement ID	Toponym	Pre-BB interval	Start Bell Beaker phase	End Bell Beaker phase	Post-BB interval	BB occupation span
476	Zambujal	0-162	2779-2582 cal BC	2492-2224 cal BC	na	0-114
662	Horní Ian	0-388 (combined)	2566-2326 cal BC	2108-1837 cal BC	0-239	182-514 (combined phase)
49	Arij Koplaan	0-388	2588-2313 cal BC	2462-2145 cal BC	na	0-193
317	Lède du Gurp	0-751	2906-2486 cal BC	2583-2314 cal BC	0-345	0-202
399	Mortens Sande II	0-444	2576-2126 cal BC	2427-1768 cal BC	na	0-338
273	Ergersheim	0-273	2361-2059 cal BC	2178-1707 cal BC	71-606	0-336
40	Noordzeeka-naal	na	2038-1881 cal BC	1901-1736 cal BC	0-149	3-213

Table 5.12 Summary of intervals, spans and start/end of Bell Beaker phase.

phases from Ergersheim, Noordzeekanaal and La Lède du Gurp (see figure 5.28 and table 5.12), several things stand out.

As argued, the duration of the interval preceding Bell Beaker occupation is directly related to the fastness by which the innovation got adopted. At Zambujal a short interval can be calculated between the pre-Bell Beaker and Bell Beaker phase. At Horni Ián we cannot differentiate between Corded Ware and Bell Beaker on this site. But this can also be evidence for a short interval between these two occupation phases. At Vlaardingen, the interval between pre-Bell Beaker and Bell Beaker habitation is of medium length. Longer intervals are found on the sites of La Lède du Gurp and Mortens Sande II.

Following this, taking the specific settlements as the examples for a whole research area, the adoption of the Bell Beaker innovation in the Portuguese Estremadura and in the Czech Republic, can be characterised as fast. The adoption of the Bell Beaker phenomenon in Western France and in Southern Scandinavia and Northern Germany, contrastingly, can be identified as slow. The Lower Rhine Area takes an intermediate position in this respect.

Next to intervals, we analysed the span of Bell Beaker occupation. The span of Bell Beaker occupation at a settlement measures the sustainability of the Bell Beaker innovation at this particular settlement. At Zambujal the occupation span of the Bell Beaker phenomenon was short, lasting just over 100 years maximum. At Mortens Sande II, Ergersheim and possibly Horni Ián, a long occupation span lasting possibly more than 300 years was calculated. The settlements of Noordzeekanaal, Vlaardingen Arij Koplaan and La Lède du Gurp show a medium span of Bell Beaker occupation, lasting around 200 years maximum. From this it is inferred that the Bell Beaker phenomenon at Zambujal was relatively unsustainable, whereas on the other settlements the adopted innovation was of a more sustainable nature.

5.6 Innovation and time: conclusion

This chapter focused on the first research question "How did the adoption process of the Bell Beaker phenomenon take place in temporal terms?" Studying the phasing, the impact and sustainability and the pace and timing of the Bell Beaker innovation, several answers were given for each particular research area.

The first analysis focused on the phasing of the adoption process. It was hypothesised that the adoption of the Bell Beaker innovation would pass through the three

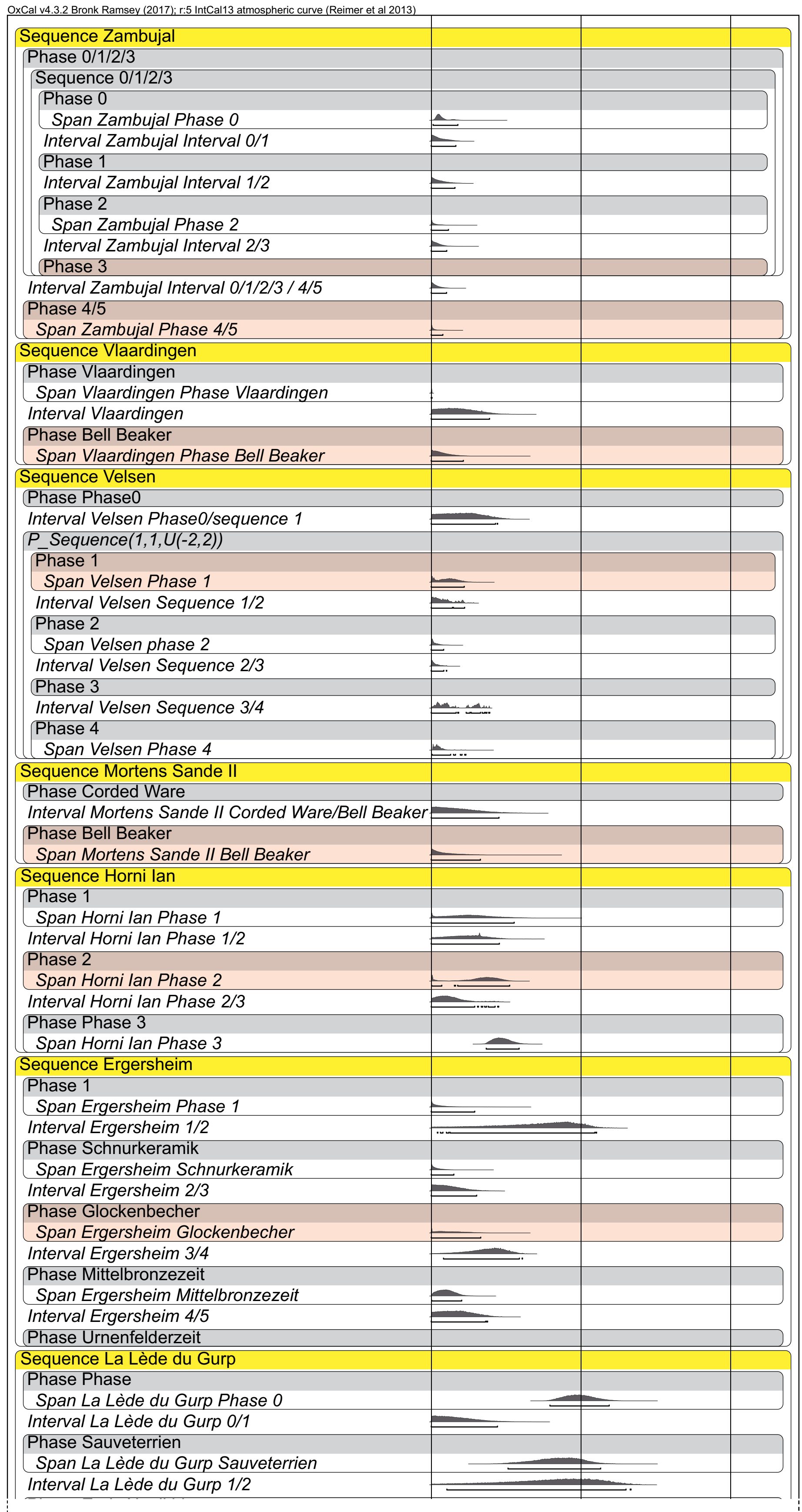


Fig. 5.28 The intervals and spans of the different occupation phases on settlements (yellow: the different settlements, red: Bell Beaker phases).

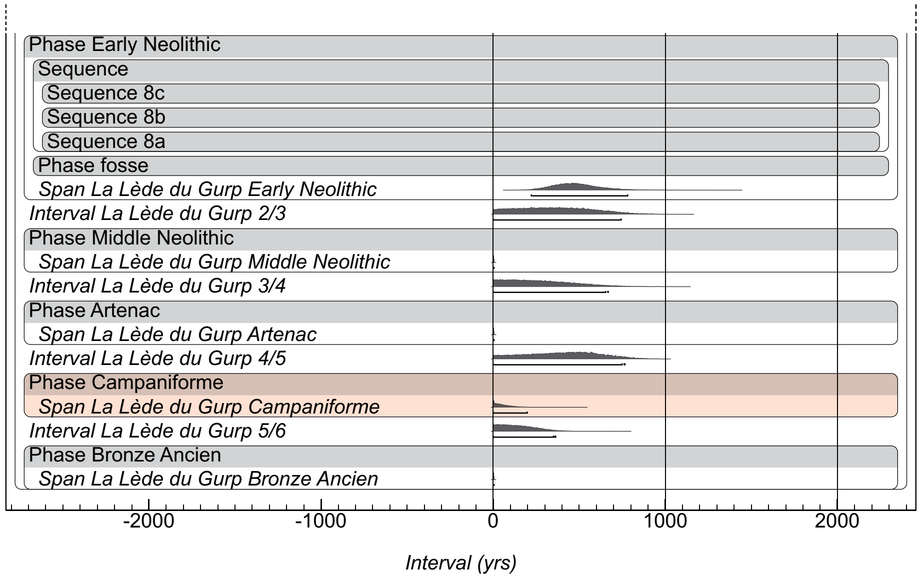


Fig. 5.28 (continued) The intervals and spans of the different occupation phases on settlements (yellow: the different settlements, red: Bell Beaker phases).

stages of adoption, as described in the work of Zvelebil, based on Rogers' S-curve model: Availability, Substitution and Consolidation. These phases were hypothesised to be related to the percentages of Bell Beaker pottery found on settlements.

In none of the research areas is the Availability model is readily applicable however. In Northern France, after an initial Availability stage, the Bell Beaker innovation seems to have been actively rejected in favour of the continued production and use of traditional pottery described as the Gord and Deûle/Escaut phenomena. For other parts of Europe we can conclude that the Bell Beaker innovation remained an innovation in the Availability stage of development. Common Ware pottery makes up most of the remainder of settlement assemblages across Europe. The Lower Rhine Area comes closest to showing parts of an S-curve, when an early increase in Bell Beaker pottery percentage was followed by a decrease in favour of Common Ware, the regionally developed Potbeker and the later Barbed Wire ceramics. In both Southern Scandinavia & Northern Germany and the Czech Republic, Common Ware even increased in frequency, whereas the Bell Beaker pottery diminished during the later 3rd millennium BC.

The impact and sustainability of the Bell Beaker phenomenon was studied in the second analysis. This was not studied by analysing pottery frequencies themselves, but by taking the amount of settlements in particular ranges of Bell Beaker pottery percentages. This number of settlements demonstrates the impact and sustainability of the innovation, according to the theory employed here. The current hypotheses focus on Bell Beaker adoption all favour a high impact and a sustainable effect on Late Neolithic society. However here we discovered that a much more varied reception existed, at least with regard to settlement contexts. While the data shows a high impact of the Bell Beaker innovation in all research areas, the sustainability, as seen in the amount of settlements with high percentages of Bell Beaker pottery, was varied. Low percentages in Southern Scandinavia & Northern Germany and in the Czech Republic indicate a less sustainable innovation, whereas the somewhat higher frequencies in the Portuguese Estremadura, Western France and the Lower Rhine Area point to a more sustainable development.

A third hypothesis focusing on the temporal aspects of adopting the Bell Beaker phenomenon centres on the swift and rapid changes that current models hypothesise. Bayesian analysis of the occupation intervals has shown that this is not a uniform rapid process across Europe as has always been assumed by studies focusing on migration and diffusion. While the dataset of Bayesian models is relatively small it does point to some interesting clues. Regional variation in the pacing of adopting the Bell Beaker innovation existed.

Finally, when we look at the timing of the innovation itself, there are several observations that do not fit with the general model that is prevalent today. Earliest evidence, and probably a continuity in occupation can be found in *both* the Portuguese Estremadura and the Lower Rhine Basin, between 2600-2500 BC. Research by Müller/Van Willigen (2001) and recently by Cardoso (2014) come to different conclusions with regard to the Portuguese Estremadura. While the first study presents a quantitative analysis of many radiocarbon dates, including older samples and insecure contexts, Cardoso's analysis of primarily Leceia is fraught with problems. All early radiocarbon dates associated to Bell Beakers in his analysis stem from a single house without a clear stratigraphy and with an occupation predating the Bell Beaker phenomenon by centuries.

Taking this into consideration, the claim for a start of the Bell Beaker phenomenon prior to the 26th century BC must be disregarded. Based on the Bayesian analysis from the La Lède du Gurp and Horni Ián settlements, communities in Western France and the Czech Republic adopt the Bell Beaker phenomenon only 100-150 years later, between *c.* 2500 and 2400 BC. In Southern Scandinavia & Northern Germany, the Bell Beaker phenomenon is possibly even later adopted, somewhere between 2400-2350 BC. This relatively late start is in agreement with previous studies that focused on radiocarbon dating in the Danish Late Neolithic (*e.g.* Vandkilde 1996). These later dates for Central and Northern Europe are also in agreement with the large scale analysis of Müller and Van WIlligen (2001).

6 Analysis: Social landscapes of innovation

6.1 Introduction

The previous chapter focused on the processes involved in the adoption of the Bell Beaker innovation. The analysis of the processes of adoption and various aspects of the temporality, impact and sustainability of the Bell Beaker innovation has shown us a large degree of variability between research areas.

This chapter focuses on the second research question, moving beyond processes. This chapter focuses on the actors, media and mechanisms behind the innovation process. The research question "what social landscapes characterise the adoption of the Bell Beaker phenomenon?" is central to this topic. The study of social landscapes is divided into the analysis of communication networks and practices that support these networks, and a study of the mechanisms behind these Bell Beaker networks. This combined analysis of networks and mechanisms allows for a better understanding of the variability in processes observed in the previous chapter.

The first analysis focuses on the reconstruction of networks. Until now no real thorough study of similarities and differences between Bell Beaker settlements exist, as it was always assumed that Bell Beaker settlements show too much variability and are unable to aid us in understanding the Bell Beaker phenomenon. By reconstructing networks of the similarities and differences between settlements we test this hypothesis, and, at the same time get an overview of the various social landscapes of the Bell Beaker phenomenon: the communication networks, different cliques of settlements, geographical distribution patterns, spatial and chronological variability and the importance of certain mechanisms within this network. Aiding this is the analysis of the distribution of several practices of which material remains have been found on settlements.

Later paragraphs put these Bell Beaker networks into perspective by reviewing the various different diffusion mechanisms that have been proposed for the Bell Beaker phenomenon. Mechanisms include the exchange of ideas and practices, the exchange of objects (such as pottery), and the migration of people. By putting these various mechanisms in the context of the modelled communication networks, much more knowledge is gained as to their importance and their relevance for the social landscape that is the Bell Beaker phenomenon.

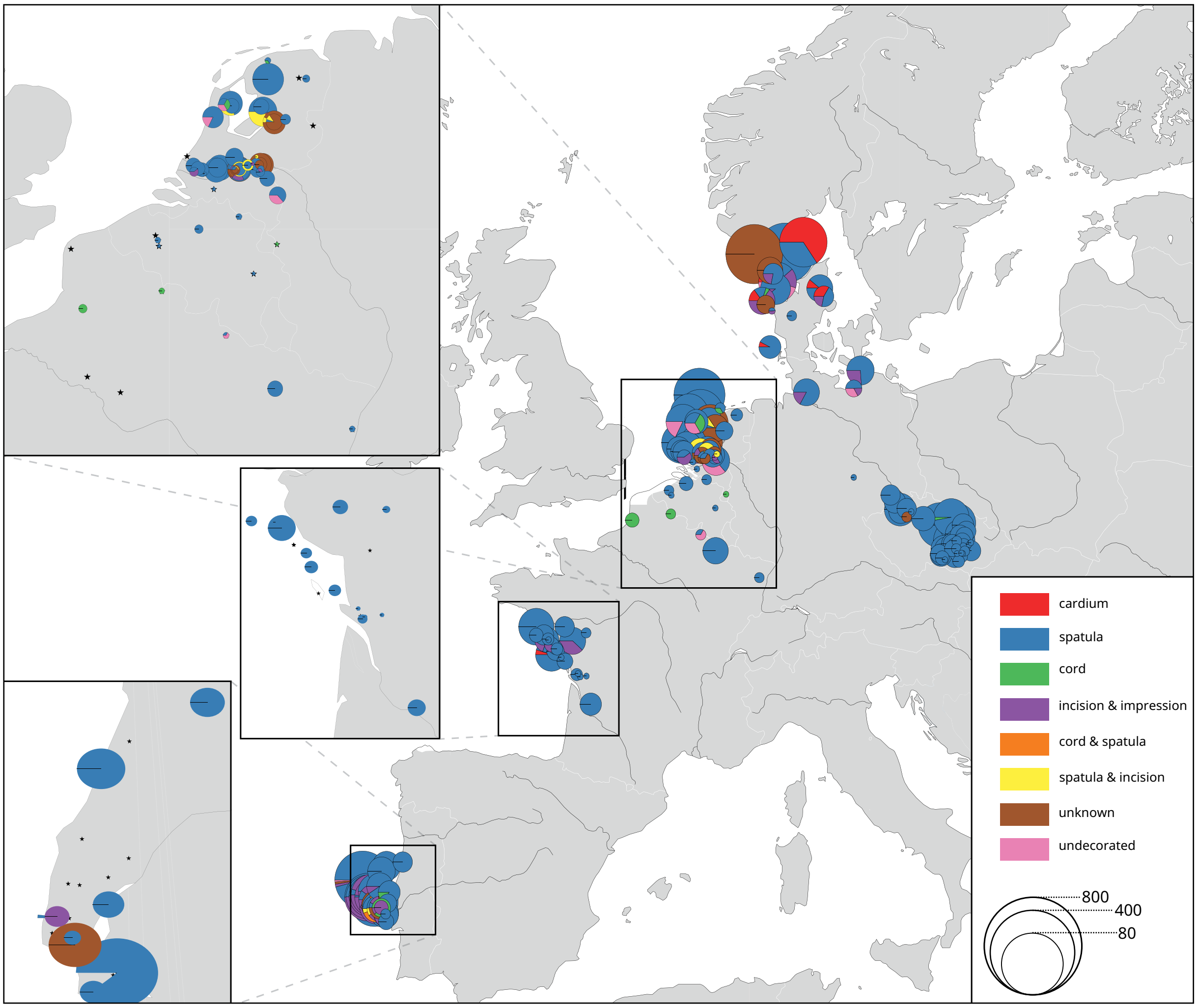


Fig. 6.1 The distribution of decoration techniques on Bell Beaker pottery (size of the pie indicates the number of sherds on a logarithmic scale).

6.2 Innovation mechanisms: networks

6.2.1 Introduction

At first, the communication networks between Bell Beaker communities are studied. Communication networks are modelled based on the similarities and differences found between settlements. Settlements that are similar to each other, share a wide variety of objects and practices, and thus exhibit a strong communication between each other. And vice versa, on settlements that are different from each other, objects and practices are varied and diverse, and the model shows weak or no communication links. By studying these communication networks, we are able to reconstruct social communities, and we can address the mechanisms behind the Bell Beaker innovation.

In chapter 2 we have seen how different categories of material culture and associated practices have in the past often been related to the diffusion of the Bell Beaker phenomenon. Practices such as metallurgy, horse domestication, flint specialisation, spelt wheat and alcohol were reviewed. It was clear that many of these practices already existed locally prior to the middle of the 3rd millennium BC, but similarly do become associated with the Bell Beaker phenomenon on a more regional level. It is unclear how this change happens. In order to study the spread of these practices

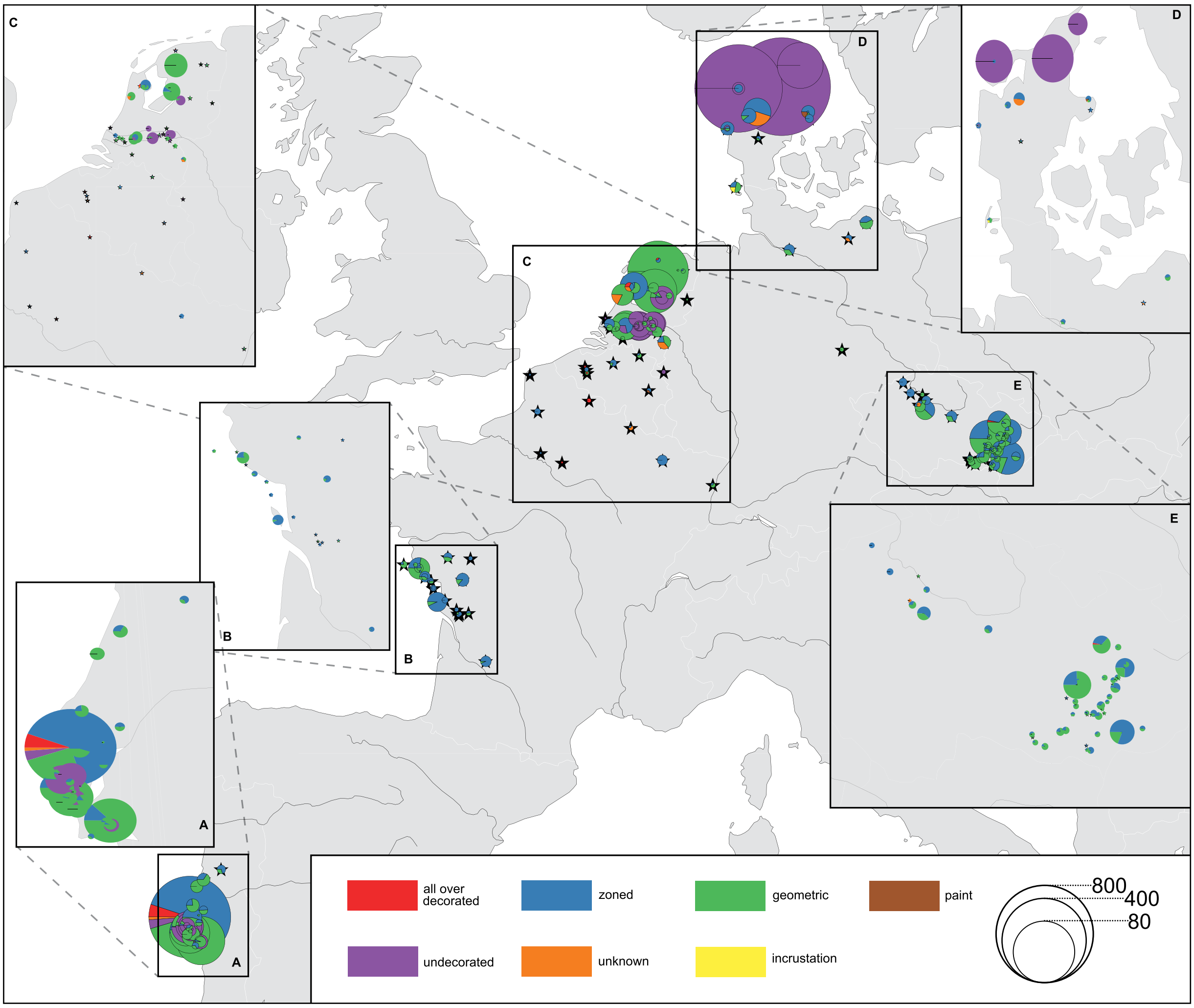


Fig. 6.2 The distribution of decoration motifs on Bell Beaker pottery (size of the pie indicates the number of sherds on a logarithmic scale).

in relation to the Bell Beaker phenomenon, and to model the networks that have facilitated the communication between communities and the diffusion of innovations, the dataset is expanded beyond the realm of pottery frequencies. From all the settlements in the database, detailed data was gathered on the material culture (pottery, stone/flint artefacts and raw materials and metal artefacts) and subsistence (botanical and zoological remains). While at first these datasets might not relate to communication networks. However common practices in subsistence strategies, in the production and shapes of certain artefacts, in specific practices carried out settlements, do hint at a shared understanding and communication.

At first, an overview of this dataset is presented focusing on the overall comparability of the dataset itself between regions and the premises on which the network models are built. Secondly, with this dataset, a network analysis is carried out, using statistical methods for calculating the similarities between entities, for the reconstruction of communities or cliques and for assessing the strength of the communication networks at various degrees. This network analysis is executed on both the pottery data and consequently on the complete dataset. After these first networks, we split the dataset, and review the six research areas and look for regional spatial and chronological patterns, in relation to the earlier observed regional innovation processes. By taking all these steps we come closer to understanding the Bell Beaker network and the underlying communication networks in their various regional facets.

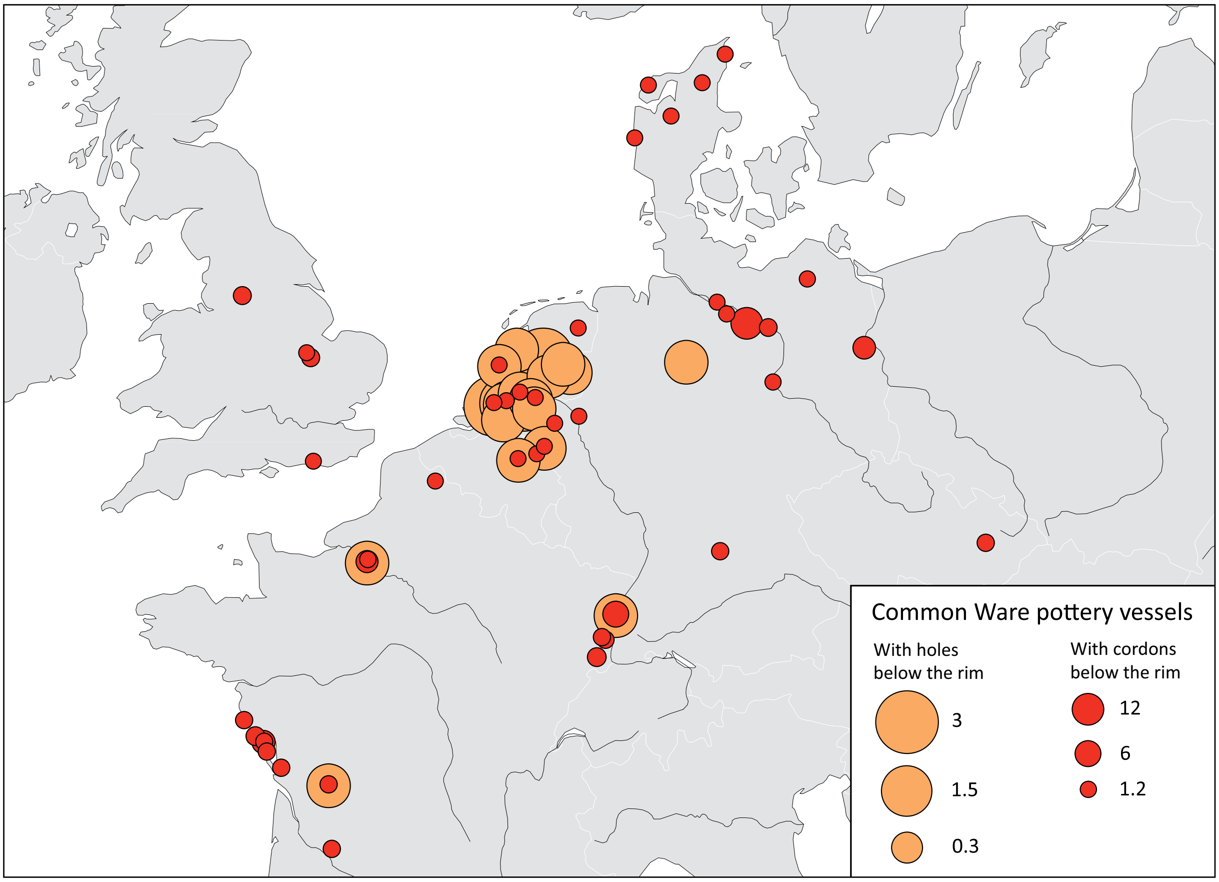


Fig. 6.3 The distribution Common Ware pottery vessels with holes beneath the rim and with cordons below the rim.

6.2.2 Overview of the settlement data

6.2.2.1 Pottery

With regard to the pottery data, we focus on percentages and the presence of specific decoration techniques and motifs on both Bell Beaker and Common Ware pottery from our six research areas. As discussed before, decoration motifs and techniques are easily communicated and exchanged between communities, as these are often well visible and easily changed. Bell Beaker decoration motifs comprise of either all-over, geometric or zoned varieties, whereas techniques include impression by means of cord, spatula and/or *Cardium* shell and incision.

Overall, Bell Beaker pottery decoration techniques are dominated by spatula impression across Europe (see fig. 6.1). The *Cardium* impression technique appears on settlements in the Portuguese Estremadura, the Lower Rhine Area, Western France and Southern Scandinavia & Northern Germany. Cord impression is found across Europe on a small scale, but not at all in Western France or the Czech Republic. On only two settlements the combination of cord and spatula impressions is found, while the combination of incision with either spatula or other kinds of impressions is more common. Decoration motifs consist in majority of either a zoned of geometric motif (see fig. 6.2). All-over decorated vessels also show up in lower numbers in most research areas, with the exception of Southern Scandinavia & Northern Germany and Western France, where they are absent on the recorded settlement assemblages. This might be related to the generally accepted theory of all-over-ornamented pottery belonging primarily to the earliest stages of Bell Beaker pottery. The application of paint or incrustation onto

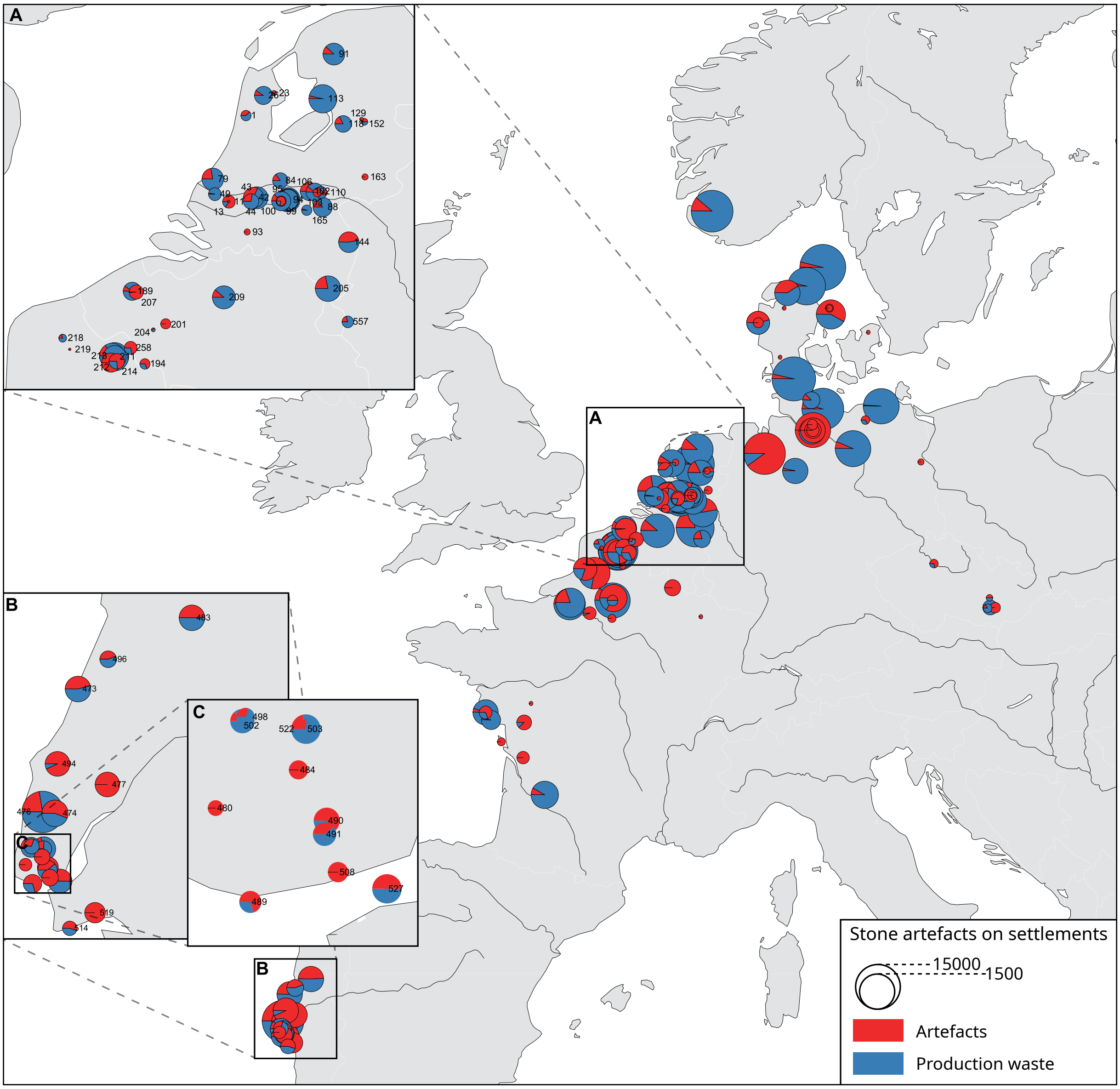


Fig. 6.4 The distribution of flint and stone artefacts and production waste.

the decorated pottery vessel outer wall is found rarely. Zoned/geometric spatula impressed pottery are clearly found predominantly on Bell Beaker settlements across Europe.

By comparison, the characteristics of Common Ware pottery decoration are described. Decoration techniques on Common Ware pottery are widespread across North West and Central Europe (see fig. 6.3). Both applied and impressed decoration techniques occur frequently. A distinctive decorative element, impressed holes beneath the rim, is only found on Common Ware vessels in the Lower Rhine Area and rarely in Northern France, Western France and Southern Scandinavia & Northern Germany. Another element, applied cordons, occurs more frequently across Northwest and Central Europe. Decoration motifs on Common Ware pottery show a more Europe-wide distribution. All-over decorated vessels are found in the Lower Rhine Area. Both zoned and randomly applied motifs are found in Southern Scandinavia & Northern Germany, the Lower Rhine Area and Portuguese Estremadura. Geometric motifs are found in the Lower Rhine Area and Southern Scandinavia & Northern Germany.

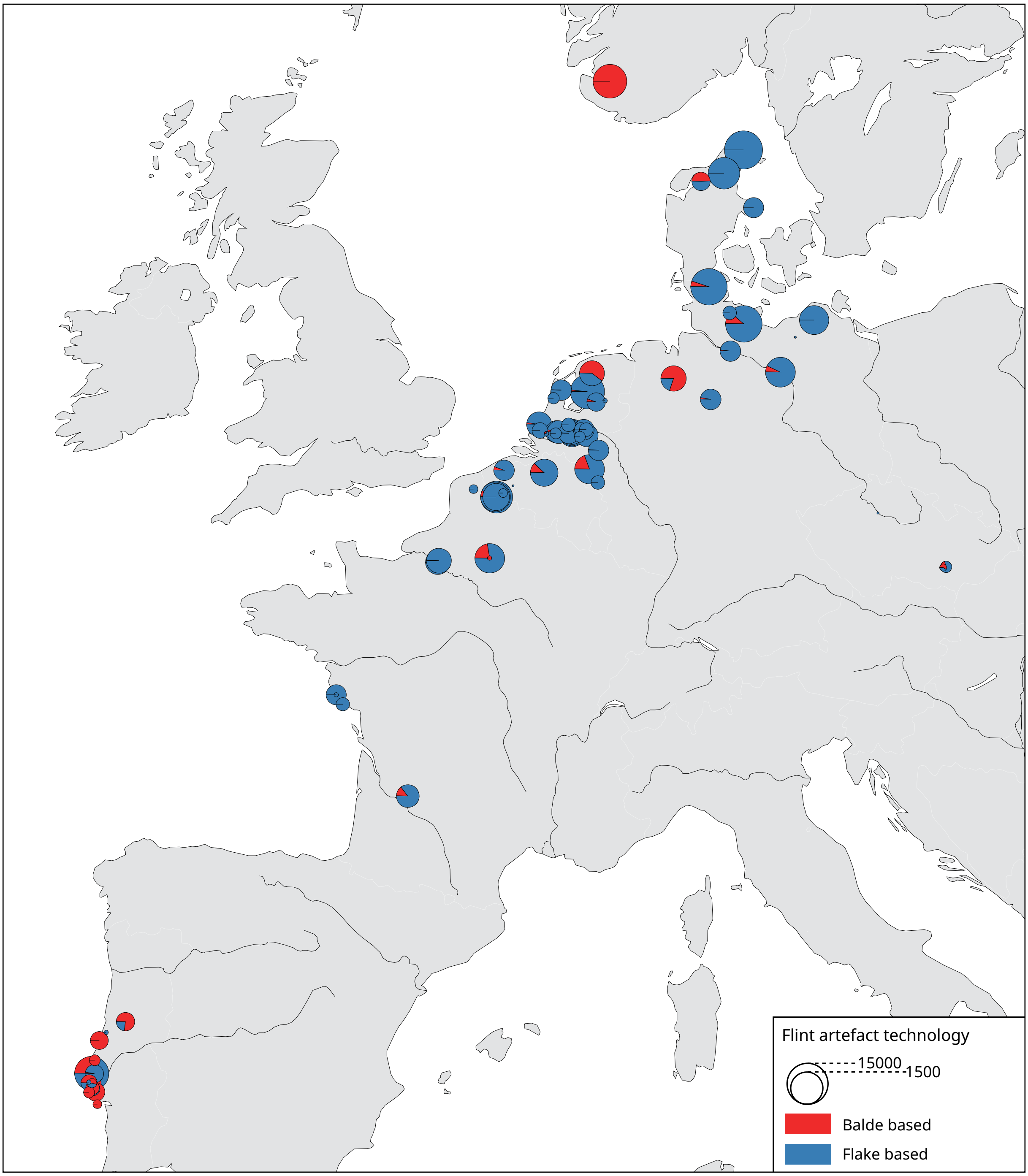


Fig. 6.5 The distribution of flint flake technology (in blue) versus flint blade technology (in red).

6.2.2.2 Stone and flint

For stone and flint artefacts an overview is presented of the following aspects: the percentage of artefacts versus production waste, the percentages of raw materials used per settlement and the distribution pattern of specific artefacts (daggers and arrowheads) found on settlements. These variables capture the various practices carried out with regard to stone and flint tool production on Bell Beaker settlements across Europe. Daggers and arrowheads, finely crafted by means of pressure-flaking and sometimes parallel retouch, are particular artefacts frequently associated with the spread of the Bell Beaker phenomenon. Studying all these different variables

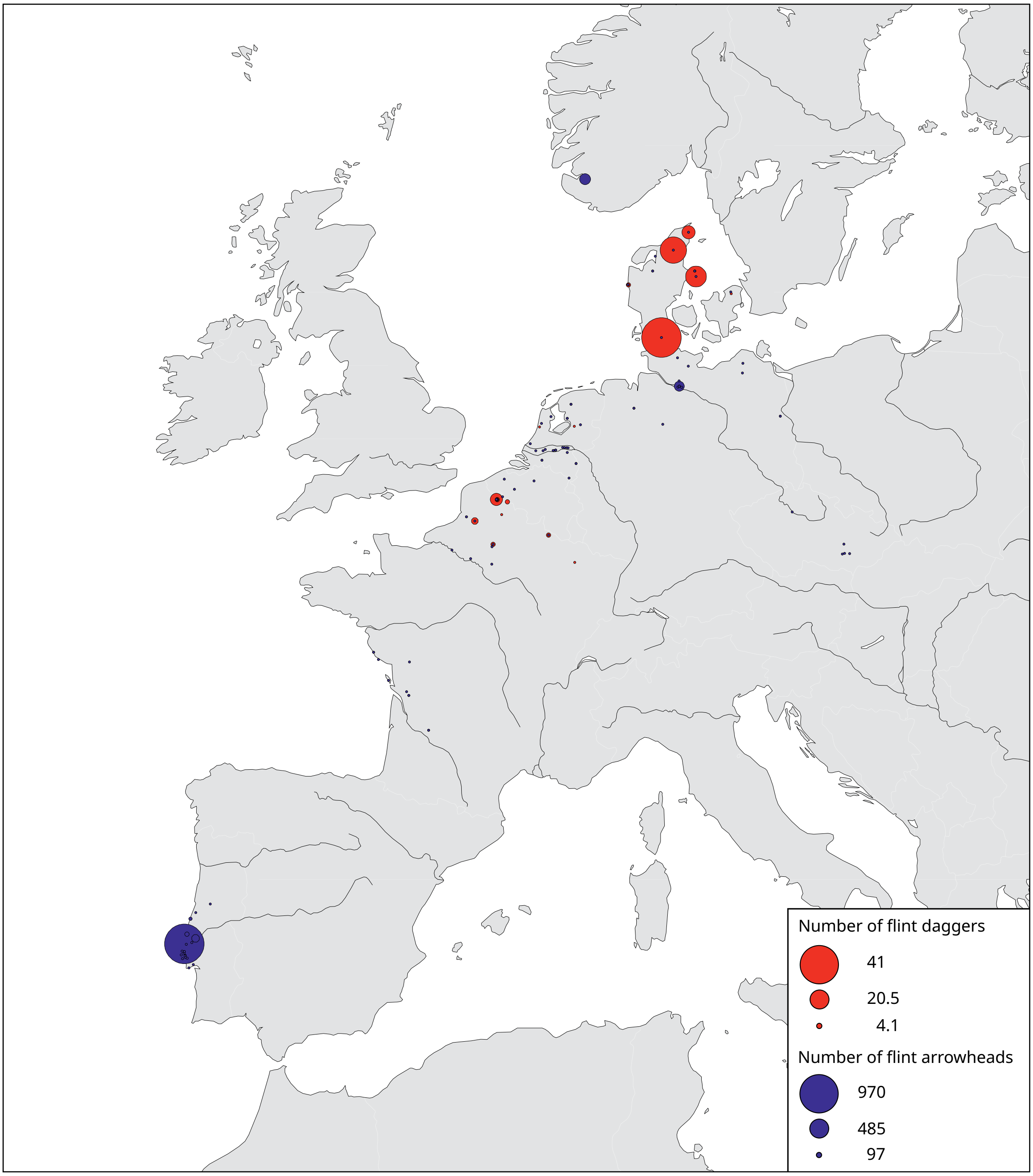


Fig. 6.6 The distribution of flint daggers (in red) and arrowheads (in blue).

shows how various communities are affected by these new technologies with the adoption of the Bell Beaker phenomenon. This also tests the hypothesis about the impact that the spread of these new artefacts has on the Bell Beaker communication networks in particular with Scandinavia, as was argued by some (*e.g.* Varberg 2015). Likewise, we would expect a migration, or a diffusion of ideas to be associated with changes in technology and shape of stone and flint artefacts, in particular daggers and arrowheads.

Most settlements show a predominance of production waste over artefacts, with two exceptions in Northern Germany, where in the earlier 20th century mainly artefacts were collected after excavation (see fig. 6.4). Flake based stone and flint

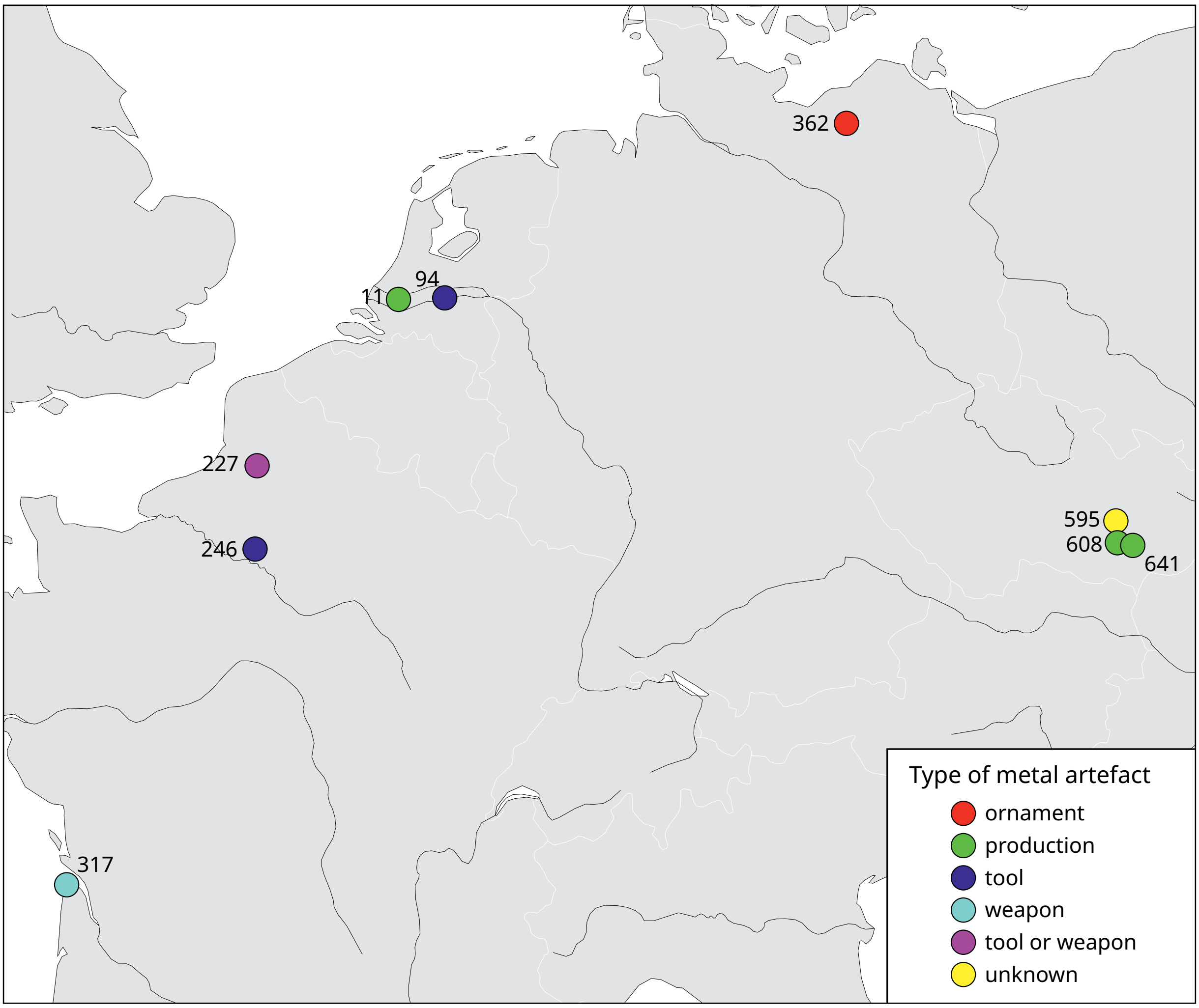


Fig. 6.7 The distribution of metal artefacts from Bell Beaker settlements.

artefact production technology is more ubiquitous than a production sequence based on blades (see fig. 6.5). Notable exceptions are many of the smaller settlements in the Portuguese Estremadura, a single site in the Lower Rhine Area (Oldeboorn), and two sites in Southern Scandinavia & Northern Germany (Hunte 1 and the Norwegian site of Slettabø). These three latter settlements all also contain evidence or earlier Neolithic occupation and therefore possible intrusion. Interesting is the difference technologically between many of the Portuguese settlements and the other research areas, indicating that no uniform change in flint technology took place with the adoption of the Bell Beaker innovation. With regard to raw material usage, the picture is dominated by flint, after which quartzite and sandstone (two metamorphic rock types) are found in considerable numbers.

With respect to artefacts (see figure 6.6), the distribution of arrowheads shows some important things. First of all, arrowheads are only frequently found on settlements in the Portuguese Estramadura. These arrowheads are often of the very distinctive mitra, lozenge or hollow-base (regionally known as *Eiffeltower*-arrowheads) types (see also paragraph 3.3.2.2 and figure 3.1). In other parts of Europe, arrowheads found on settlements are rare. Shapes most common here are variations of barbed and tanged, triangular and hollow-base arrowheads. For daggers found on settlements, it was unfortunately not possible to ascribe many of them to a type, as most examples were fragmented. Not many daggers or dagger fragments were found on settlements. A concentration of daggers is found in Scandinavia, especially

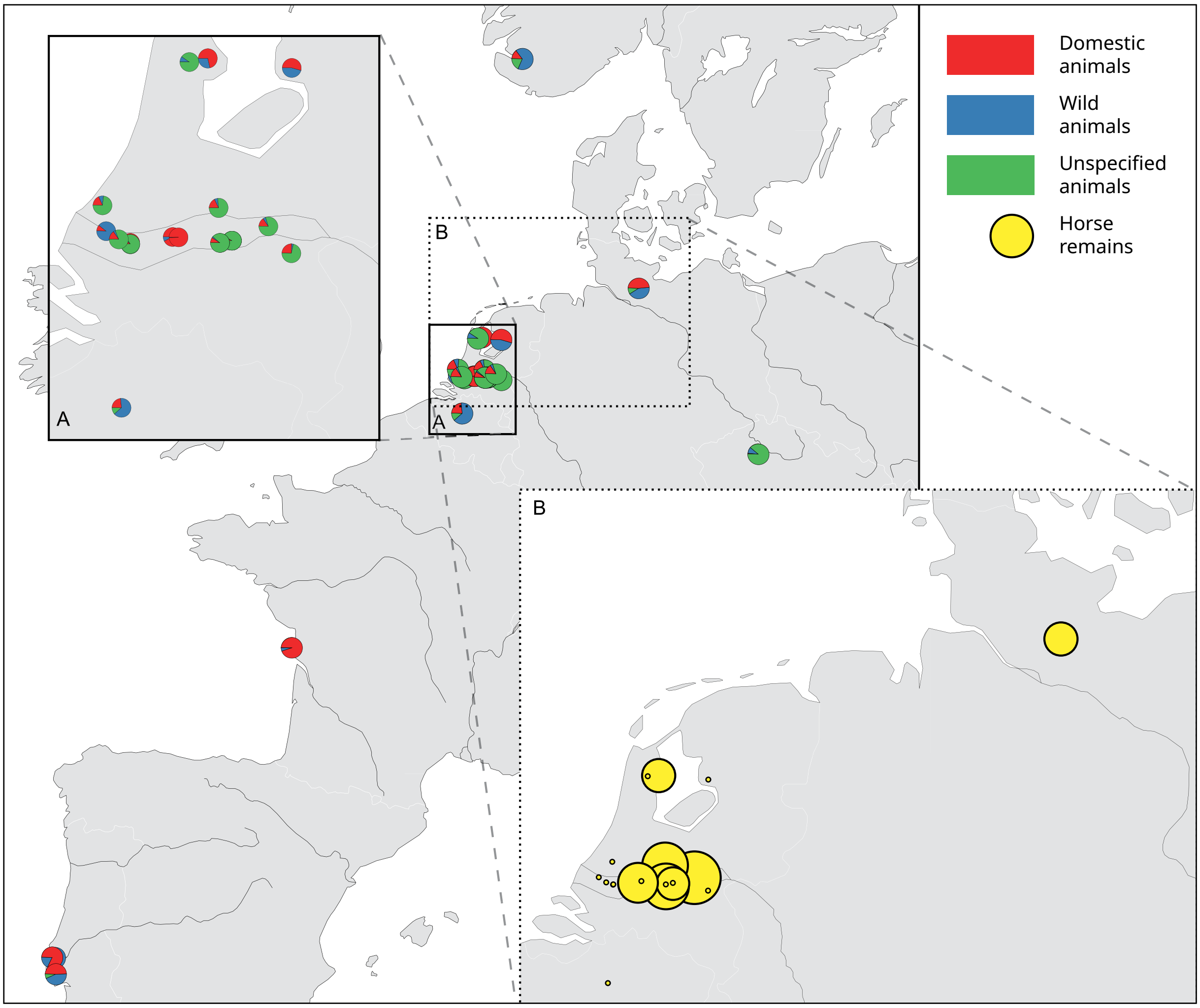


Fig. 6.8 The percentages of wild versus domestic animals found on settlements, with in inset B an overview of the domestic horse remains found on Bell Beaker settlements.

on the settlement of Bejsebakken in Denmark, where a production site is situated (Sarauw 2006a, 2006b). In the Portuguse Estremadura and Western France, daggers are less frequent, while thin, foliated, knives are more common. Thus also a difference exists between certain research areas with regard to the shapes of arrowheads and the presence of particular types of daggers and knives.

6.2.2.3 Metal

For metal artefacts found on settlements, the distribution of various functional categories is presented (see fig. 6.7). The spread of metallurgy as a practice, described as the Chalcolithic Frontier, is sometimes attributed to the Bell Beaker phenomenon (*e.g.* Brodie 2001). We have seen earlier (see paragraph 2.3.1.1) that in some areas of Europe, the practice of copper metallurgy predates the Bell Beaker phenomenon. Mapping these artefacts, and more importantly waste, still informs us on the spread of practices related to communication networks associated with the Bell Beaker innovation.

Interesting is the presence of metal production waste, found in the Lower Rhine Area (a droplet at Carnisselande, Moree *et al.* 2011a, 69-70) and at two settlements in the Czech Republic (Siroke Obrany I and Slavkov II; Ondráček *et al.* 2005, 15). Other objects include a Palmela point from La Lède du Gurp in Western France, an object mainly known from the Iberian Peninsula and frequently found in graves

SettlementID	Toponym	% wild	% domestic	% unspecified
49	Arij Koplaan	89.2	10.8	0.0
474	Penedo	83.3	11.1	5.6
367	Slettabø	66.1	14.8	19.1
209	Zennegat	64.7	23.5	11.8
113	Emmeloord J97	45.5	54.5	0.0
527	Cova da Moura	42.9	50.0	7.1
352	Wolkenwehe	42.0	49.0	9.1
115	P14	35.2	15.0	49.8
23	Oostwoud	28.6	71.4	0.0
279	Les Loups	19.0	81.0	0.0
476	Zambujal	18.1	81.9	0.0
666	Úholickach	10.0	0.9	89.0
11	Carnisselande 3	9.0	33.2	57.8
26	Sijbekarspel De Veken	8.7	0.6	90.7
79	Wateringse Veld	8.6	18.5	73.0
42	Molenaarsgraaf	7.6	92.4	0.0
84	Hofstad Vleugel 20	5.6	17.8	76.6
306	L'Ecuissière	5.1	94.5	0.4
13	Carnisselande 5	4.9	10.7	84.5
102	Lienden/Kesteren	4.7	15.5	79.8
646	Marsovice I	3.9	0.1	96.0
188	Rhoon	3.4	15.6	81.0
88	Oosterweg	3.1	25.6	71.3
95	Boog C Zuid	3.0	8.6	88.4
288	Diconche	2.6	95.4	2.0
101	Eigenblok Grafheuvels	2.3	9.0	88.7
98	Knooppunt B2	1.9	6.2	92.0
94	Boog C Noord	1.6	8.5	89.9
99	Eigenblok West	1.3	3.0	95.7
106	Hiensche Veld	1.2	0.0	98.8
43	Ottoland Kromme Elleboog	1.0	99.0	0.0

Table 6.1 Percentages of domestic versus wild animals on settlements associated with the Bell Beaker phenomenon.

SettlementID	Toponym	% wild	% domestic	% unspecified
107	Zettensche Veld West	1.0	0.0	99.0
97	Spoorbrug Voorvliet	0.8	8.3	91.0
96	Boog D Zuid	0.6	7.3	92.1
192	Donk NEO1	0.0	100.0	0.0
379	Myrhøj	0.0	100.0	0.0
480	Penha Verde	0.0	100.0	0.0
529	Ergersheim	0.0	100.0	0.0
578	Liptice II	0.0	100.0	0.0
582	Hostivar I	0.0	100.0	0.0
587	Radovesice	0.0	100.0	0.0
592	Holubice II	0.0	100.0	0.0
593	Holubice V	0.0	100.0	0.0
595	Boritov VII	0.0	100.0	0.0
611	Berdichovice II	0.0	100.0	0.0
612	Blazovice I	0.0	100.0	0.0
619	Zádovice	0.0	100.0	0.0
10	Carnisselande 2	0.0	76.2	23.8
100	Eigenblok Oost	0.0	1.7	98.3
103	Peyenkampse Veldweg	0.0	0.0	100.0
108	Zettensche Plas	0.0	0.0	100.0
109	Zettensche Veld Oost	0.0	0.0	100.0
110	Vergulde Bodem	0.0	0.0	100.0

Table 6.1 (continued) Percentages of domestic versus wild animals on settlements associated with the Bell Beaker phenomenon.

(see paragraph 6.3.2.3). Three tools, two of which come from Northern France and the other from the Lower Rhine Area. A tanged dagger from Northern France. And finally, an ornament in the shape of a band or strip from Prüzen in Southern Scandinavia & Northern Germany. Apart from the possibly bronze ornament and the two tools from Northern France, all other objects are made of copper. A single object from the Czech Republic could not be identified.

Interesting is the occurrence of a Palmela point in France (this will be discussed in more detail in paragraph 6.3.2.3), but also the metallurgy waste found in two separate areas of Europe, indicating the local production of metal objects, associated with the Bell Beaker phenomenon.

6.2.2.4 Subsistence

For an overview of subsistence data, we treat the two data categories, zoological and botanical data separately. Zoological data is studied as the percentage of domestic *versus* wild animals and as a distribution of settlements on which horse is present (see fig. 6.8). These two themes play a role in discussions surrounding the adoption and the development of the Bell Beaker phenomenon (see also paragraph 2.3.1.1). While it is expected that the Neolithisation process has reached it Consolidation stage before the Bell Beaker phenomenon and wild animals only play a minor role in subsistence during the later 3rd millennium BC, recent studies have suggested that hunting and foraging still played a significant role in parts of Europe during the Late Neolithic (Müller *et al.* 2011, Fokkens *et al.* 2016). Whether this regional variability in subsistence is more widespread, and also present in other parts of Europe or a primarily regional phenomenon more related to environment, is tested here. Additionally, studies focusing on domestication of horse have in the past referred to the Bell Beaker phenomenon (see also paragraph 2.3.1.1). The earliest domesticated horses predate the Bell Beaker phenomenon in Central Germany, the Iberian Peninsula and in Eastern Eurasia by a millennium, however it is unclear how widespread domesticated horses are before the Bronze Age (*cf.* Kristiansen/Larsson 2005, 184). Studying the distribution of domesticated horse remains can test any association with the Bell Beaker innovation in spreading this practice in Western Europe before the Bronze Age.

On the Bell Beaker settlements in our research areas, wild animals occur frequently in settlements in the Lower Rhine Area, while also present in some settlements in the Portuguese Estremadura, Southern Scandinavia & Northern Germany and the Czech Republic (see table 6.1). The high percentage of wild animals at these settlements can be related to earlier Neolithic phases of occupation, as this is not always made clear. The majority of animals found on settlements in the Portuguese Estremadura, Czech Republic and in Western France are however domesticated. The domestic herd itself consists mainly of cattle, accompanied by sheep/goat and pig. The percentage of sheep/goat and pig combined only rarely outnumber the percentage of cattle. Unsurprisingly, quantities of dog and horse are low in comparison. From this overview it appears that a subsistence based on hunting wild animals is exceptional (and primarily related to environmental circumstances such as at the wetland settlement of Oostwoud), even for the Lower Rhine Area where the main evidence comes from. Hunting wild animals played a minor role in subsistence, based on this evidence alone.

Horse remains are found quite frequently in low numbers in the Lower Rhine Area, Southern Scandinavia & Northern Germany, the Czech Republic and in Western France. High numbers of horses are only found on settlements dating to this period outside of our research areas, in Hungary (*e.g.* Bökönyi 1978). This at least implies that domestic horses played a role within the Bell Beaker phenomenon of the Lower Rhine Area and Southern Scandinavia & Northern Germany. How this relates to the practice of domestication will be discussed below.

With regard to botanical data, an overview of the composition of the different arable crops found on the settlements is given, alongside the distribution of spelt wheat seeds and chaff remains. Especially the findings of spelt wheat as a domesticated crop in Switzerland and Southern Germany around the mid-3rd millennium BC has received some recent attention (*e.g.* Jacomet 2008). Whether this crop is also

Table 6.2 Spelt wheat on Bell Beaker settlements (+ is presence)

SettlementID	Toponym	*Triticum Spelta*	*Triticum Spelta* chaff
384	Enkehøj	+	0
415	Birnkæs	+	0
420	Gilmosevej	161	925
470	Østbirk	+	0
595	Boritov VII	+	0

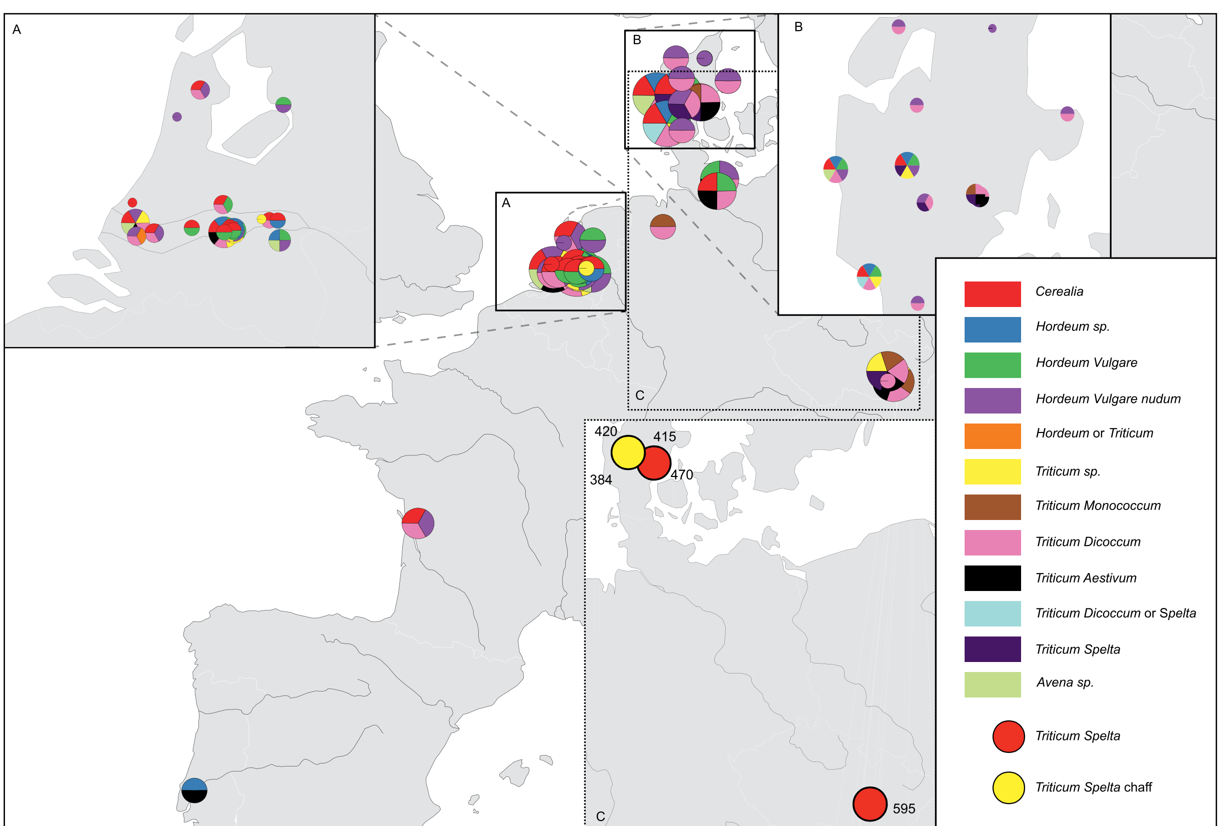
found in other parts of Europe and can possibly be related to the Bell Beaker innovation, is tested here (see figure 6.9).

Naked barley is mainly found on settlements in the Lower Rhine Area, Western France and Southern Scandinavia & Northern Germany. Hulled barley is found in the Lower Rhine Area, Southern Scandinavia & Northern Germany and Czech Republic. Einkorn wheat is found on settlements in the Czech Republic and Southern Scandinavia & Northern Germany. Emmer wheat is more widespread and found in the Lower Rhine Area, Western France and Southern Scandinavia & Northern Germany. Bread wheat is found in the Lower Rhine Area, the Portuguese Estremadura, the Czech Republic and Southern Scandinavia & Northern Germany. Domesticated spelt wheat is reported from several settlements in Southern Scandinavia & Northern Germany and in the Czech Republic (see table 6.2), however as spelt is currently only positively identifiable from its threshing remains (Jacomet 2008, 364), the identification at Gilmosevej in Denmark stands out (Jørgensen 1979).

6.2.3 A reconstruction of communication networks

In the forthcoming three paragraphs the datasets concerning pottery, stone and flint, metal and subsistence economy will be combined with each other to model networks of communication between settlements. In paragraph 3.3.2.1 we described the specific methods, the Brainerd-Robinson coefficient and the Girvan-Newman algorithm, that form the basis for our analysis. These communication networks will serve the purpose of explaining the social landscape of the Bell Beaker innovation: the different actors (*i.e.* settlements) involved and the media that gets transmitted and adopted is studied here. In subsequent paragraphs we will explain the development of these communication networks by looking at the various mechanisms at play.

Fig. 6.9 The distribution of arable crops found on settlements, with in inset B an overview of Triticum spelta seeds and chaff remains on Bell Beaker settlements within the research areas.



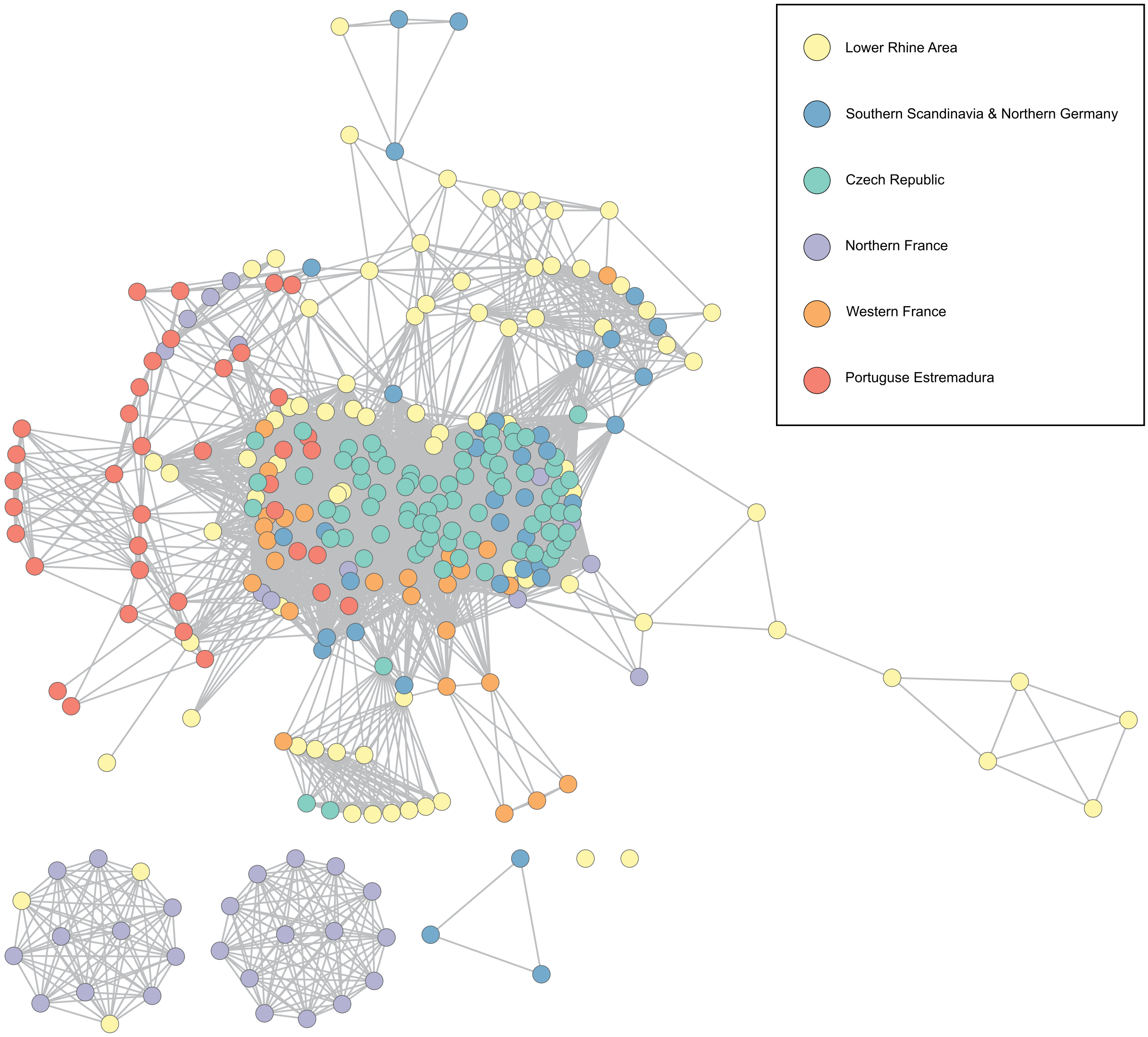


Fig. 6.10 Pottery network denoting the similarities between the pottery assemblages from settlements.

6.2.3.1 A Bell Beaker pottery network

For the reconstruction of the network based on pottery data, the frequency data concerning pottery types, decoration types and decoration motifs for Bell Beaker and Common Ware vessels was collected from all settlements within the six research areas. A loop-free and undirected network was created, based on the Brainerd-Robinson coefficient, used to measure the similarities between entities (see fig. 6.10).

When reviewing this pottery network, several things can be noted with regard to the clustering. First of all, there are three separate clusters of large numbers of settlements. Two clusters mainly comprise settlements from Northern France, while the third cluster is densely packed and contains most of the settlements from the other research areas. Present in one of the smaller clusters are three settlements from the Lower Rhine Area (Waardamme Vijvers, Huise and Hertsberge Papenvijvers). These settlements show no evidence for Bell Beaker pottery and can be attributed to the Deûle/Escaut tradition. Five further settlements fall out of the network completely (354, 342, 360, 186 and 191), because of their deviant pottery assemblages. The former three settlements have only a very low number of Bell Beaker sherds and are mainly associated with Funnel Beaker pottery in Southern Scandinavia & Northern Germany. On the latter two settlements from the Lower Rhine Area, Bell

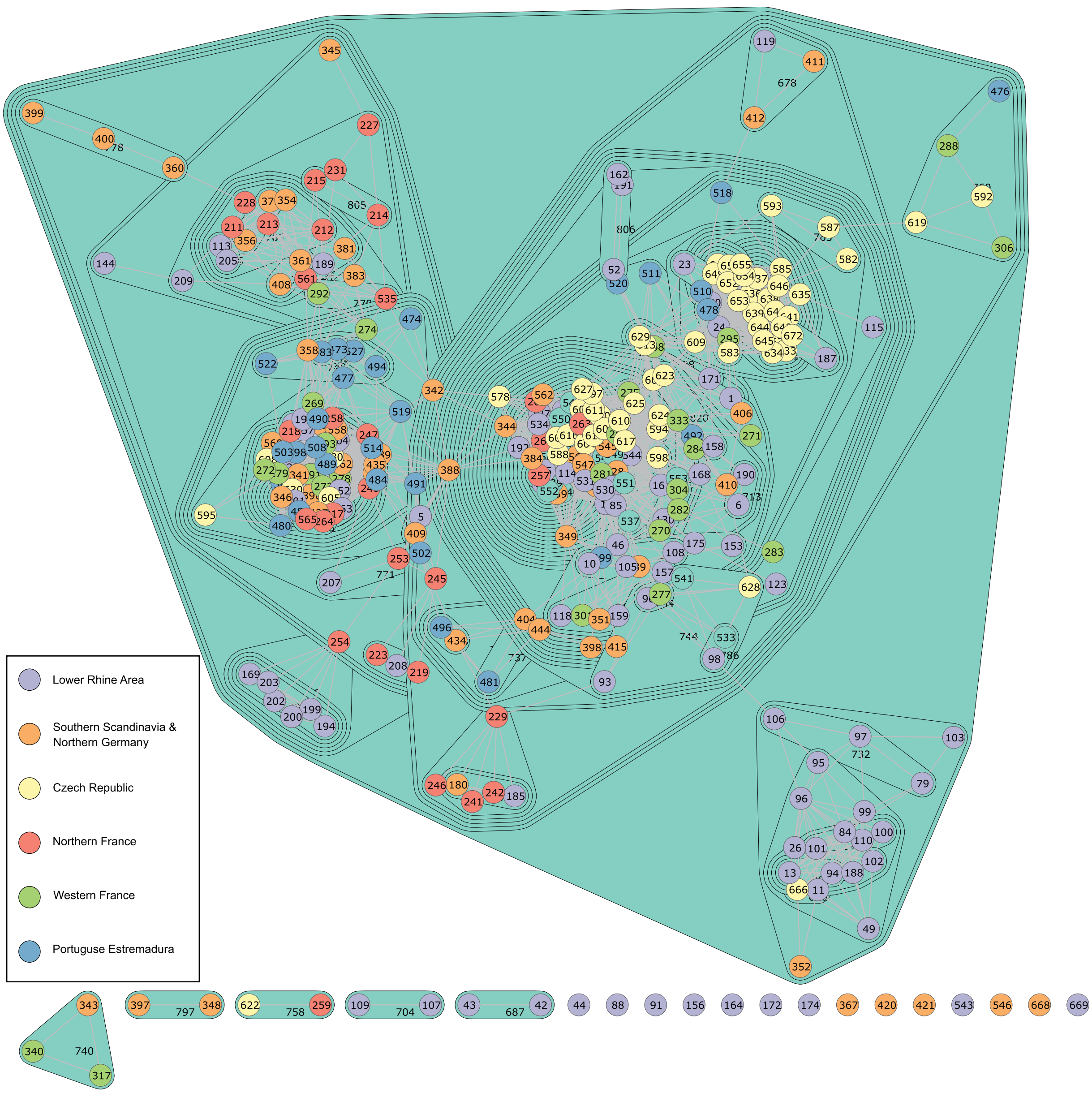


Fig. 6.11 Combined network denoting the similarities between the finds assemblages from all settlements, and the Girvan-Newman clusters shaded in blue.

Beaker pottery is a minority in comparison to Corded Ware and Vlaardingen pottery. These settlements will not be further treated here.

There's a large similarity between all the settlements on which Bell Beakers are found, indicative of an intense communication and exchange of information about pottery decoration techniques and motifs between these settlements. This is not unexpected as Gosselain (2000) already states that ideas about new techniques and motifs of pottery decoration are relatively easy to exchange and adopt between different regions. This makes the other two clusters all the more noticeable, for they did not adopt the decoration techniques and motifs associated with the Bell Beaker pottery cluster.

Another way of looking at this network is to look at the spread of nodes as a measure of variability within a region. This spread indicates the variability within the dataset for a particular region. The spread is small in the Czech Republic indicating that pottery from settlements here shows little variability. A larger spread for the nodes from settlements in Western France and Southern Scandinavia & Northern

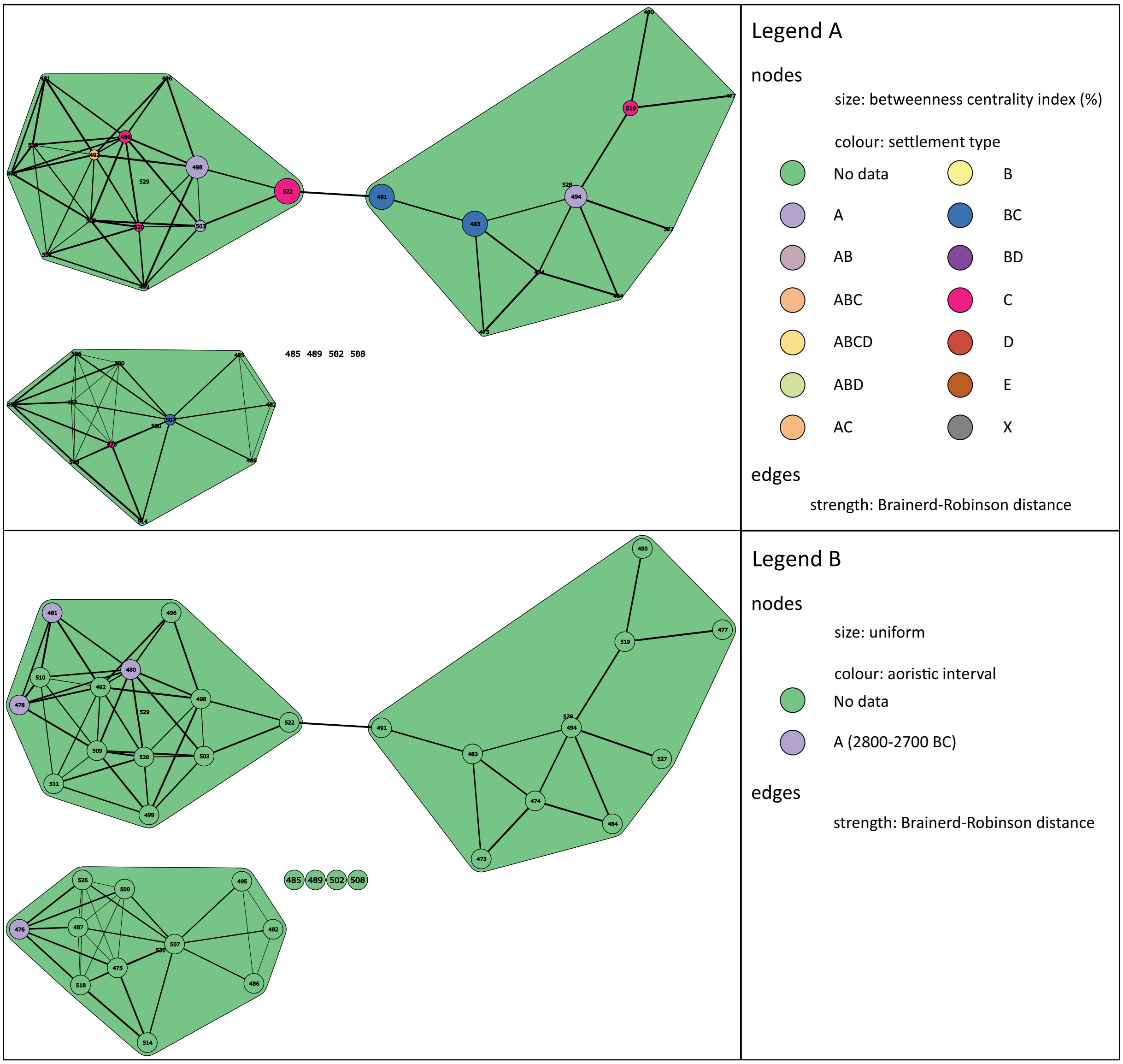


Fig. 6.12a & b Network of settlements in the Portuguese Estremadura (a: Girvan-Newman clustering; b: chronological network; c: geographical network).

Germany indicates that here larger variability exists. The Portuguese Estremadura and Lower Rhine Area have the largest spread in nodes, indicating a large degree of variability in Bell Beaker and Common Ware pottery.

6.2.3.2 A combined network

Apart from only looking at pottery for the analysis of communication networks between settlements, we can use the other data to obtain a more balanced perspective. This combined network, in which all data on finds assemblages from all settlements within the six research areas is taken together, is calculated and visualised in a way similar to the pottery network, but here the Girvan-Newman clustering is shown (see fig. 6.11).

This network consists of several distinct clusters, with subdivisions. Additionally there are some that settlements not attached to the network in any way. Only the settlements that form part of the three largest connected clusters will be treated here. A relatively small cluster of 20 settlements consists of 18 settlements from the Lower Rhine Area, one from the Czech Republic and another one from Southern

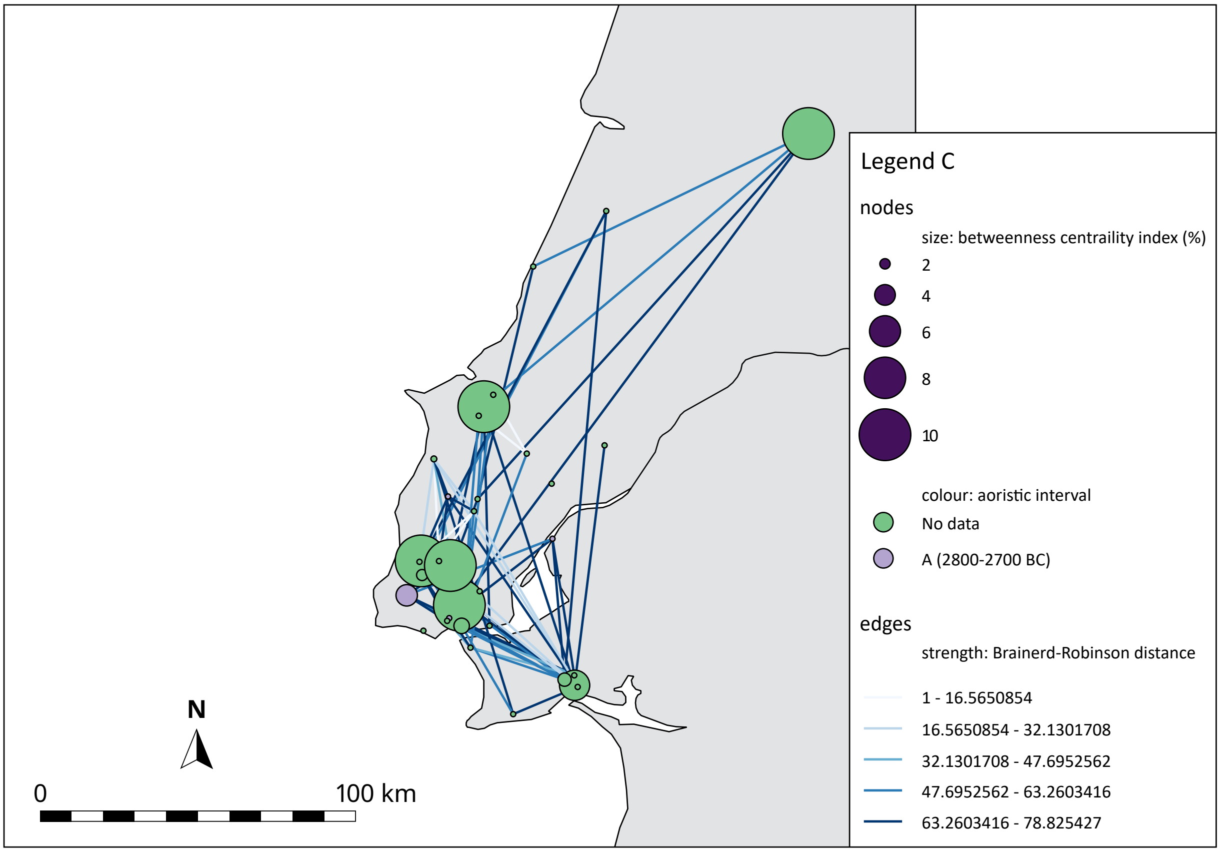


Fig. 6.12c Network of settlements in the Portuguese Estremadura (a: Girvan-Newman clustering; b: chronological network; c: geographical network).

Scandinavia & Northern Germany. The majority of settlements fall within several large highly connected clusters.

In general, it is not very clear how to interpret the patterns behind this clustering. There appears to be a large degree of similarity between settlements based on the combined dataset; at least larger similarities than between the different pottery datasets. This implies that subsistence economy and the use of stone, flint or metal artefacts are not defining characteristics that separate communities from one another in the later 3rd millennium BC. On the contrary: on the basis of this analysis, it can be argued that shared practices existed across Central, Western and Northwest Europe. A problem with this large network is the question of incomplete datasets. Not every settlements has, for instance, botanical data available, which automatically influences the Brainerd-Robinson coefficient and creates a cluster of settlements whose main characteristic is to not have botanical data available. In archaeological networking terms, uncertain or missing data can be worked around statistically, but an approach reducing the effects is chosen here. In regional networks, focusing on the six different research areas, the variability in research methodology and presence or absence of data due to conservation or publishing practices, is expected to be less of an issue.

6.2.3.3 Networks per region and chronology

The networks constructed in the previous paragraph are large, and this might 'smear out' the patterns we want to see, or hide patterns due to data uncertainties, as was explained.

A better picture emerges when we consider these Bell Beaker networks on a regional scale. Doing this, allows us to study certain nodes with a higher importance, using the concept of betweenness centrality. The betweenness centrality index cal-

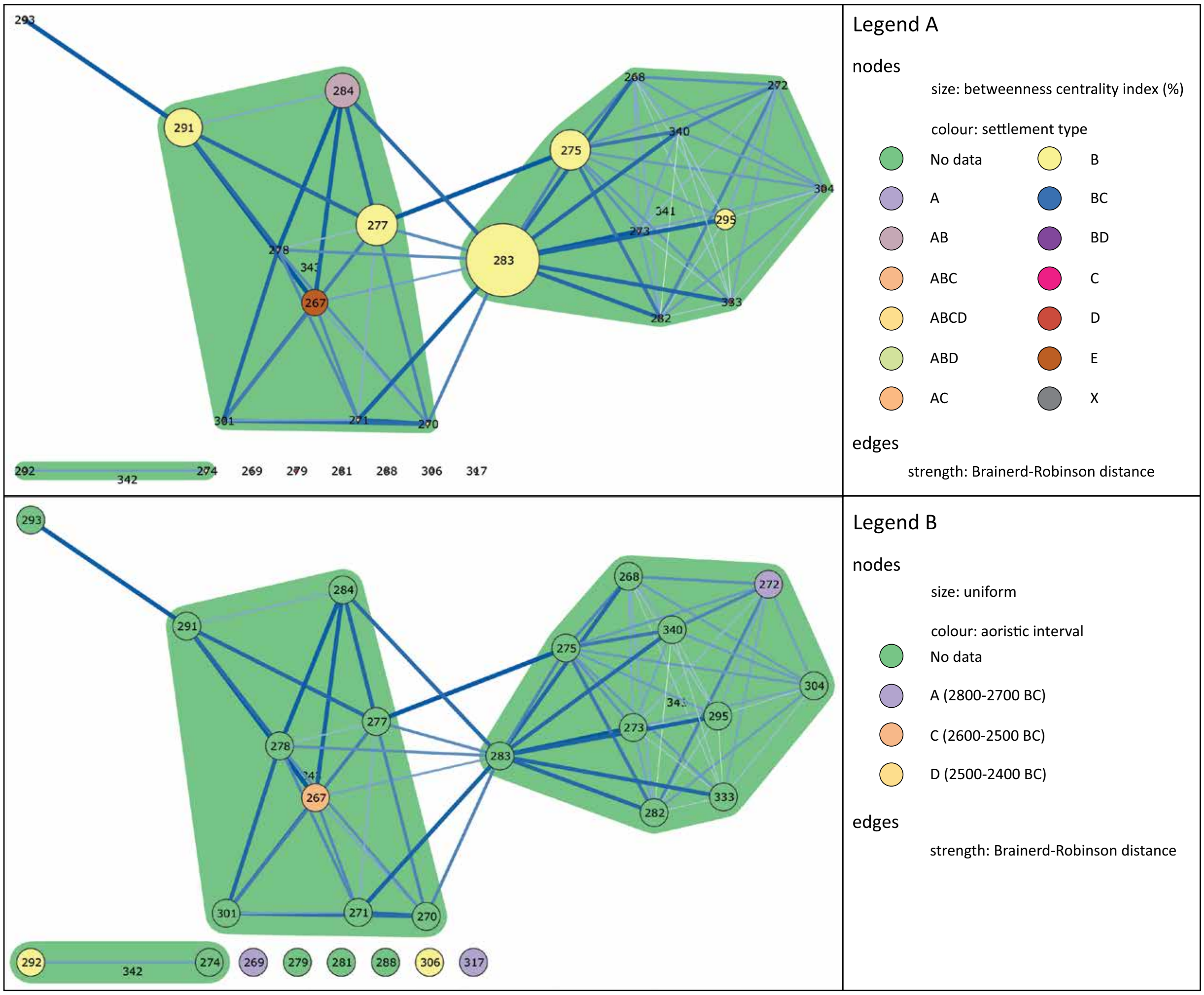


Fig. 6.13a & b Network of settlements in Western France (a: Girvan-Newman clustering; b: chronological network; c: geographical network).

culates the amount of paths information can flow between nodes and is often used in studies related to communication networks to assess the importance of nodes in enabling this communication (see also paragraph 3.3.2.1). Secondly, we can study the relationship between certain settlement types that might have played a more significant role within the network and the adoption of the Bell Beaker phenomenon. Finally this allows for studying the aspect of chronology in the development of these regional Bell Beaker networks.

The regional networks are made up of largely the same dataset as the previous networks. The dataset is only extended with chronological data. The earlier obtained aoristic chronological framework (see paragraph 5.3.1) was used to assign the settlements to periods of 100 year. All settlements with radiocarbon dates that directly date the phase of occupation are, in this manner, assigned to a 100 year period. Doing so, it provides an absolute chronological framework for a proportion of settlements within our network (namely those settlements for which direct radiocarbon dates exist). There are several chronological aspects of these regional networks that can now be explored. First of all, the relationship between settlements, their degree of connectivity within the network and their chronological value. Are the oldest settlements better connected within the network? Secondly, it now becomes possible to follow the development of the network through time and space on a regional comparative level.

Many Bell Beaker settlements however do not have a good absolute chronological framework yet, and therefore any conclusion drawn from this should be considered a working-hypothesis.

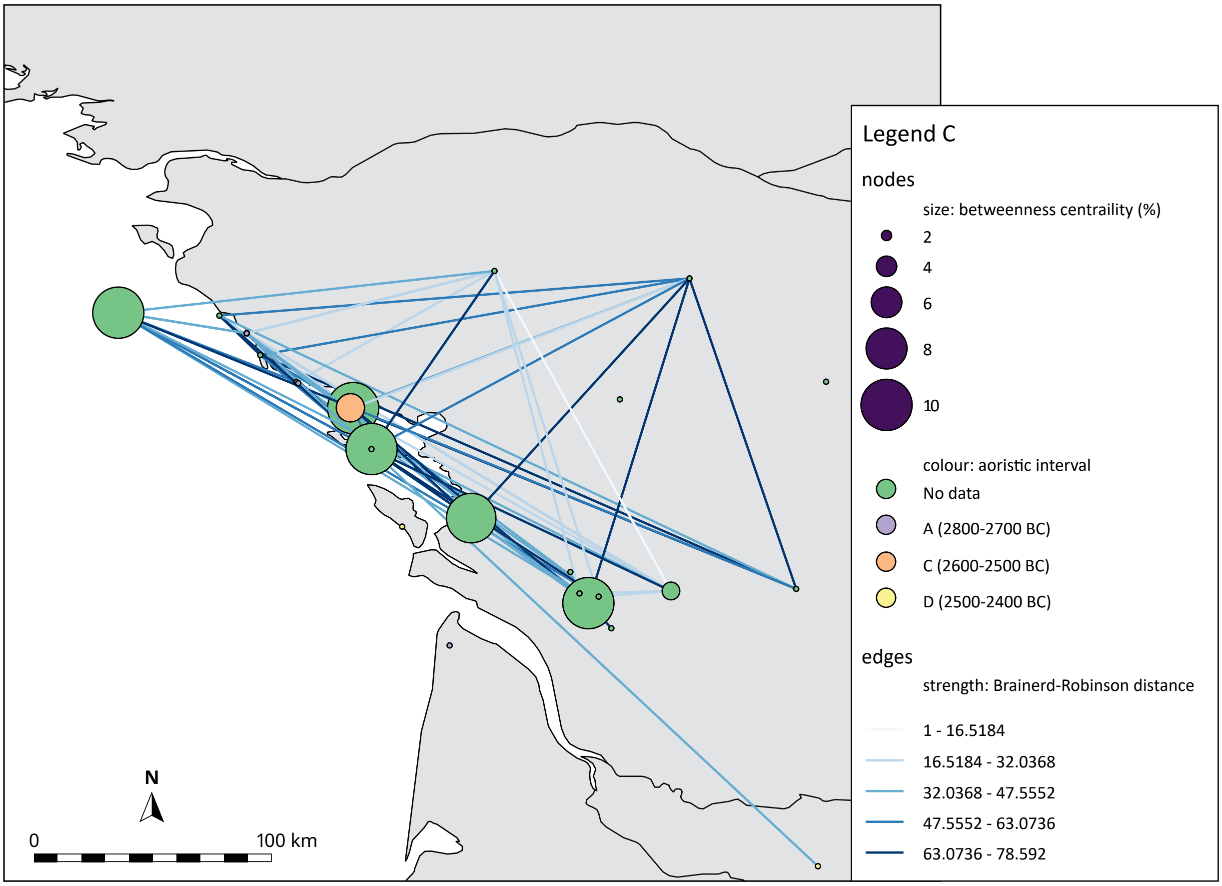


Fig. 6.13c Network of settlements in Western France (a: Girvan-Newman clustering; b: chronological network; c: geographical network).

Portuguese Estremadura

The network constructed for the Portuguese Estremadura (see figure 6.12) shows several sites that have a higher betweenness centrality. Therefore, these settlements are more important within the communication network and flow of information between the nodes. These sites consist of features (Outeiro da São Mamede and Funchal), cultural layers and structures (Fórnea, Baútas and Alto do Dafundo) and only structures (Pedrão, Penha Verde and Negrais). Interestingly, these are not the well-known enclosed settlements, such as Leceia, Vila Nova de São Pedro or Zambujal. Enclosed settlements are expected to play a central role within the distribution of the Bell Beaker phenomenon (Kunst 2007). From this data it can be argues that this holds true only for certain settlements.

The Girvan-Newman clustering shows three distinct clusters, in which the central position of these settlements becomes clearly visible. When we assess the chronological position of these settlements in relation to the betweenness centrality index, to see whether earlier sites might also have played a more important role within the development of the Bell Beaker network, the picture becomes less clear due to a lack of direct ^{14}C dates from many settlements. Only the settlement of Penha Verde is dated relatively early, and it shows a high betweenness centrality. When studying the pottery from these more important settlements, it is clear that earlier occupation is present in the form of Channelled Ware and Acacia-leaf pottery on all these 'more important' settlements in the network. With other words, the settlements with a high betweenness centrality index are not 'new' Bell Beaker settlements, but already existing settlements. The Bell Beaker phenomenon can therefore be described here as a new element in already existing communication networks.

Western France

In the Western France (see figure 6.13) research area, the settlements with a higher betweenness centrality are all coastal settlements. All of these particular settlements that played a more significant role in the communication network consist of a cultural layer (Le Vieux-Château, Les Grandes Loges, Les Deux Moulins and La Pallut) or features and a cultural layer (La Perroche). In the Girvan-Newman

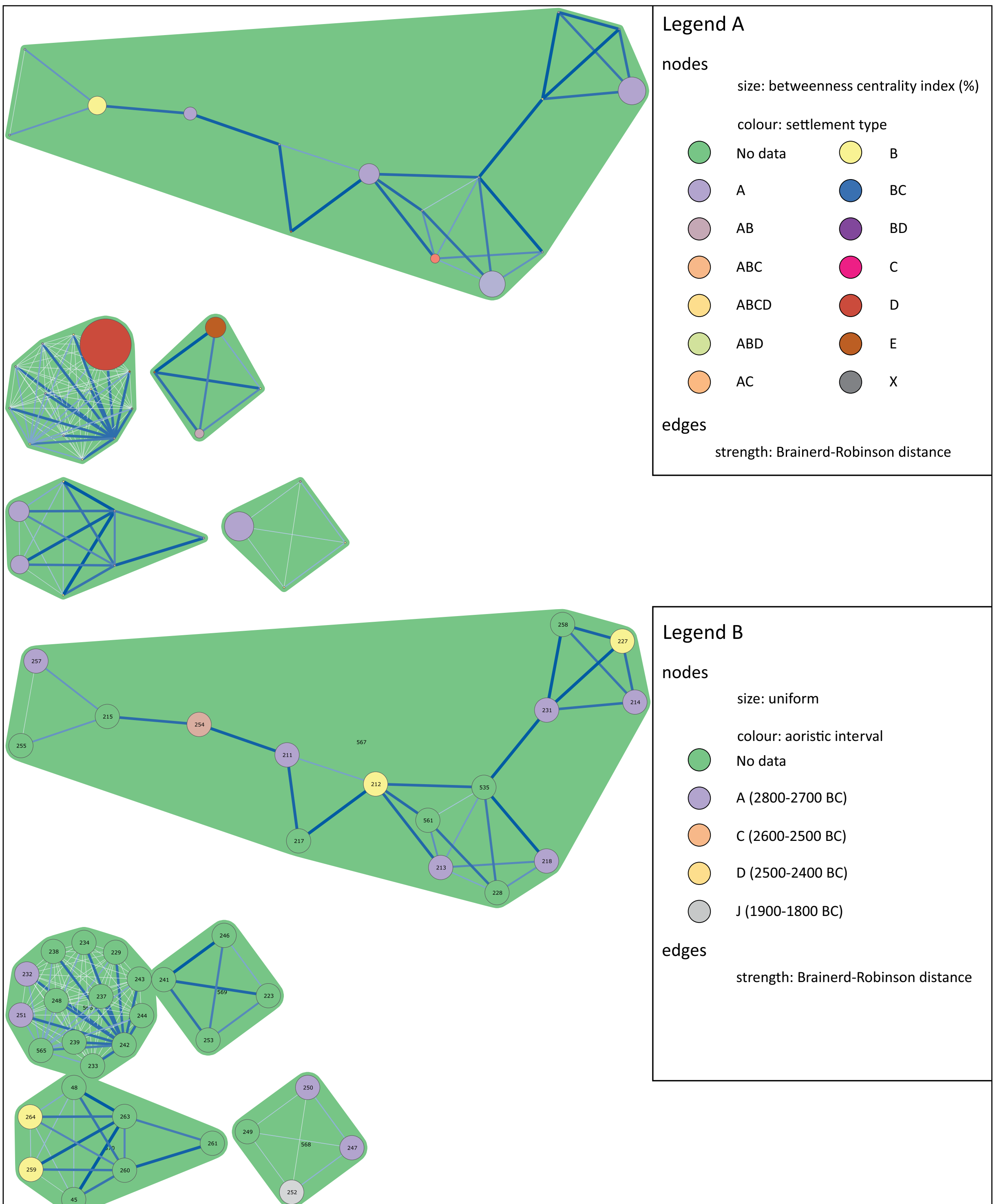


Fig. 6.14a & b Network of settlements in Northern France (a: Girvan-Newman clustering; b: chronological network; c: geographical network).

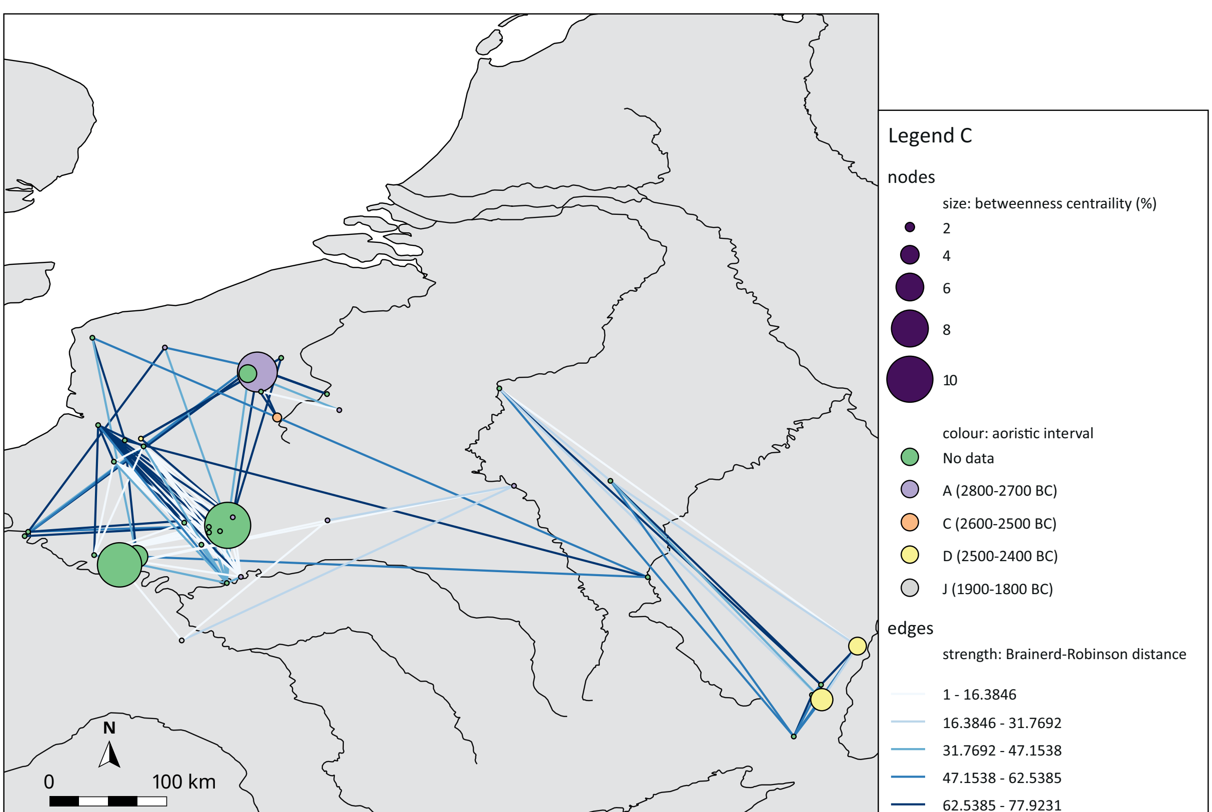
clustering, two interconnected clusters are visible and a prominent place becomes apparent for the settlement of Les Deux Moulins (283). The larger settlements, enclosures situated in the inland, have a long history of occupation by Late Neolithic Artenac communities. When considering the betweenness centrality index, it is argued here that these enclosures only play a marginal role in the communication network of the Bell Beaker phenomenon. A formal chronological network does not show any variability, as only a limited number of settlements is directly dated.

The coastal distribution of the most important settlements within the network indicates that a maritime connection with regard to the spread of the Bell Beaker innovation should be sought. This, together with the lack of earlier Late Neolithic occupation at specifically these coastal Bell Beaker settlements (in contrast to the Bell Beaker occupation found inland), could indicate the arrival of new people. This also clearly contrasts the Portuguese model in which the most important settlements were precisely those with a long occupation history, already indicating two completely different mechanisms at play in the development of communication networks associated with the Bell Beaker phenomenon.

Northern France

In Northern France (see figure 6.14) the analysis shows several separate networks, which are not all connected to each other. Geographically these networks are also separated from each other. Firstly, there's an eastern network connecting the riverine (Meuse and Rhine) settlements consisting of features and cultural layers and the cultural layers from caves in Wallonia. Secondly, there are two central networks on the higher plains and in the Deûle and Scheldt valleys, consisting of features and structures associated with Gord and Deûle/Escaut material culture. The other three networks comprise of settlements found on the Belgian/French coast and in the Seine river valley, consisting mainly of features and cultural layers, associated with Bell

Fig. 6.14c Network of settlements in Northern France (a: Girvan-Newman clustering; b: chronological network; c: geographical network).



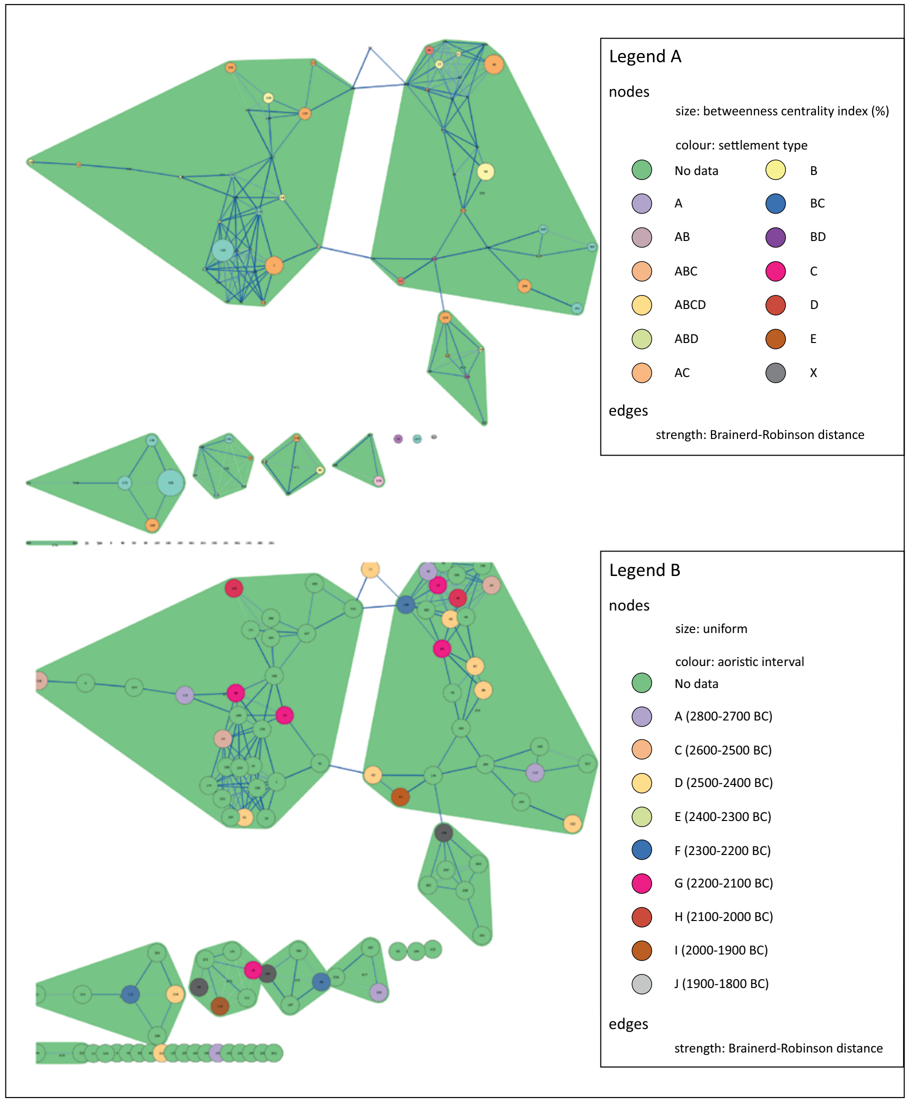


Fig. 6.15a & b Network of settlements in the Lower Rhine Area (a: Girvan-Newman clustering; b: chronological network; c: geographical network).

Beaker material culture. These four networks are better visible in the Girvan-Newman clustering, where it also becomes visible that there are no links between these four different networks.

Within specifically the Bell Beaker network, the settlements with the highest values of betweenness centrality are situated in the Paris Basin (Station d'Epuration, Sagy and Bois des Menues Terres) within a relatively hierarchical network in which many other settlements exhibit strong links to the single settlement of Station d'Epuration. The settlements of the Gord and Deûle/Escaut networks instead show a more spread out network in which no single settlement has a high betweenness centrality index, indicating a spreading of most flows of information between these settlements. Based on this analysis we would suggest two separate ways in which information exchange was organised; the Bell Beaker hierarchical network of the Seine valley, and the Gord and Deûle/Ecaut ways in which this was structured less hierarchical, but where links are similarly strong and uniform. Chronologically, there is not clear development visible, due to the lack of directly dated settlements. The two settlements in the Rhine valley (Grasweg/PAE and Holzackerfeld) do show a correlation between their radiocarbon dates and a relatively high betweenness centrality.

These insights could prove valuable when considering the adoption process taking place in Northern France, with the new Bell Beaker innovation on the one

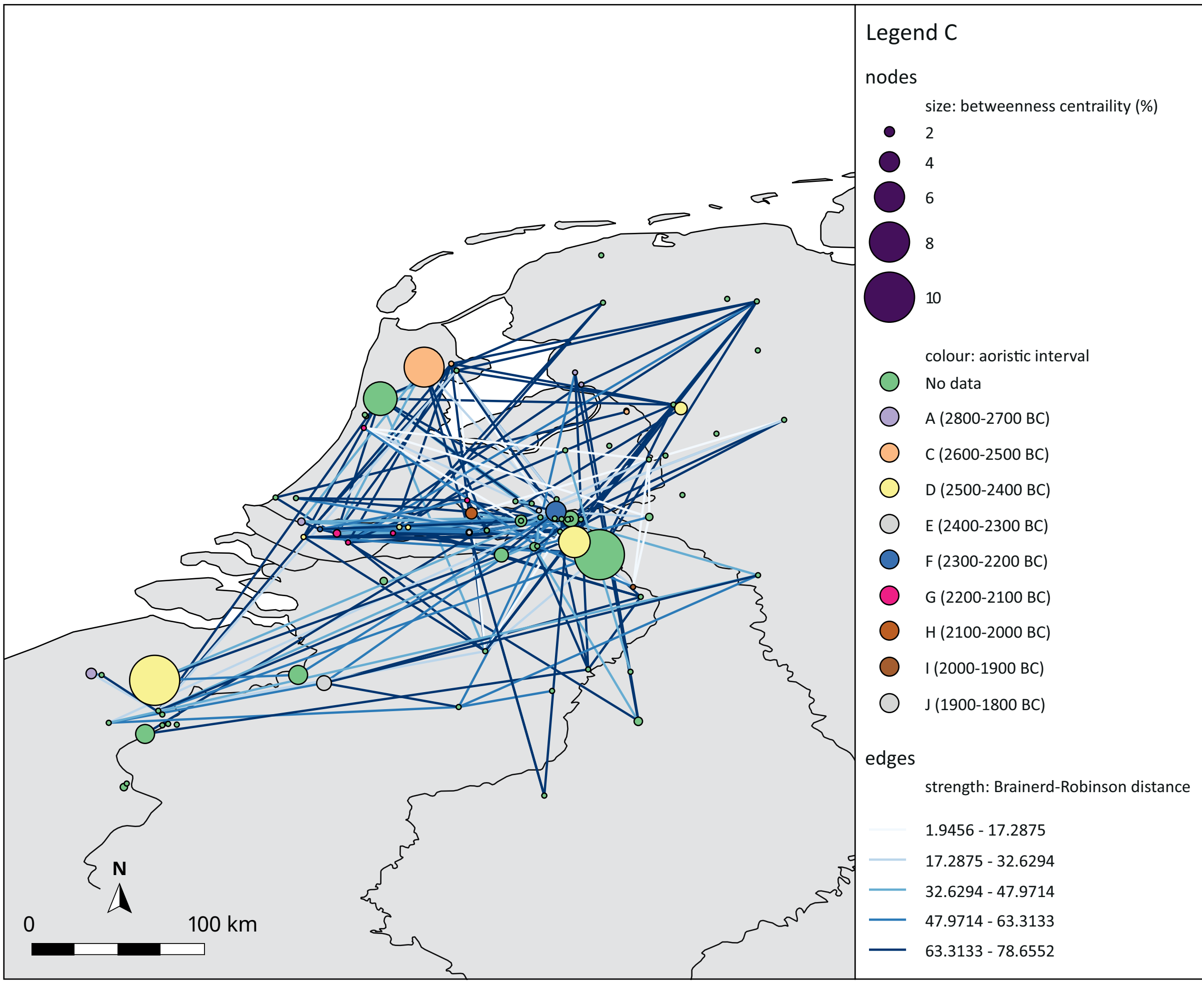


Fig. 6.15c Network of settlements in the Lower Rhine Area (a: Girvan-Newman clustering; b: chronological network; c: geographical network).

hand and the traditional Gord and Deûle/Escaut on the other hand. The communication networks, their strength and organisation, are invaluable in the spread of an innovation, as Rogers and Granovetter have already shown and we have argued before (see paragraph 2.3.1.2). A clear geographical separation between Bell Beaker settlements and Gord and Deûle/Escaut settlements could also have played a role here. With regard to material culture, a single Bell Beaker pottery fragment was found on a Deûle/Escaut settlement, a copper dagger was found on a Gord settlement and clear differences are also exhibited in the sourcing of stone and flint raw materials with Bell Beaker settlements favouring local flint, and Gord and Deûle/Escaut communities using primarily imported Grand-Pressigny flint.

Lower Rhine Area

The Bell Beaker network in the Lower Rhine Area (see figure 6.15) shows three larger clusters in an strikingly high connected network. Almost all nodes connect to each other in a way unlike most of the other research areas. There are several smaller less connected clusters. In the large network there are several settlements, consisting of features and cultural layers, which have a relatively high betweenness centrality. Thus these settlements can be considered more important within the communication network. These settlements are Cuijk Groot Heiligenberg, Akersloot Klein Dorregeest, Zettensche Veld West, Sijbekarspel De Veken, Wijchen Oosterweg and Mechelen Zennegat. These settlements are primarily situated in the central Dutch riverine and coastal areas. Other settlements, more peripheral within the network

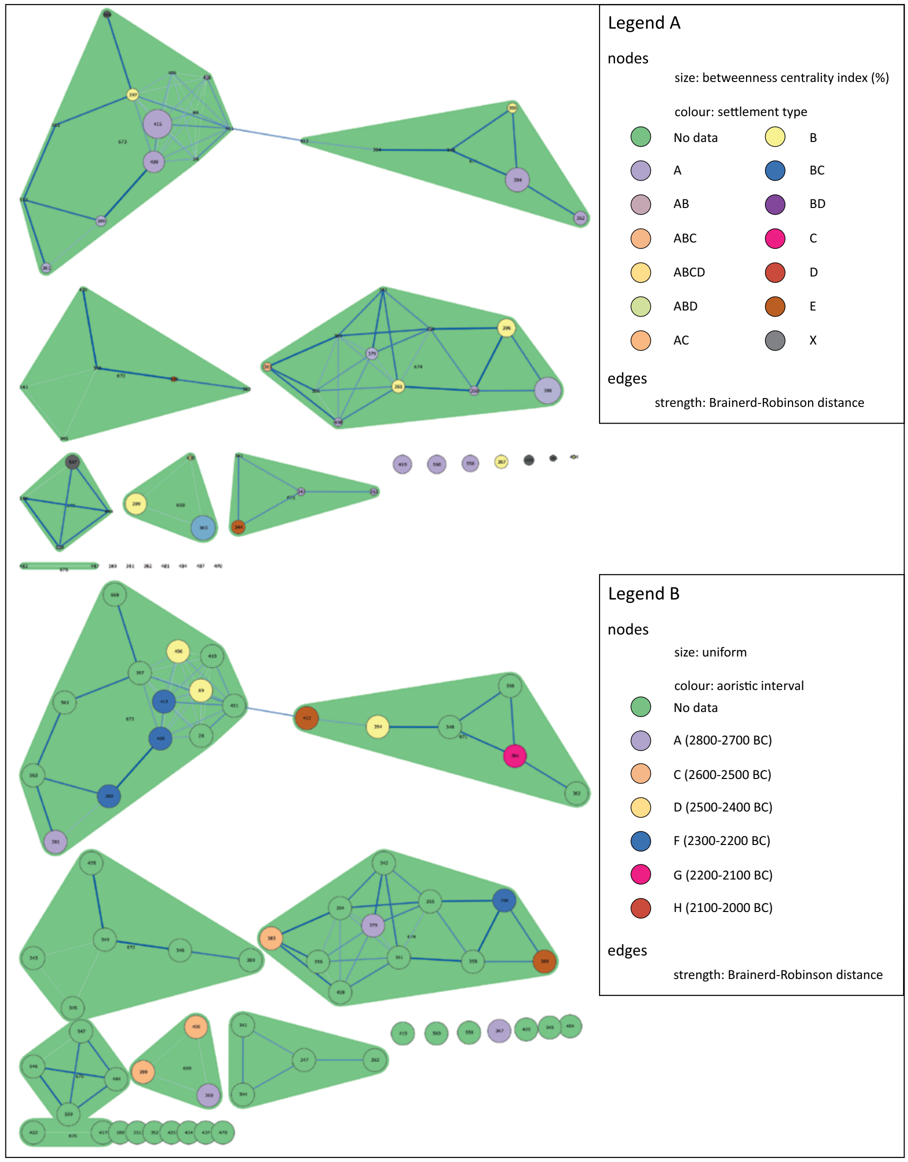


Fig. 6.16a & b Network of settlements in Southern Scandinavia & Northern Germany (a: Girvan-Newman clustering; b: chronological network; c: geographical network).

and of less importance with regard to the communication of innovations, are found both in the coastal and riverine areas and in the sandy uplands.

With regard to chronology, the Lower Rhine Area has a large enough dataset of directly dated settlements. Although many settlements are not directly dated, there are some patterns visible. Several older settlements, such as Sijbekarspel and Vlaardingen, have a higher betweenness centrality index and could have been among the earliest settlements from which the Bell Beaker innovation spread along these reconstructed communication networks. The particular settlement of Sijbekarspel is located in coastal Westfrisia and known for its zoned and All-Over-Cord decorated pottery (see Beckerman 2015, 102-104).

Southern Scandinavia & Northern Germany

In Southern Scandinavia & Northern Germany (see figure 6.16) the network is a relatively loose network, consisting of four clusters, with only several weak links between the clusters and between the nodes within the clusters. Also, many settlements completely fall outside of this network. This already tells us that a large variability exists between settlements in this research area, from which we can infer that

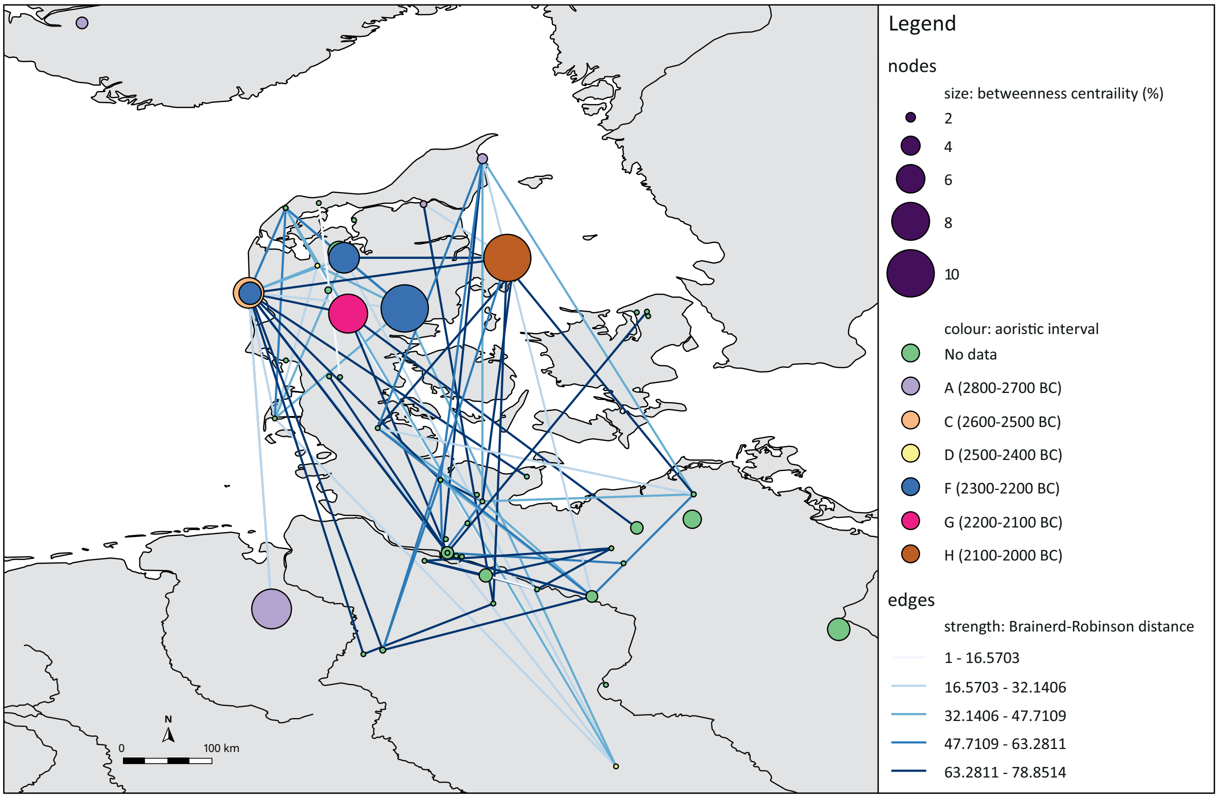


Fig. 6.16c Network of settlements in Southern Scandinavia & Northern Germany (a: Girvan-Newman clustering; b: chronological network; c: geographical network).

communication networks were probably not very strong between these settlements. These weak links are remarkable given the large exchange network of specialised flint artefacts existing from 2300 BC onwards (see Apel 2001, Siemann 2003).

Within the larger clusters, many of the settlements with high betweenness centrality are features and structures such as houseplans with sunken floors (such as at Hemmed Kirke, Myrhøj, Bejsebakken and Tastum). These settlements are mostly situated along the coast in Middle and Northern Jutland. These are the settlements where most *Cardium* impressed Bell Beaker pottery and also the largest concentrations of flint daggers have been found. The data suggests that these settlements are also relatively early in the Danish Bell Beaker sequence, and probably held an important position in the communication network distributing the Bell Beaker innovation across Southern Scandinavia and Northern Germany. The network itself however still has a very loose structure and consists of many separate or nearly separate clusters. The reason behind this, and the subsequent way in which Bell Beaker settlements in Northern Germany are relatively isolated, is unclear.

A single of these isolated Bell Beaker settlements in Northern Germany is Hunte 1 (360). This settlement contains traces from subsequent Funnelbeaker, Corded Ware and Bell Beaker phenomena (Kossian 2007), with evidence for large scale animal husbandry practices, predating the Bell Beaker phase.[14] However, the stratigraphy here is unclear and this settlement does not seem to be central to the Bell Beaker network in Northern Germany and Southern Scandinavia. It might be more related to settlements in the Lower Rhine Area instead.

14 Personal comment Dr. R. Ebersbach who reanalysed the animal remains from the 1930s excavations.

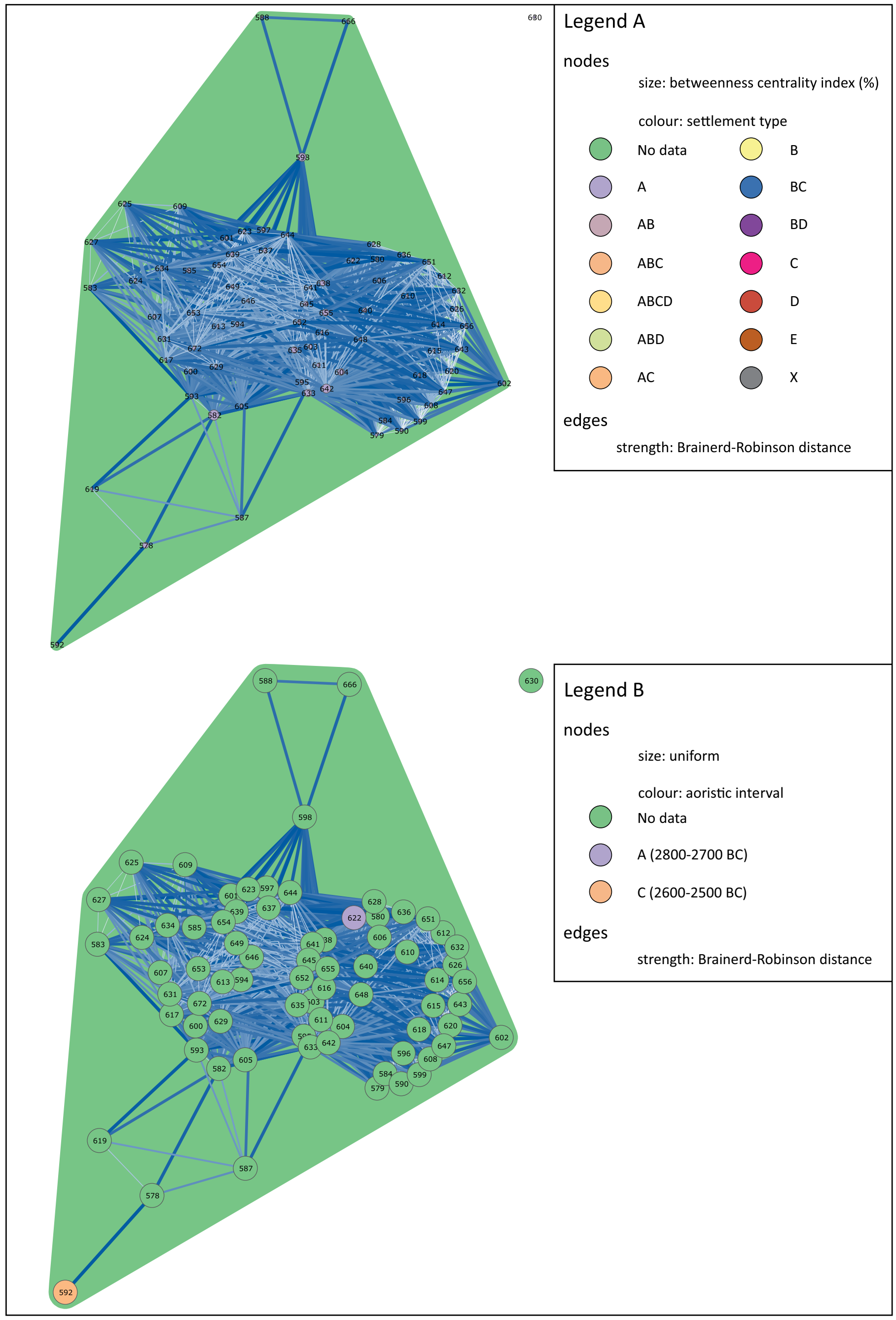


Fig. 6.17a & b Network of settlements in Czech Republic (a: Girvan-Newman clustering; b: chronological network; c: geographical network).

Czech Republic

The Bell Beaker communication network of the Czech Republic (see figure 6.17) shows a dense network consisting of 75 nodes and 1506 links. Many settlements show a low betweenness centrality, indicating that there is not a real differentiation in the flow of information through the network itself. All settlements in the Czech Republic consist of single features or clusters of features (see for instance Horni Ián). Many settlements show similar kinds of material culture and also do not show a continuous or long-term occupation (note the absence of intrusions in the pottery assemblages mentioned in paragraph 5.2.2.2). Also directly dated Bell Beaker settlements are nearly absent. Thus it is not possible to test the relationship between chronology and the development of the Bell Beaker network in the Czech Republic. The

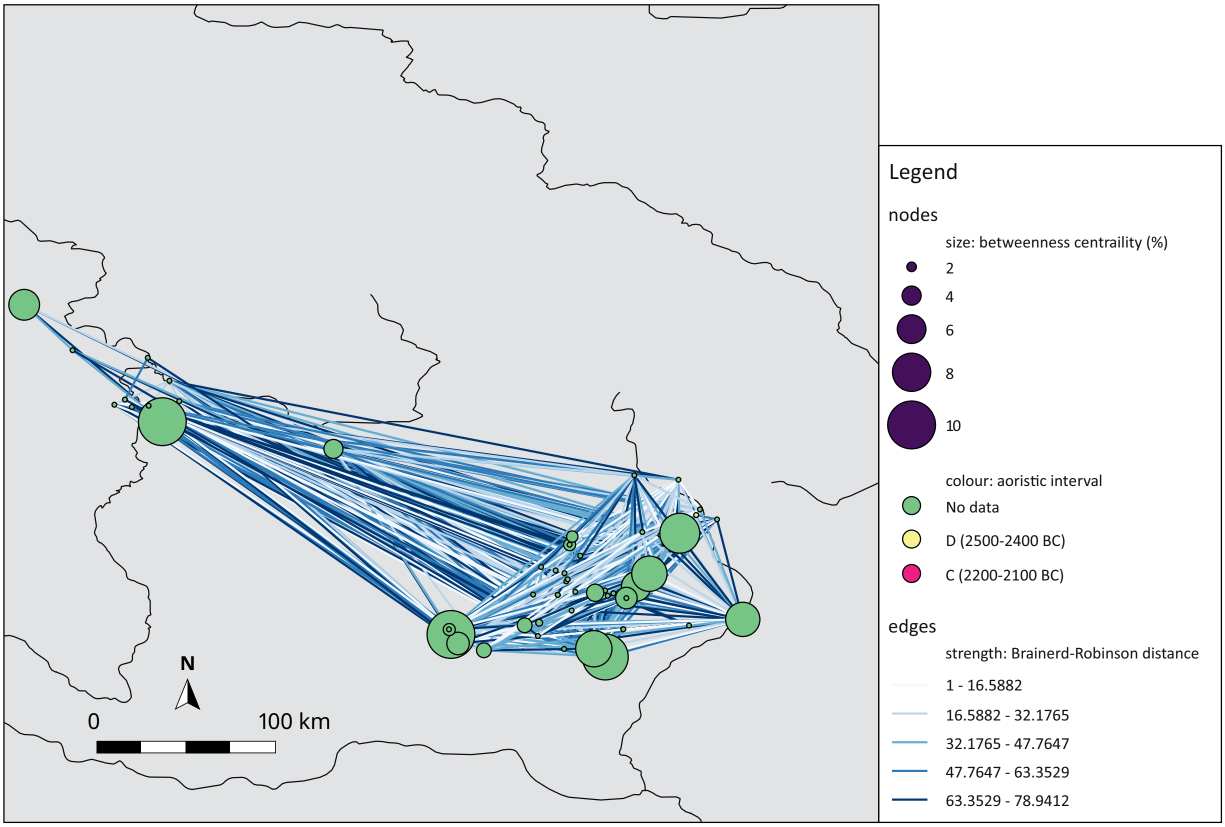


Fig. 6.17c Network of settlements in Czech Republic (a: Girvan-Newman clustering; b: chronological network; c: geographical network).

dense cluster of the network does however indicate a relatively uniform adoption of the Bell Beaker phenomenon across the research area.

6.2.4 Innovation and networks: discussion

In the previous paragraph we studied Bell Beaker settlements from a networking perspective. We focused on several different variables; detailed pottery characteristics, stone and flint artefacts, metal objects and botanical and zoological remains. This method was used to study the similarities and differences between Bell Beaker settlements from a quantitative perspective, by looking at the various human practices (*e.g.* fashions, technologies, subsistence strategies) that constituted those settlements. Reconstructing these networks of similarities and differences in practices gives an overview of the various social landscapes of the Bell Beaker phenomenon: the communication networks, different cliques of particular settlements, geographical distribution patterns, spatial and chronological variability and the importance of certain mechanisms within these networks. An insight into the networks underlying dataset was provided by several distribution maps focusing on the respective data.

Several conclusions can be drawn from this visualisation and analysis. Similar Bell Beaker pottery decoration techniques and motifs are almost completely spread out across all the research areas. The concentration of *Cardium* shell impression in the coastal areas of the Iberian Peninsula, Western France, Southern Scandinavia and Central and Eastern Netherlands was previously analysed by Salanova together with with Prieto Martinez (Prieto-Martinez/Salanova 2009) and Drenth (Drenth/Salanova 2012). Absence of all-over ornamented motifs and cord decoration techniques in some areas is notable, and might hold a chronological relevance within the developing Bell Beaker network.

Common Ware pottery is more regionally varied with regard to decoration techniques, motifs and additional characteristics. Holes beneath the rim mainly occur in the Lower Rhine Area, while handled or knobbed Common Ware vessels are commonplace in the Czech Republic. An additional feature of Common Ware pottery in the Lower Rhine Area and Southern Scandinavia & Northern Germany, is the presence of all-over-ornamented and zoned decoration, while undecorated or randomly decorated vessels are found in all the research areas. With regard to flint artefact technology, a primarily blade-based production sequence is known only from the Portuguese Estremadura. Flint arrowheads found in the Portuguese Estremadura also show morphological characteristics that are distinct from the other research areas. Metal objects are rare, but evidence for production waste (droplets, slag) is found in the same research areas from which also so-called 'smiths graves' are known (Drenth/Freudenberg 2008; Freudenberg 2010; Bertemes/Heyd 2002). When discussing subsistence data, the continued use of wild animal species is well attested for many settlements in the Lower Rhine Area and Southern Scandinavia & Northern Germany, as also voiced recently by Fokkens *et al.* (2016). It is also in precisely these areas that horse remains dating to the Bell Beaker period are found within our research areas. The crop composition on settlements is mainly centred on (naked/hulled) barley and (einkorn/emmer) wheat, with addition of oat, possibly cultivated, in the Lower Rhine Area and Southern Scandinavia & Northern Germany and spelt wheat in Southern Scandinavia & Northern Germany and the Czech Republic.

The analysis of the pottery network has shown that most settlements are interconnected, based on similar decoration techniques and motifs. Only several settlements in Northern France, accompanied by some settlements in the Lower Rhine Area, exhibit a distinct concentration. These latter settlements are Gord and Deûle/Escaut phenomena, contemporaneous but distinct from Bell Beaker. One must note however, that here only pottery is discussed. This thus maybe reflects a pottery decoration information exchange network, but this is not reflective of the complete network that might have existed at large. And as this research also focuses on the identification of communities and cliques, based on variability in human practices recorded in the settlement material culture, we also addressed other finds categories in a second network model. In general, this network shows more similarity between all the settlements. Apparently, apart from pottery decoration, much of the settlement material culture is similar across the different research areas. The earlier mentioned distribution patterns, of metallurgical objects on settlements, of the presence of spelt wheat or oat cereals, of domestic horses, of differences in flint artefact production or of the typological variability in arrowhead shape, are thus only minor in comparison to the shared practices across the different research areas. Concluding, if a uniform "Bell Beaker package" existed across Europe, in which these practices were taken up, this would have led to a wider distribution pattern of these practices.

When we turn to the regional network models, we can start to see differences between regions in terms of the number and variability of nodes, number and strength of links, the number of connected clusters, and the geographical distribution of certain networks. These differences, as said, inform us about different communication networks, different cliques of communities sharing certain practices (table 6.3).

In particular important in terms of understanding the spread of the Bell Beaker innovation in relation to the modelled communication networks is the Girvan-Newman clustering. A large variability in human practices inevitably leads to low interconnectedness between settlements, and the formation of certain clusters. The different ways in which the Bell Beaker innovation spreads through the nodes is therefore seen when comparing the different clusters (see figure 6.18).

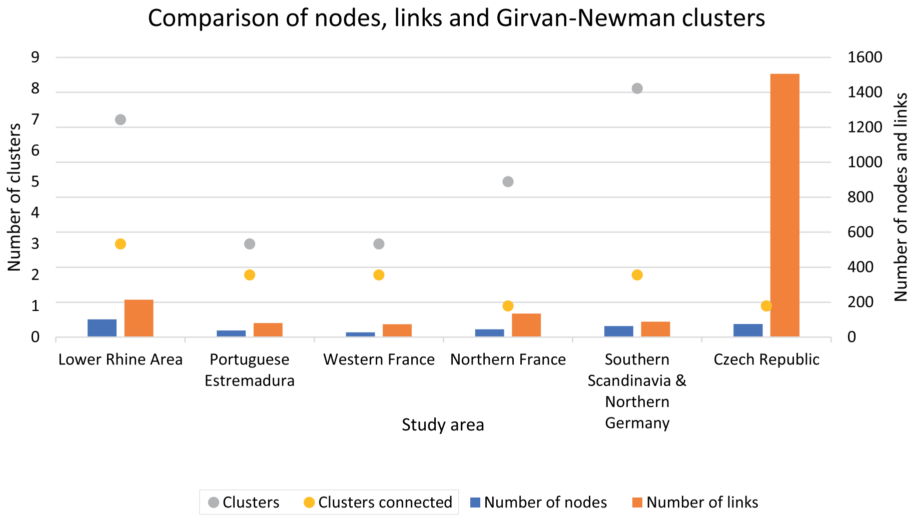


Fig. 6.18 The different research areas, showing the total and connected numbers of clusters (left y-axis) and the number of nodes and links (right y-axis).

Study area	Number of nodes	Number of links	Girvan-Newman clusters (and connected)	Link strength	Geographical distribution	Settlement types	Node variability
Lower Rhine Area	101	214	7 (3)	Medium	Coastal/riverine	A, B, AB	Homogenous
Portuguese Estremadura	38	80	3 (2)	Medium	Coastal	BC	Heterogenous
Western France	27	74	3 (2)	Strong	Coastal	A	Heterogenous
Northern France	44	134	5 (1)	Strong	Inland/riverine	A	Heterogenous
Southern Scandinavia & Northern Germany	63	88	8 (2)	Weak	Coastal	A, B	Heterogenous
Czech Republic	75	1506	1 (1)	Strong	No concentration	A	Homogenous

Table 6.3 Network characteristics.

When we see strong links within a Girvan-Newman cluster, this tells us that the human practices on these settlements are very much alike and there apparently existed a large degree of information exchange on what settlements should look like and what material culture should be produced and used and in what way it should be discarded. Especially for the Czech Republic this is the case, and also in Northern France and Western France there are strong clusters. While in Western France this cluster is formed by Bell Beaker pottery using communities, this is not the case in Northern France, where especially the clusters in which Bell Beaker pottery is present have less strong links. It is the clusters that have Gord and Deûle/Escaut pottery in which settlements are strongly linked to each other. These strong links, "strong ties" in Granovetter's words, have probably caused the rejection of the Bell Beaker phenomenon in Northern France. Contrastingly, the strong ties in Western France include the older and partly contemporaneous Artenac settlements, where also Bell Beaker material culture, and Bell Beaker inspired material culture (*cf.* Cormenier 2009) was found. Here a different attitude towards the Bell Beaker phenomenon must be envisioned.

On the other end of the spectrum of clusters is Southern Scandinavia & Northern Germany. Here, a large number of small and unconnected clusters is found and the link strength between settlements is relatively weak. From this we can conclude that the information exchange between communities within this research area was low and a large variability existed in the ways people dealt with, accepted, reinvented and appropriated the Bell Beaker phenomenon. This is remarkable given the notable exchange network of flint objects existing in this research area. Apparently this exchange of flint objects did not lead to a large degree of similarity between settlements.

The Lower Rhine Area and Portuguese Estremadura can be positioned in the middle, where the amount of clusters is not very high, and strong links within and connections between clusters exist. Apparently here information exchange led to different ways of dealing with the Bell Beaker phenomenon, but many practices were still shared between settlements.

In these two paragraphs we've shown that different ways exist in which communities within the research areas have dealt with the Bell Beaker phenomenon in respect to both spatial and chronological dimensions. The Bell Beaker phenomenon was seen from the perspective of a diffusion and exchange of new information within existing networks between communities. In the next two paragraphs the focus of attention shifts towards the interplay between tradition and innovation. How this relationship pans out on a local level, where structure and agency are at play on a daily basis, is studied through a detailed analysis of the most ubiquitous element in the material culture repertoire: pottery.

6.3 Innovation mechanisms: movement

In the previous paragraphs we discussed the communication networks that facilitate the spread of the Bell Beaker innovation across Europe. We have seen how these different communication networks can influence the ways in which communities adopt the Bell Beaker innovation.

In the following paragraph we delve deeper into the mechanism that substantiates these shared practices and the creation of these communication networks: the concept of movement. Discussed are the several types of movement: movement of pottery through exchanges, the movement of ideas and the mobility of people. In the past scholars often resorted to simple distribution maps with large arrows, presupposing movement, in explaining the diffusion of the Bell Beaker phenomenon across Europe. Here we show that distribution maps alone are not an answer to the spread of a phenomenon, the distribution of specific artefacts is grounded in shared practices through communication networks as highlighted above, and they are part of mechanisms of movement that drive this diffusion of innovations. A review of the evidence and interpretations for the exchange of pottery, the exchange of ideas and the mobility of people is presented below.

6.3.1 Exchange of pottery

The mechanism of pottery exchange as a driving force behind the diffusion and adoption of the Bell Beaker phenomenon was already hypothesised by Clarke (1976, see fig. 6.19). He took the evidence for the long distances (>256 km) that Cornish Early Neolithic fine ware pottery had travelled as an analogy for the Bell Beaker fine wared pottery as a partial explanation for the emergence of a Beaker network of exchanges.

In 1985, a relative small scale study was carried out into the raw material chemistry of a single Bell Beaker (Lanting 2015, 123-124). It seemed at the time that this Bell Beaker (from a burial mound at Harskamp, the Netherlands) had a vessel shape and decoration motif divergent from the Dutch Veluvian (*i.e.* "of the Veluwe") tradition, more in line with Moravian counterparts. The goal was to see whether a direct connection could be established. A sample from this vessel was analysed by means of XRD (x-ray diffraction) and compared to samples taken from Bell Beakers from Moravia and the Veluwe. Results show a clear difference between the Veluvian

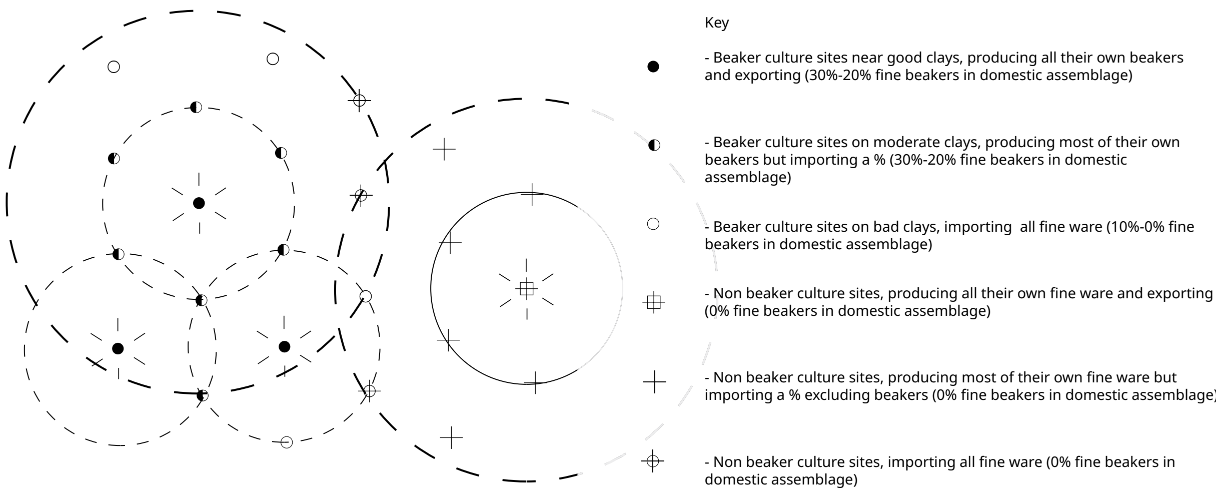


Fig. 6.19 Clarke's model II for a Bell Beaker network based on the exchange of Bell Beaker fine ware (after Clarke 1976, fig. 5).

samples and the Moravian samples, with the supposed "Moravian" Bell Beaker from Harskamp adhering to the Veluvian cluster. Apparently the clay used in the production of this Bell Beaker vessel was locally acquired and not dissimilar to the clay used in other Bell Beakers found in the Central Netherlands.

The first large scale studies into pottery raw material sourcing, by means of Neutron Activation Analysis were carried out by Rehman *et al.* (1991, 1992). Their study uses 546 samples of Bell Beaker pottery from funerary contexts in Central Europe (Austria, Hungary, Bavaria, Moravia, Bohemia). They find that *between* these five regions the differences in composition are significant. Contrastingly, *within* the regions a varied picture emerged, characterised by "…local trading of Beaker ceramics in most of the regions studied…" (Rehman *et al.* 1991, 102). As pottery compositions are generally different from locally sampled clay sources, more work is needed into finding these sources. Methodologically somewhat similar is the recent study by Isabel Dias *et al.* (2017), who, for Portuguese Bell Beakers, also found that most (but in this case not all!) Bell Beaker pottery was produced locally.

A different example of studying the movement of Bell Beaker pottery, is presented by the study of Convertini (1996, 1997). He uses petrography and XRF analysis to address the origin of clay and temper for the Bell Beaker pottery from 13 settlements in both France and Switzerland. In total 272 analyses of thin sections and XRF were made. The number of 'exotic' sherds in these assemblages is very low and amounts to 10 samples from three sites, and not all of these 10 samples are thin-walled spatula decorated Bell Beaker vessels. Apart from the absence of evidence for long distance mobility of Bell Beaker vessels, his work provides an overview of possible local clay sources, tempering agents, paste preparation practices and firing temperatures.

A recent overview into Bell Beaker pottery mobility (Salanova *et al.* 2016) combines several studies into Bell Beaker petrography since the 1990s, such as the earlier mentioned work of Convertini. This review distinguishes local production, regional and supra-regional exchange of pottery from different contexts (funerary, domestic, ritual) across Europe. Their overall conclusion is that regional exchange of pottery did take place at a low degree, related to specific contexts at which different communities gathered in residential mobility or for funerary practices. Most of the pottery remains a local product, and evidence for the long distance movement of pottery, and associated exchange mechanisms, is almost completely lacking.

This mechanism of pottery exchange, as highlighted by Clarke (1976, 472) therefore, can only account for regional diffusion of the Bell Beaker phenomenon in particular research areas such as the Czech Republic, and cannot account for the widespread diffusion across Europe.

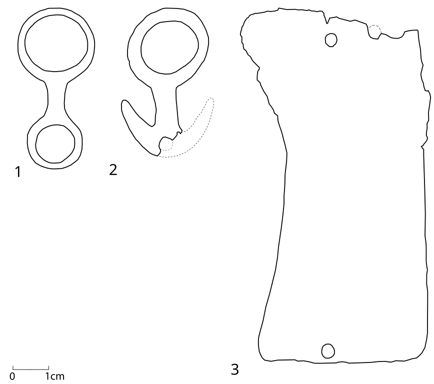


Fig. 6.20 Bone hourglass and anchored pendants and bone plate (1: Velsen Noordzeekanaal, the Netherlands (after Clason 1974); 2: Biederitz, Germany (after Voigt 1956, Abb 4, Taf 26:10); 3: Zvejnieki, Latvia; after Loze 2006, fig. 9.1)).

6.3.2 Exchange of ideas

6.3.2.1 Introduction

With regard to the exchange of ideas, two examples are presented here by an analysis of distribution patterns and contexts, demonstrating the importance of, and the variability within, this particular mechanism.[15]

The first example follows specific bone pendants and plates found in both settlements and graves across 3rd millennium BC Europe (an earlier version was published as Kleijne 2016). The second example follows the Palmela point, a characteristic copper weapon found mainly in the Iberian Peninsula, dating to the later part of the 3rd millennium BC. In this analysis, next to their distribution, both the use and the depositional context play a role. As Bradley (1984, 172, fig. 4.2) describes, purpose and status of objects, and the ideas associated to objects, can shift through time and from one context to another. When there is a pattern of continuity in contexts associated with objects, we can interpret this as the continued exchange of ideas. Variability can be the result of local appropriation, changes in use, or changes in values ascribed to the objects.

6.3.2.2 Pendants and plates

An inventory was made (see appendix E, table 1 and 2) of two types of (primarily) bone objects found in graves and on settlements dating to the 3rd millennium BC: the hourglass and anchored pendants or *Knochenanhänger* and the belt plate (see figure 6.20). Hourglass shaped pendants consist of two circles joined by a middle piece. The anchored pendants have an anchor instead of a small circle. The bone plates are rectangular pieces of bone with holes along the side and often provided with incised geometric decoration motifs.

In total 33 hourglass pendants are known, including 5 out of amber and 1 made from stone. These 33 pendants are found in Late Neolithic funerary contexts (19 times), as loose finds (12 times) and twice in settlement contexts dating to the Early Bronze Age (Ilm-Kreis Arnstadt and Velsen Noordzeekanaal). When considering the 19 pendants from burials, 6 are associated with Bell Beaker funerary practices, whereas 4 have been found in Corded Ware inhumation graves and an additional 4 stem from Schönfeld cremation graves and a single pendant possibly came from

15 Many other examples exist in the literature, for instance the work done on wristguards (Sangmeister 1964, 1974; Fokkens *et al.* 2008), v-perforated buttons (Hájek 1968; Winnicka 2017), bow shaped pendants (Růžičková 2009; Ryan *et al.* 2018) or bone toggles (Rahmstorf 2008).

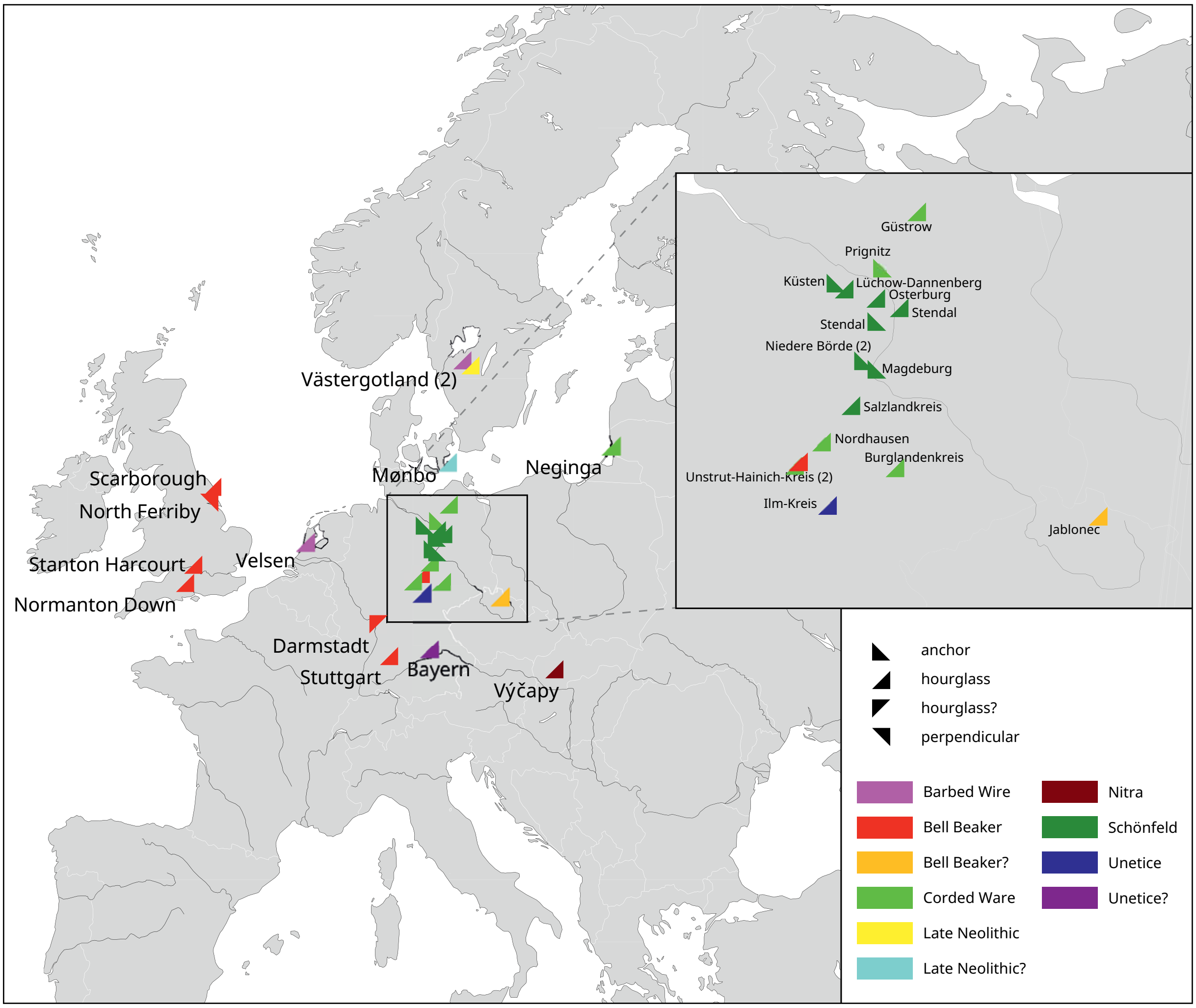


Fig. 6.21 The distribution of bone pendants across Europe.

a Globular Amphorae cist.[16] Graves, both single inhumation graves and megalithic burial tombs, associated with Únětice, Nitra, Barbed Wire and undefined Late Neolithic material culture have yielded the additional pendants (see figure 6.21).

Interestingly, this type of pendant is not only found in Bell Beaker graves, but also in Corded Ware and Schönfeld funerary contexts, both predating the Bell Beaker phenomenon. It can even be argued that the bone hourglass pendant shape in itself is originating in earlier Neolithic examples found in the Balkans and made out of gold (*e.g.* Behrens 1970). Not only hourglass shaped bone pendants are found in Late Neolithic graves. Another type of pendant, the anchored pendant, is found primarily in Schönfeld cremation graves, but also once in a Corded Ware grave (Schönfeld Havelberg, Prignitz grave 1). Radiocarbon dates associated with pendants are rare and mainly point to a long span of use and deposition during the 2nd half of the 3rd and first centuries of the 2nd millennium BC (see table 6.4).

Also, when comparing the sizes of the different hourglass and anchored pendants, not much variation exists (see Kleijne 2016, 49). Probably the pendants were used

16 From Kuźnica Żelichowska (Selchowhammer) in Poland. The pendant is mentioned by several authors (Wetzel 1979, 58-59; Priebe 1938, 52, Anm. 5) and the burial itself is provisionally published (Pockrandt 1976; Kokowski 2010) but the pendant or associated artefacts have not been studied. Contact with the of Trzcianka Museum and the Archaeological Museum of Poznan has not led to a satisfactory result, and the material is presumed lost. Thanks to M. Strzelczyk and Prof. Dr. M. Szmyt.

Toponym	Association	Context	Lab code	BP	Sigma	$\delta^{13}C$	Sample
Noordzeekanaal	Barbed Wire	settlement	GrN-5975	3620	35		peat
Serrahn 2	Corded Ware	grave	UZ-4085	3845	70		bone collagen
Zuffenhausen	Bell Beaker	grave	GrN-9298	3830	35		bone collagen
Falbygden Luttra 16:1	Late Neolithic	grave	OxA-22004	3583	29	-20.8	bone collagen
			OxA-22005	3459	32	-20.3	bone collagen
Wilsford G1(b) feature 1502	Bell Beaker	grave	NZA-29534	3878	20		bone collagen

Table 6.4 Findspots of pendants, with associated radiocarbon dates.

similarly across the three different phenomena. With regard to associated individuals, Schönfeld anchored pendants are often found with children (3 times). Both Corded Ware and Bell Beaker hourglass pendants are found with males and infants. Females accompanied by this type of pendant are lacking completely throughout the 3rd millennium BC.

Thus, based on all the above, we can infer that shared practices of dressing and equipping particular ancestors existed between the Corded Ware and the Bell Beaker phenomena. These dressing and equipping practices changed in the Early Bronze Age, where less strict rules applied, and pendants were kept on settlements or deposited (with secondary interments?) in megalithic tombs. A continuation of use and perhaps value throughout the Schönfeld, Corded Ware and Bell Beaker phenomena is argued for.

With regard to the bone or antler plates (see appendix E, table 3 and 4), a similar development can be seen. Sometimes these objects are called wrist guards, belt buckles, bracelets or simply plaquettes, but more research into their function is needed. Curved bone wristguards are known from Funnel Beaker contexts in Scandinavia (Becker 1963). The plates are often found in areas close to the pelvis or near the underarms of the buried individual. A future detailed analysis of the position of these grave goods could highlight this more clearly.

In total 30 sites with plates (mostly in pairs of 2) are known from Central and Eastern Europe. Of these 30 sites, 3 are Corded Ware settlements, whereas 11 are Corded Ware burials. Other sites are 1 Lubans settlement, 1 Fatjanovo-Balanovo burial, 1 Lubljana settlement, 1 Bell Beaker burial, 4 from Globular Amphorae cists and single graves and 3 graves for which the association is unclear (either Corded Ware, Bell Beaker, Globular Amphora or Únětice). An additional 4 Scandinavian burials dating to the Late Neolithic have also yielded decorated and perforated plates (see figure 6.22).

The plates themselves, 43 in total, are mostly decorated by means of geometric zigzag incised motifs, although completely undecorated (6 cases) examples or and in a few cases plates notched along the edges (2 instances) do exist. All the plates exhibit holes, mostly round in shape and paired, along the edges, in order to be attached and kept in place along a belt of some sort. Several plates from Globular Amphora cists in Poland (Nowy Dwor, Czarnokonce and Uwisla; see Kozłowski 1924, Taf. XXV) are curved and show larger holes, more resembling limb protective gear. Seven further examples, 4 of which were found in Scandinavian Late Neolithic graves (Stenberger *et al.* 1943, 1960) and others from Danish megaliths, are triangular in shape. A single one coming from the Lubljana lake dwelling settlement (Korosec/Korosec 1969, 128, Taf. 87:1) and a final 2 from the Fatjanovo-Balanovo burial in Russia (Häusler 1956, Taf. 20:2; Bader 1940) are more oval in shape. These show a similar geometric decoration, but a different attachment configuration with many more holes. The differences between all these plates, and their function remains elusive without further study into use-wear and production traces.

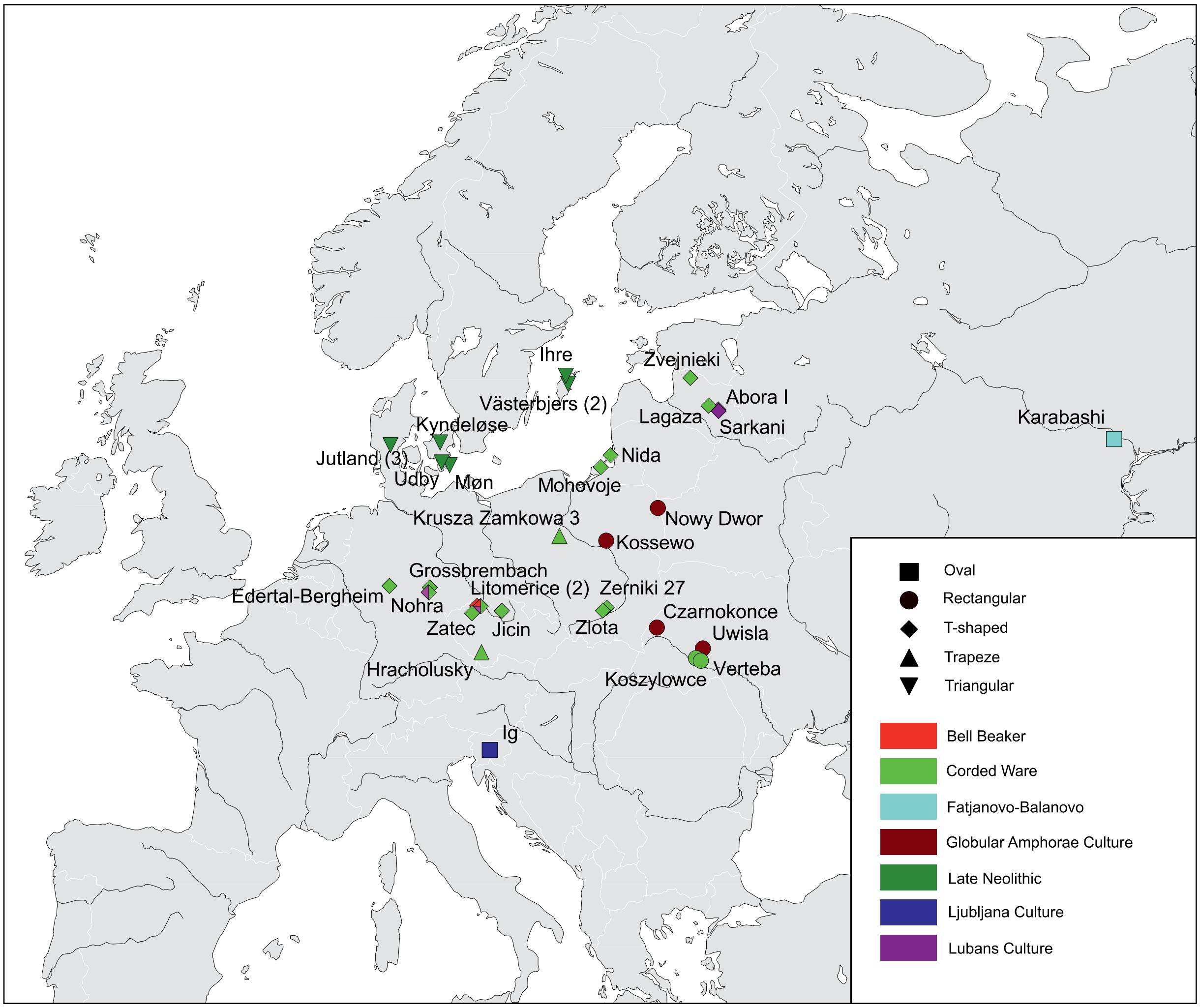


Fig. 6.22 The distribution of bone plates across Europe (geometric zigzag, geometric lines, undecorated and notched).

Radiocarbon dates are known from 7 sites, 5 of these are Corded Ware burials (Krusza Zamkowa 3, Zvejnieki 186, Zerniki 27, Nohra 6 and Ząbie grave 398), a single Lubans settlement (Lagaza) and one burial that could be Corded Ware or Globular Amphorae (Grossbrembach). A quick glance at the spread of dates shows that these bone/antler plates have a long tradition, traceable back to the earliest Corded Ware and Globular Amphorae graves, and continuing into the local Early Bronze Age of Latvia (see table 6.5). Based on associated artefacts we can also include a Bell Beaker example into this list from Sulejovice (Litoměřice, Czech Republic; Schwarz 2014, Abb 24:5; 6; Pleiner/Rybová 1978, 305-306, Fig. 84; Muscha 1958:1).

This signifies another example of continued funerary practices between Corded Ware and Bell Beaker communities, and possible shared cosmologies related to how to dress and equip the ancestors. These shared cosmologies extend from western Ukraine and the Baltic to Central Germany with respect to the bone plates and even further across the North Sea when we also consider the bone hourglass pendants. Further analysis of use-wear and placement within the grave (*cf.* Fokkens *et al.* 2008) can help understand the function of these objects, the specific practices involved in their presentation and developments through time and space.

Concluding, in these two examples we have seen how the ideas and practices associated with particular objects can be exchanged through time and space between different cultural phenomena, stretching for several hundreds of years and within a very particular funerary context. Can we see a similar mechanism of exchange of

Toponym	Association	Context	Lab code	BP	Sigma	δ13C	Sample
Grossbrembach	Corded Ware or Globular Amphorae?	grave	KI-4147	3920	50		bone collagen
Krusza Zamkowa site 3	Corded Ware	grave	Bln-1812	4395	70		bone collagen
Lagaza	Lubans	settle-ment	TA-749	3685	70		wood
			TA-396	3640	70		wood
			TA-382	3640	70		wood
			TA-868	3240	70		wood
Nohra burial VI	Corded Ware	grave	KIA-32304	4135	28		bone collagen
Zerniki site 27	Corded Ware	grave	Ki-6331	4170	40		bone collagen
			Ki-6330	4120	45		bone collagen
Zvejnieki burial 186	Corded Ware	grave	UA-15545	4190	60	-21	bone collagen
Ząbie grave 398	Corded Ware	grave	OxA-X-2417-15	4187	31	-22.5	antler

Table 6.5 Findspots of plates, with associated radiocarbon dates.

ideas taking place when looking at objects that are only characteristic within the Bell Beaker phenomenon?

6.3.2.3 Palmela points

Of the various objects that are characteristic of the Bell Beaker phenomenon, Palmela points are among the most widespread in West Europe. Palmela points are typical leaf-shaped copper or bronze objects (see fig. 6.23). The shape of the Palmela point was first typologically characterised by Delibes de Castro (1977, 109-111). Delibes de Castro's type A shows an oval concave blade, A1 with a normal length tang, A2 with a long tang, A3 with a short tang. Type B shows an oval convex blade, with the tang being long for B1 and short in B2. The blade of Type C is best described as diamond or rhomboidal shaped. Later Garrido Pena studied the different shapes (2000, 172-179) for the Spanish Central Meseta region by means of a cluster analysis on metric data. His cluster analysis does not indicate any spatial preferences.

An inventory was made of all the copper and bronze Palmela points found on Bell Beaker and Early Bronze Age settlements in the Iberian Peninsula and beyond (see figure 6.24 and appendix F). In total 231 sites have yielded 342 Palmela points. The majority of Palmela points are found in Spain, France and Portugal, but also points have been found as far as Morocco and Algeria in Northern Africa and Luxemburg in Northwest Europe. Out of these 231 sites, most points are recorded as loose finds whereas the Palmela points from graves, megaliths, caves and settlements constitute a minority. Indisputable depots of Palmela points are even more scarce.

An analysis of the number of Palmela points per site shows several concentrations. Firstly, a concentration is situated in the Portuguese Estremadura region, where Palmela points have been found on enclosed settlements, in caves and in megalithic monuments. Another concentration of Palmela points is found in the north of Portugal and Northwest of Spain, where they are found in graves, settlements and as loose finds. A third concentration is found in the Central Meseta of Spain. Here a lot of loose finds of Palmela points are known, and additionally several points were obtained from graves and megaliths. Outside of the Iberian Peninsula a first concentration can be spotted in the Garonne estuary in Western Central France,

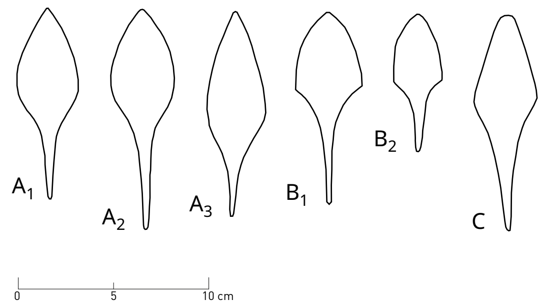


Fig. 6.23 Typology of Palmela points (after Delibes de Castro 1977).

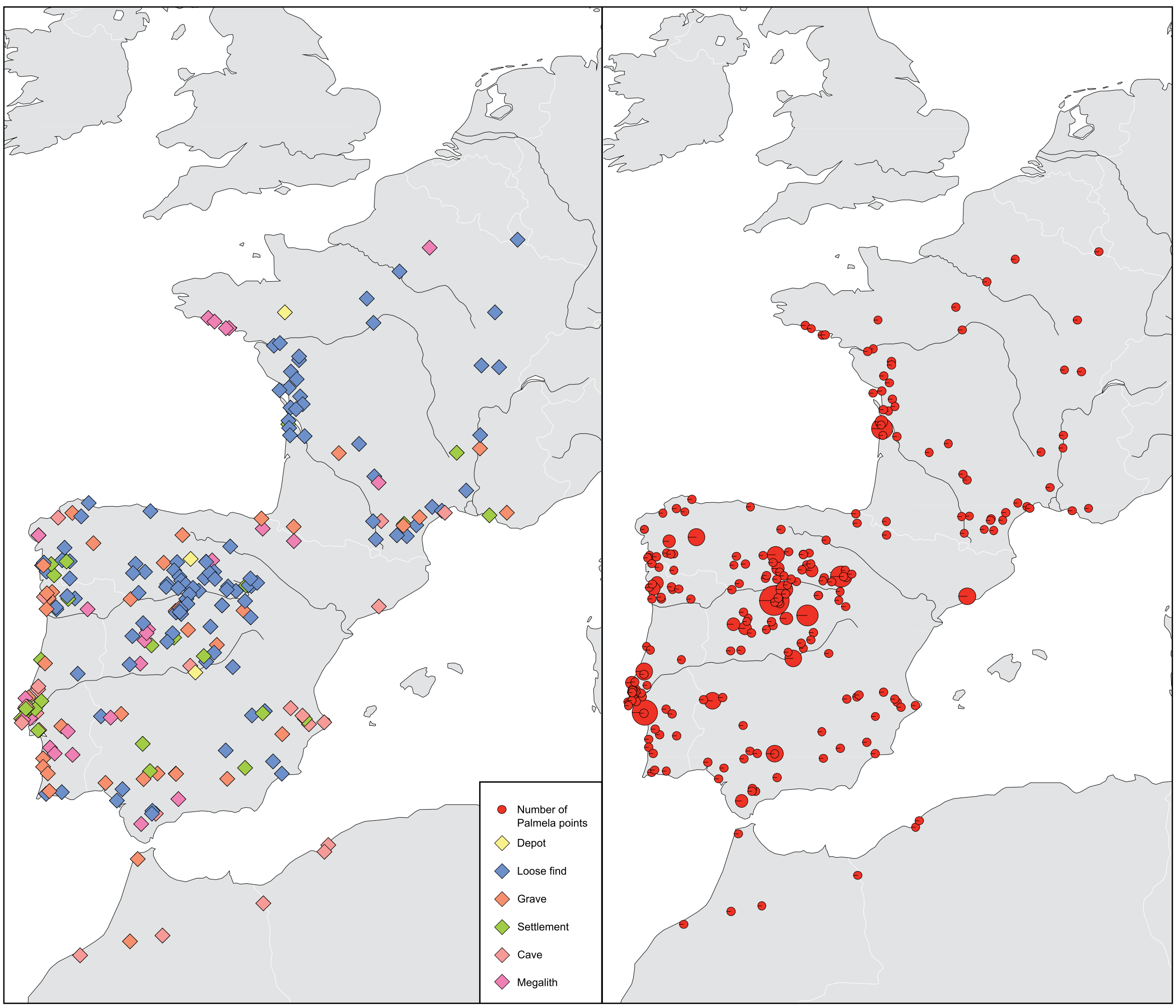


Fig. 6.24 The distribution of Palmela points: contexts and number of points per site.

mainly consisting of loose finds and a single settlement find. Finally, a small but notable concentration of Palmela points in terms of context comes from several megaliths in the Morbihan region of Brittany in France.

Radiocarbon dates for contexts associated with Palmela points are rare (see table 6.6). The grave of Perro-Alto (Fuente Olmedo, Valladolid, Spain; Martin Valls/Delibes de Castro 1974, 62-72, 1989, 80-81) gave two ^{14}C dates on human bone associated with, amongst others, a Palmela point. Two dates are known from level IIC of the settlement of Cerro de la Virgen (Orce, Granada, Andalucía, Spain; Delibes de Castro/Fernández-Miranda 1981b, 157, Almagro Gorbea 1970, 20; Müller/van Willigen 2001, 62, fig. 3) in which a Palmela point was found. The settlement of La

Toponym	Context	Phase	Lab code	BP	Sigma	Material
Perro Alto	Grave		CSIC-483	3620	50	human bone
			OxA-2907	3730	65	human bone
Cerro de la Virgen level IIC	Settlement		GrN-5764	3800	35	charred plant remains
			GrN-5598	3833	35	charcoal
Lède du Gurp	Settlement	Bell Beaker	Ly-7967	3990	50	unknown
			Ly-7966	3995	45	unknown
			Ly-7965	4080	45	unknown
		Bronze Ancien	Beta-118449	3800	70	unknown
Zambujal phase 5	Settlement		KN-4506	3847	34	charcoal
			KN-4507	3466	53	charcoal
Los Husos I level IIC (Palmela from IIB3)	Cave		I-3985	3920	100	bone

Table 6.6 Findspots of Palmela points, with associated radiocarbon dates.

Lède du Gurp (Grayan-et-l'Hôpital, Gironde, France; Roussot-Larroque 2002) yielded a Palmela point, either from the Bell Beaker or the Early Bronze Age layer of occupation. From the settlement of Zambujal, a single Palmela point is associated with phase 5, the latest phase of habitation on the settlement, and three more Palmela points were found in disturbed contexts or as loose finds nearby (Torres Vedras, Portugal, Sangmeister/De La Cruz Jiménez Gómez 1995, 6-8). The cave of Los Husos yielded a Palmela point in layer IIB3, while a ^{14}C date from layer IIC predating the Palmela point, is known (Alava, Euskadi; Delibes de Castro/Fernández-Miranda 1981a; Polo Díaz/Fernández Eraso 2010, table 1).

Interpreting the distribution and spread of Palmela points in terms of an exchange of ideas is more difficult. Early overviews have focused on the distribution of the Bell Beaker phenomenon on the Iberian Peninsula (*e.g.* Harrison 1977, 40, fig. 24; Harrison/Gilman 1977), and see it as an innovative Bell Beaker specific object. The distribution across the Iberian Peninsula and beyond is however not explained, apart from a possible role in maritime exchanges with Northern Africa. This exchange might also be in relation to the presence of ivory in the Iberian Peninsula (Harrison/Gilman 1977; Schuhmacher 2017).

The absence of an overview of metal composition analyses complicates finding a possible 'origin' of this object. Also the chronological resolution at the moment is not fine grained enough to be able to differentiate temporally. In total, the radiocarbon dates confirm earlier hypotheses about the date of Palmela points, as a relatively late artefact within the Bell Beaker phenomenon, occasionally even found in Early Bronze Age (El Argar) contexts, mainly after 2200 BC. ^{14}C dates from the settlement of La Lède du Gurp, with its problematically associated Palmela point, and from the cave of Los Husos I level IIB3 as a *terminus post quem*, are the oldest absolute dates. A summed calibration shows a peak between 2300-2200 cal BC (see figure 6.25). This ties in with earlier ideas about chronology of Palmela points (Schuhmacher 2014, 45), but more research, predominantly into site stratigraphy and chronological modelling of radiocarbon dates, is needed.

Additionally, the many different, in some cases regionally specific, contexts in which Palmela points have been found also clouds their use in either funerary or domestic contexts. The mere presence of Palmela points might have been enough

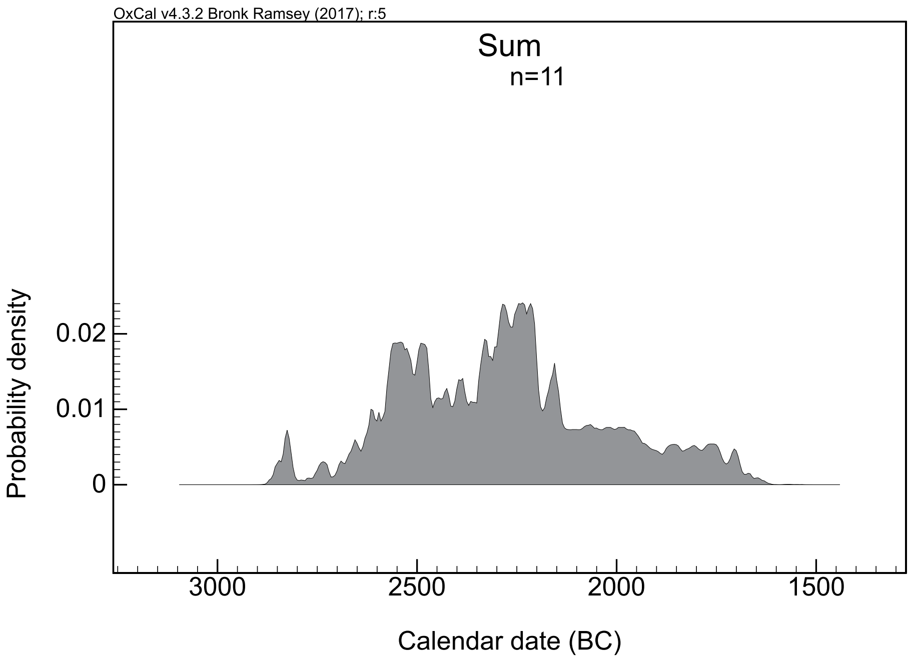


Fig. 6.25 Summed calibration of radiocarbon dates associated with Palmela points.

of a symbol to be associated with, without a single overarching, strict or normative notion of what to use it for (In funerary practices? As arrowhead?). Solid evidence for use of Palmela points is scarce. In many cases only the copper or bronze point itself is preserved. As an exception, the Palmela point from Camino de las Yeseras was attached to some sort of shaft of Juniper wood (Ruiz *et al.* 2012). Additionally, early experiments done by Gutiérrez Sáez *et al.* (2011, 2014; see also Gutiérrez Saez/Martín Lerma 2015) confirm that some Palmela points might have been used as arrowheads, spearheads or javelin heads. But also in this respect, more work is needed.

In conclusion it seems that Palmela points were used and deposited in locally and regionally defined practices (such as the concentration of Palmela points in Morbihan megalithic monuments), while at the same time it appears that the shape conforms to certain shared and exchanged ideas about 'what a copper point should look like', irrespective of where on the Iberian Peninsula or beyond, one finds this Palmela point. When considering the distribution of Palmela points in France, it is remarkable to note that this particular element of an "Iberian interaction sphere" overlaps with the Northwest European interaction sphere of producing Common Ware pottery in characteristic S-shaped vessels, with holes beneath the rim and cordons (see paragraph 7.2). Apparently, in France these interaction spheres are not mutually exclusive.

6.3.3 Mobility of people

6.3.3.1 Introduction

The mobility of people has been an important mechanism in several studies explaining the diffusion of the Bell Beaker phenomenon, as we have already described in chapter 1. This development started from late 19th and early 20th century recognition and the construction of the "Bell Beaker culture" as a separate entity. From this period onwards, scholars began forming ideas and hypotheses about the origin and subsequent spread of the Bell Beaker culture across Europe. The most recent examples of this 'migration and invasion thinking' are found in literature using isotopic, palaeogenetic and epi-genetic datasets.

In the following parts of this chapter the revival of this 'migration interpretation' is critically assessed by looking at the different datasets. This assessment is not an exhaustive list of all papers, as new research is generated at an ever-increasing pace (see for an overview also Furholt 2017). Selected results from consequently ancient DNA, isotopic and epigenetic analyses are presented. After this, the ways in which migration is perceived within these studies is reviewed. Concluding this review, new ways of understanding migrations are presented, focusing on the more general and relative concept of mobility. This concept is generally used in other fields of science from natural physics, biology and anthropology to finally archaeology.

6.3.3.2 Ancient DNA analysis

Several ancient DNA (aDNA) studies exist at the moment dealing specifically with the Bell Beaker phenomenon. These studies are cumulative and also take earlier datasets into their analyses and new models (see figure 6.27). Many other aDNA studies focus on earlier Neolithic and later Bronze Age samples, but these works also have a profound influence on interpretations related to late 3rd millennium BC population genetics. The earliest work focused on Central German Late Neolithic samples and the evidence from both mitochondrial and Y-chromosome aDNA (Brandt *et al.* 2014; Haak *et al.* 2008; Lee *et al.* 2014). Additional Late Neolithic samples of mitochondrial aDNA have been analysed from Denmark (Melchior *et al.* 2010). Most recently, Olalde *et al.* (2018) present a new analysis of many aDNA samples associated with the Bell Beaker phenomenon from a Europe-wide survey.

The result of this cumulative research effort is that earlier hypotheses based on a small dataset are tested immediately when new data is being added. And new data is continuously being added to this corpus of ancient genomes from Europe. However, this also leads to a continuous focus on 'more data' instead of a critical perspective of data interpretation, sometimes neglecting the underlying premises and the flaws in the theoretical underpinnings behind these studies (see also for instance the replies of Haak (2018) and Fermández Dominquez (2018) to Furholt's (2018) critique). Therefore, here I return to some of these early examples, not in an effort to demonstrate that their dataset is wrong or incomplete, but that their basic premisses might contain more systemic flaws. Yes, more data leads to a more nuanced picture, but does it also lead to a better understanding of prehistoric mobility?

Brandt *et al.* (2014) present an overview of the aDNA dataset at that time from mtDNA and Y-chromosomal DNA. Individuals associated with the Corded Ware phenomenon, preceding the Bell Beaker phenomenon in Central Germany, are characterised by mtDNA haplogroups I, U2, T1, U4 and U5a. Bell Beaker individuals on the other hand show a dominant genetic signature of haplogroup H (48.3%). This specific haplogroup is only recorded in Mesolithic and Neolithic populations in the Iberian Peninsula. More importantly, 20% of the Bell Beaker *maternal* lineages in Central Germany matches those of the preceding Corded Ware. Brandt *et al.* (2014) interpret this 20% as an admixture of individuals within the local population. As mtDNA is passed on through the maternal lineage, this, according to Brandt *et al.* (2014) means that a migration of men to Central Germany must have taken place. These men, Brandt *et al.* (2014) argue, have maternal ancestry in Iberia. Unclear is how many generations this maternal ancestry would go back, or how frequent haplogroup H could have possibly been outside the Iberian Peninsula. Y chromosomal (paternal) evidence is found mainly of haplogroup R1b, present in several Central European Bell Beaker individuals (also by Lee *et al.* 2014). Brandt *et al.* (2014) also associate this haplogroup with the Iberian Peninsula, referring to work on the recent distribution of R1b haplotypes in Europe by Myres *et al.* (2011). This evidence further strengthens the authors' argument of male migrations from Iberia. In conclusion, Brandt *et al.* (2014, 14) state that: "…the migration event associated with the

Bell Beaker culture (event D) was potentially driven by male diffusion followed by admixture with residential Corded Ware communities, which finally resulted in the formation of the Únětice culture…". Brandt *et al.* (2014) state that, based on the R1b haplotype, an Iberian origin can be posed likely for Central European Bell Beaker male individuals. This echoes well with the archaeological model for the Iberian hypothesis as forwarded in the *Rückstrom* model (Sangmeister 1963) or the Iberian model (Harrison 1977; Müller/van Willigen 2001).

However, with regard to the point of origin of the Y chromosome R1b haplotype, Brandt *et al.* (2014) completely rely on the maps of Myres *et al.* (2011). This study presents us with the modern day frequencies of Y-chromosome in Europe, among which are different variants of the R1b haplotype. This particular haplotype is concentrated around Southern France and Iberia. To me, this means that the modern day population in these regions share a common ancestor with Bell Beaker people in Central Germany. This certainly does not mean that Central German Bell Beaker populations had any ancestry in the prehistoric Iberian Peninsula. It might have even more easily been the other way round, and some individuals in Iberia being the only ones still having Bell Beaker ancestry in their R1b haplotypes! So in order to argue for the movement of people, it is not a valid argument to refer only to a recent distribution of haplotypes as the "place of origin".

More recently, Haak *et al.* (2015) executed a genome-wide study from many individuals in Central Germany among which were several associated with Bell Beaker material culture. This study focused on the relationships with the eastern European Yamnaya and Corded Ware cultures. They found the Y-chromosomal haplogroup of R1b in Mesolithic Spain, Mesolithic, Neolithic and Early Bronze Age Russia and Early Bronze Age Central Europe. In Central Europe 60% of the Late Neolithic/Early Bronze Age burials could be ascribed to this haplogroup, while in the Russian Neolithic and Bronze Age this was 100%. From this they suggest that this haplogroup spreads into Europe from the East after 3000 BC (*contra* Brandt *et al.* 2014), associated with the Yamnaya and Corded Ware phenomena, replacing ca. 75% of the existing European Y-chromosome ancestry, and a small degree of admixture with local Neolithic populations. The contribution of this migration in the Bell Beaker phase decreased due to more admixture with local populations. Haak *et al.* (2015) furthermore assign this later migration to the arrival of Indo-European languages. A complementary study is the work of Allentoft *et al.* (2015). This study presents new analyses focusing on complete genome aDNA of the Bronze Age of Central and Eastern Europe. They argue that the Late Neolithic Central European individuals show a genetic similarity to earlier Yamnaya individuals: "steppe ancestry". A similarity which is highest in Corded Ware individuals (as argued by Haak *et al.* 2015) and lowest in Hungarian Late Neolithic individuals (indicating high levels of admixture with 'native' populations) and intermediate in Central German Bell Beaker samples.

The most recent work by Olalde *et al.* (2018) carries out Y-chromosome analysis on a genome wide dataset. Importantly, this work focuses specifically on understanding the Bell Beaker phenomenon from a genetic perspective. They present the aDNA genome of 226 individuals associated with material culture commonly ascribed to the Bell Beaker phenomenon, from all over Europe. Their analysis shows several interesting things. Firstly, "steppe ancestry" (the haplogroup R1b-M269 is "… commonly associated with the arrival of steppe migrants in central Europe after 3000 BC…" (Olalde *et al.* 2018, 190)) is nearly absent from Bell Beaker individuals from the Iberian Peninsula, and almost omnipresent in the rest of Europe. Migration of males from the Iberian Peninsula did therefore not took place and did not cause the spread of the Bell Beaker phenomenon across Europe.

Secondly, there exist large genetic differences between pre-Bell Beaker and Bell Beaker (with steppe-ancestry) individuals in Britain. This difference between

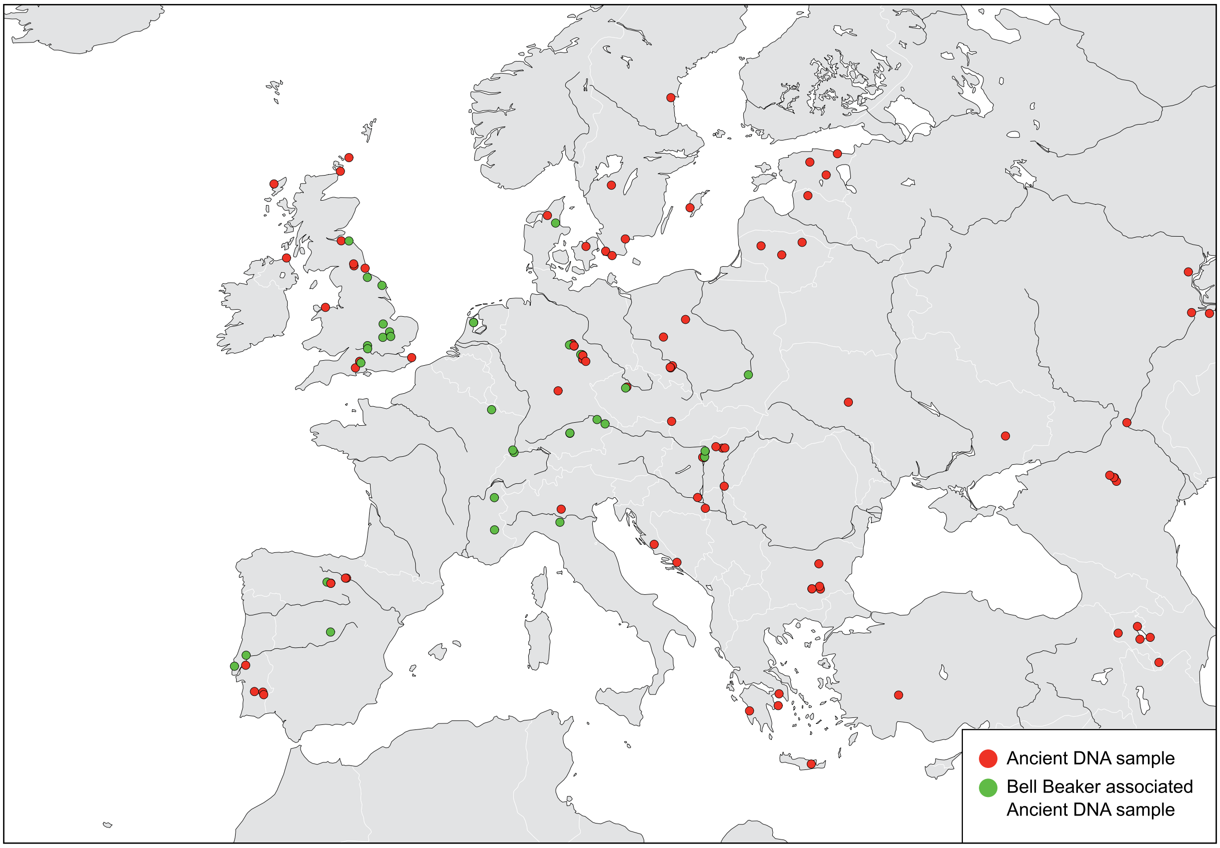


Fig. 6.26 All the aDNA samples and Bell Beaker associated aDNA samples across Europe, situation January 2018 (based on data in https://umap.openstreetmap.fr/en/map/ancient-human-dna_41837).

pre-Bell Beaker and Bell Beaker genetic composition is not present in Continental Europe. It is argued by Olalde *et al.* (2018) that this represents a nearly complete 'genetic turnover' of ancestry in Britain with the introduction of the Bell Beaker phenomenon, around 2450 BC.

Another recent study by Szécsényi-Nagy *et al.* (2017) presents an overview of the Neolithic and Early Bronze Age mitochondrial DNA on the Iberian Peninsula, looking at the female ancestral lineages. Their work confirms this hypothesis by showing a pattern of continuity and almost no migration from Central Europe in the genetic composition of Iberian populations during the Late Chalcolithic and Early Bronze Age. "The expansion of groups from the eastern steppe which profoundly impacted Late Neolithic and EBA groups of Central and North Europe, cannot (yet) be seen in the contemporaneous population substrate of the Iberian Peninsula at the present level of genetic resolution…" (Szécsényi-Nagy *et al.* 2017, 9).

These studies, Haak *et al.* (2015), Allentoft *et al.* (2015), Szécsényi-Nagy *et al.* (2017), Olalde *et al.* (2018) use Principal Component Analysis and Clustering Analysis following specific algorithms (so-called ADMIXTURE (Alexander *et al.* 2009)) to find the genetic relationships between groups that are genetically more similar than others.

However, there are several assumptions that go unmentioned in all these papers. First of all, it is not discussed how these cultural groups are assigned. When does a buried individual become a "Bell Beaker" or "Corded Ware" or "Yamnaya" individual? For example, a mayor role is given in Olalde *et al.* (2018) to the Oostwoud cluster of individuals from the Netherlands (Fokkens *et al.* 2017). However, none of the Oostwoud Bell Beaker burials have any grave goods that associates them specifically with the Bell Beaker phenomenon (apart from the layer of ploughsoil that contained Bell Beaker material culture, see paragraph 7.3.3.3 for an analysis of the Oostwoud pottery assemblage), and their interment is separated by more than 600 years. Does the ADMIXTURE model allow for large temporal differences between individual samples? And can we still say that all these individuals belong to the same genetic and cultural group as other 'classic' Bell Beaker burials? This also further questions the validity of archaeological categories such as 'Bell Beaker' in terms of categorising human individuals associated with a certain type of material culture. A large body of research exists, focusing on the "people behind the pots", and more specifically issues of identity formation (*e.g.* Shennan 1989), the not unproblematic or unambiguous nature of funerary contexts (*e.g.* Parker Pearson 1999) and social aspects of technology (*e.g.* Lemonnier 1993).[17]

Secondly, we should consider the relativity of the dataset. Instead of accepting the large scale 'migration' and 'population movement' we should ask ourselves how many people do actually need to move before this observed pattern is reproduced? Could perhaps one highly mobile individual account for this genetic ancestry?

A third point, specifically to the British case of a genetic turnover, it is notable that the pre-Bell Beaker sample population against which the Bell Beaker samples were placed, are all Early Neolithic individuals found in earthen long barrows. These individuals lived up to 1450 years before the Bell Beaker phenomenon reached the British Isles. This 'genetic turnover' could thus have happened anytime within, or slowly during, the 1500 year timeperiod between 3800 and 2450 BC.

A further statement relates to the sample size in the present-day models of population genetics. Calculations, using a wide variety of sources and methods, show an absolute population size in Central Europe and Southern Scandinavia of around 3 million inhabitants (Müller 2013, 10, fig. 10). Other calculations show that for some Early and Middle Bronze Age cemeteries in the Southern and Eastern Netherlands, only 13-16% of the population was buried within these cemeteries (Theunissen 1993, 40; Lohof 1991, 225), with probably even lower numbers for the Late Neolithic, as from these areas Late Neolithic barrows are scarce in comparison to Early and Middle Bronze Age barrows. Additionally, Bourgeois (2013, 178) calculates that in the Central Netherlands, where Late Neolithic barrows are more frequent, an interval of barrow construction between 8 and 12 years can be assumed. Of course these different numbers are difficult to compare with each other and similarly difficult to extrapolate to other areas of Europe, because of different barrow densities and because formation processes generally underrepresent the numbers (because of unexcavated barrows and burials without barrow). Despite these sketchy calculations, the relativity remains the same: Out of all of these 3 million people around 2500 BC in Central Europe, several tens of thousands of specific individuals get selected for burial as an idealised ancestor (*cf.* Fokkens 2005, 2012a). Ancient DNA analysis has now been carried out on 226 of these individuals.

Finally, as said before, the Corded Ware and Bell Beaker burials we see can be best interpreted as deceased individuals chosen to represent a shared ideal (*cf.* Fokkens 1999, 2005, 2012a). These individuals are dressed in specific ways of internationality, a specific fashion recognisable to all in the Bell Beaker network. Also, the body was placed in a specific position and orientation, related to gender and identity. These rules were shared across large distances across the European Continent, and governed a large part of the burial ritual. It is likely that, not only the objects, garments and practises reflect this internationality, but this internationality is also mirrored in the deceased individual that was selected for this ritual. Perhaps even a person with a particular *ancestry* was chosen to undergo this specific ritual, for primarily this reason. This practice, the creation of an 'international ancestor', where both object and subject share each other's qualities, would then pose a

---

17 This is not only the question of archaeology dealing with population genetics. As Marks (2017) illustrates it is the biological practice of classifying humans, whereas much more is revealed through the study of their humanity (and thus through a contextual archaeology of prehistoric burials in which genetics and ancestry play their part).

cultural bias when dealing with sampling these burials for ancient DNA. In effect, it would lead to many individuals having this “steppe ancestry” haplotype.

6.3.3.3 Isotope analysis

Another scientific method for studying human mobility is the use of strontium and oxygen isotopes. These methods developed in the late 1990s and have, at the moment, been applied to several regional case studies associated with the Bell Beaker phenomenon. With regard to the element of strontium (Sr), the ratio between the specific isotopes of $_{86}$Sr and $_{87}$Sr is dependent on geology and soil chemistry, taken up by humans through food consumption. The element of oxygen (O) is usually measured as the ratio between $_{18}$O and $_{16}$O and noted as δ_{18}O. This ratio is dependent on the local water chemistry, taken up through consumption. In short “you are what you eat and drink” (Evans *et al.* 2012, 754). The measured values in humans is generally compared against a local signal found in soil samples or contemporaneous animals which are most definitely local such as rodents, in the case of strontium. For finding non-local individuals by means of oxygen isotopes, the measured values are converted from $\delta_{18}O_p$ to $\delta_{18}O_w$ using a standard equation (reviewed by Pollard *et al.* 2011), and then compared against values for modern day drinking water. Sources influencing δ_{18}O values, involve the choice of teeth sample, the modification of water by (for instance) cooking, and climatic fluctuations (Evans *et al.* 2012).

Several studies exist of strontium isotope analysis on Bell Beaker individuals. The pioneering studies on Central European burials by Grupe *et al.* (1997, 1999, 2001) and Price *et al.* (1994, 1998, 2004), a study by Chiaradia *et al.* (2003) on burials from Switzerland, another Central European study by Winterholler (2004), studies on human remains found close to Stonehenge in Britain (Evans *et al.* 2006, Chenerey/Evans in Fitzpatrick 2013), and the large scale “Beaker People Project” (Parker Pearson *et al.* 2016) are the best known examples to which we will refer here. The last two studies are also the primary examples for the use of oxygen isotopes on Bell Beaker burials.

For Central Europe, Price *et al.* (2004) summarizes the results from different research areas. Their project used strontium isotopes on 82 Bell Beaker burials from Bavaria, Hungary, Austria and the Czech Republic. When comparing the local geological signal of strontium with the ratio found in these individuals it is possible to assess mobility. Of these 82 burials, 51 could be considered having a non-local strontium signature (62.2%; *sic* Price *et al.* 2004, 30). Another method, by comparing bone and tooth variability within a single individual, gives 17 out of 71 individuals or 23.9%, as non-local (for 10 individuals there were no measurements on both bone and teeth remains). These migrants were both men and women of different age classes. It was impossible to trace the origins of these different migrants, due to the complex local geology of Central Europe. Winterholler (2004) did a comparative study on the analyses of Price *et al.* (2004), using a different laboratory and somewhat different methods, and she comes to similar conclusions.

Human remains from the megalithic cemetery of Sion, dating to the Late Neolithic and Early Bronze Age, were studied by Chiaradia *et al.* (2003). Only four Bell Beaker individuals were sampled for strontium isotopes, of which at least one, so 25%, had values of non-local, but unknown, origin. This one individual is a 35-45 year old male.

In Britain, a strontium and oxygen isotope study (Chenerey/Evans in Fitzpatrick 2013) was carried out on the human remains known as the Amesbury Archer and the Boscombe Bowmen, and several other Bell Beaker burials from Normanton Down and the Stonehenge area in Wiltshire, Britain. In total 12 individuals were analysed. According to their study, 7 out of 12 have probably migrated from areas across Britain or beyond. Following this first successful example, the Beaker People Project looked at (amongst others) the oxygen and strontium isotope values of 264 Bell Beaker individuals from Britain (Parker Pearson *et al.* 2016). Preliminary results show widespread and continued local and regional mobility patterns of individuals between their childhood and death, from various regions across Britain. The percentage of non-local individuals, comparing between tooth and environmental variability within a single individual, is consistent around 41% (including data concerning non-local signals from other isotopes) throughout the later 3rd millennium BC in Britain. Most non-local individuals have values consistent with a childhood somewhere in Britain, and only the Amesbury Archer and a man from Bee Low in the Peak District, have oxygen values so low that they might have both come from various places on the European Continent (2 out of 264 is 0.7% of the total; Parker Pearson *et al.* 2016, 631). The majority of the mobile individuals moved between Wessex, the Peak District, Scotland and Wales. These mobility patterns are, according to Parker Pearson *et al.* (2016, 632-634) not related to exogamous exchange of female marriage partners, but related to specific mobile subsistence strategies such as herding and the gathering of communities. Also, a large scale migration or invasion of people from the Continent cannot explain this mobility.

Several things must be noted with regard to the study of isotopes and human mobility. While the aDNA evidence is an inferred mobility, based on shared common ancestry between individuals through time and space, isotopic evidence shows the difference between certain values related to particular moments in an individual's life, as local or non-local relative to the burial locale. Isotopic evidence therefore is not devoid of further interpretation, before we can say that mobility took place. Often assumed is, for instance, that the place of burial of an individual is also the place of death. Next to that, individuals assigned as local might actually have moved from further away than non-local individuals.

Thirdly, how individual movement fits within the larger picture is lost unless a large dataset is collected. Now we know that the Amesbury Archer was an exception among Bell Beaker burials in the British Isles. Also, as Jay *et al.* (2012) shows and Parker Pearson *et al.* (2016) argues for Chalcolithic Britain, non-local isotopic signals could also be explained by small scale mobility related to subsistence strategies (nomadism or pastoralism) instead of a migration event.

Over the past years several studies have appeared interpreting the isotopic evidence in relation to the Bell Beaker phenomenon (Vander Linden 2007; Harrison/Heyd 2007; Fokkens 2012b; Needham 2007). These papers have been trying to find models that relate patterns in archaeology to this new type of evidence. The exogamous female exchange of marriage partners, connected to the dispersion of pottery production (Vander Linden 2007), has been most influential. Contrastingly, the exchange of objects and the sharing of ideas about idealised ancestors (Fokkens 1999, 2012a, 30-31) presents a more radical alternative, shifting away from mobility as exceptional towards a type of mobility more based on communication networks.

Thus, this begs the question, should we then talk about "migration events" (*cf.* Brandt *et al.* 2014) at all? Or are there also other ways of understanding human mobility, better ways that connect both the direct isotopic data of local and non-local individuals, with the genetic data of shared ancestry between populations?

6.3.3.4 Migration interpretations: towards a mobility perspective

An important resolution to these questions can be to study mobility instead of migration. In aDNA studies the difference between these two concepts is not mentioned at all.

In my view, migration is defined as *the movement of an individual or a group from one place to another with a single direction and finality*. Human mobility, on the other hand, is a more general concept and defined as *everyone moving through a space* (such as residential mobility, subsistence mobility, labour mobility) and either

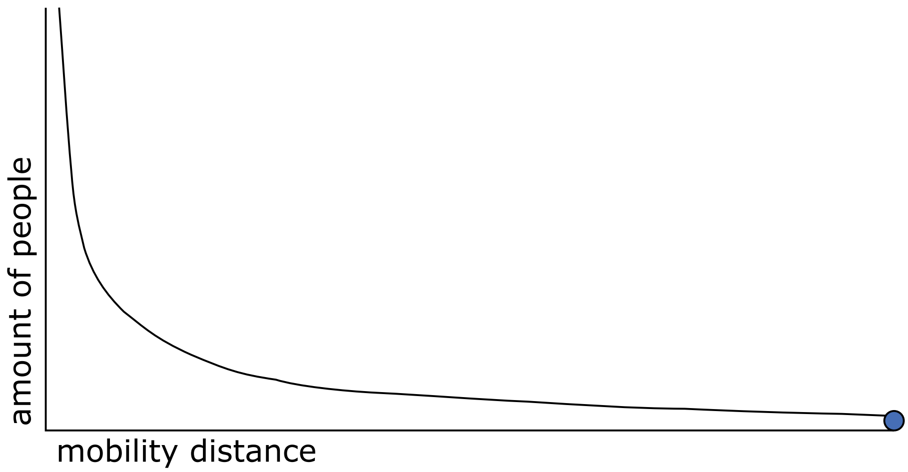


Fig. 6.27 Schematic representation of a Lévy-flight distributed mobility pattern (blue dot = the long-tailed distribution where a highly mobile individual is situated).

unidirectional or multidirectional. As such migration forms a very specific branch of mobility, where a large group of people move to a certain place. Brandt *et al.* (2014) talks about migration as an *event*.

In isotopic studies and in archaeology, the term mobility is being used when scholars discuss concepts such as residential mobility or the practices of nomadism or pastoralism (Wendrich/Barnard 2008; see also Égüez *et al.* 2018), but also in combination with analogies to ethnographic, anthropological or mythical examples of mobility, such as "Odysseus" or the "Stranger King". I think it is necessary to put all these practices into perspective and define them more rigorously. By doing so, we can shift our focus towards the comparative and relative study of mobility. Archaeology and anthropology are not the only disciplines who study this concept. Biology and physics have in the past been busy describing patterns of mobility on a very general level. The way these research communities address mobility can be important if we are to find new ways to understand and refine our models for understanding human mobility in prehistory and their impact as a mechanism for cultural changes such as the Bell Beaker phenomenon.

It was Einstein who first mathematically proved the existence of atoms and was able to describe the behaviour and mobility of atoms within a liquid as a normal distribution, coining the term "Brownian motion" (Einstein 1905). This "Brownian motion" concept was later tested by biologists in their analysis and description of the movement of albatrosses, bumblebees, deer and sharks (*e.g.* Viswanathan *et al.* 1996, 1999). Their studies made it clear that in normal situations these animals follow a pattern of Brownian motion of short step lengths with a normal distribution. However, when they are searching for new food sources in times of shortage, the model of Brownian motion does not apply. Instead, a so-called Lévy-flight model describes this subsistence based mobility. In this specific model the step lengths are defined by a power-law degree of very seldom extremely long distance mobility (a so-called 'long-tailed distribution' (see figure 6.26)), coinciding with large degrees of regular, normally distributed, Brownian motion. More recent re-analysis however, disproves the Levy-flight pattern for some animals, as it happened to be an artefact of the recording method in these cases (Edwards *et al.* 2007; Barabasi 2011, 171-180). Sims *et al.* (2008) however do see Levy-flight patterns when analysing marine predators. The method of identifying certain behaviour as a Levy-flight needs to be statistically robust.

In a recent study, this robust Lévy-flight/Brownian movement combination is also found for human mobility by two examples using recent mobile phone data and historic letters (Gonzalez *et al.* 2008, Barabasi 2011). Gonzalez *et al.* (2008, 780) write, based on an analysis of recent GPS data from anonymised mobile phones: "…the travel patterns of individual users may be approximated by a Lévy flight…" and Barabasi (2011, 177) similarly explains: "…This highly localized majority coexists with some people who move dozens of miles each day and a few individuals who travel more than hundreds of miles…”. More popularly, Barabasi coins the term “itchy feet”, when he discusses this pattern they observed. Apparently some people just don’t follow the normal distribution when it comes to mobility. Interestingly, several ethnographic studies, looking into mobility patterns for the Dobe Ju/’hoansi (Brown *et al.* 2007) and the Hadza (Raichlen *et al.* 2014) hunter-gatherer communities in sub-Saharan Africa, have also been described as this combination of a Levy-flight/Brownian movement. Whether these two studies stand the scrutiny of statistical robustness is unclear, but it would provide some clarity as to interpret the mobility seen in, for instance the Amesbury Archer. Can we see the Amesbury Archer, the outlier within the Bell Beaker mobility pattern for the British Isles, as someone with itchy feet? Someone who was one of the few people to have travelled from the Continent to Britain during this time, spreading word and practice of the Bell Beaker innovations. These innovations and ideas only got accepted because of the “Strength of Weak ties” principle: he did not form part of the existing clique.

A recent overview of mobility from a mathematical perspective shows that various models can be used to describe the gathered data. Brownian movements and Lévy-flight patterns are particular models to describe movement of individuals within nature, but not necessarily the only models applicable to archaeological data (Barbosa-Filho *et al.* 2017, 38-62).

All-in-all, these mathematical models do not provide an answer, but they do lead to new questions: could there be a different way of mathematically describing past human mobility? Can we model the data generated by genetic and isotopic research in such a way that does justice to the animal mobility models that biologists and physicists use? In this way it will be possible to combine the residential mobility or subsistence based mobility with individuals (and perceived outliers) such as the Amesbury Archer?

At the same time, such a model would fit with anthropological studies focusing on the values ascribed to objects and people from ‘far away’ places. Studies such as Helms (1988) focus on the value of foreign objects. This interpretation has seen some application in archaeology (*e.g.* Fontijn 2009), and has also been used to describe the Amesbury Archer before (Fitzpatrick 2009). Other related anthropological models are those of the ‘stranger-king’ and the ‘guru’. Prescott (2012) uses these models to illustrate the role of particular individuals in spreading knowledge towards the northern fringes of the Bell Beaker phenomenon.[18]

6.4 Conclusion

In this chapter we have focused our attention to the communication networks and the mechanisms involved in the diffusion of innovations. With regard to the communication networks, we have discussed the various underlying datasets and their distribution in relation to the Bell Beaker phenomenon. We have seen variability in the distribution of Bell Beaker and Common Ware pottery decoration techniques, with *Cardium* and cord impressions and all-over decorated motifs being more restricted to coastal research areas. Stone and flint production is predominantly based on flake technologies, apart from the Portuguese Estremadura. Also, the distinctive regional shapes of arrowheads (and to a lesser degree daggers and knives) has been reviewed. Evidence for the practice of metallurgy is found on several Bell Beaker settlements, as are some typical examples of the exchange mechanisms of metal artefacts, such as Palmela points. With regard to subsistence, the association of both

18 While these anthropological studies are illustrative, they are also anecdotal in a way, and only through comparative and generalised research, can they be tied to the sociological model of ‘strength of weak ties’ or the mathematical work on ‘itchy feet’, which was explained before.

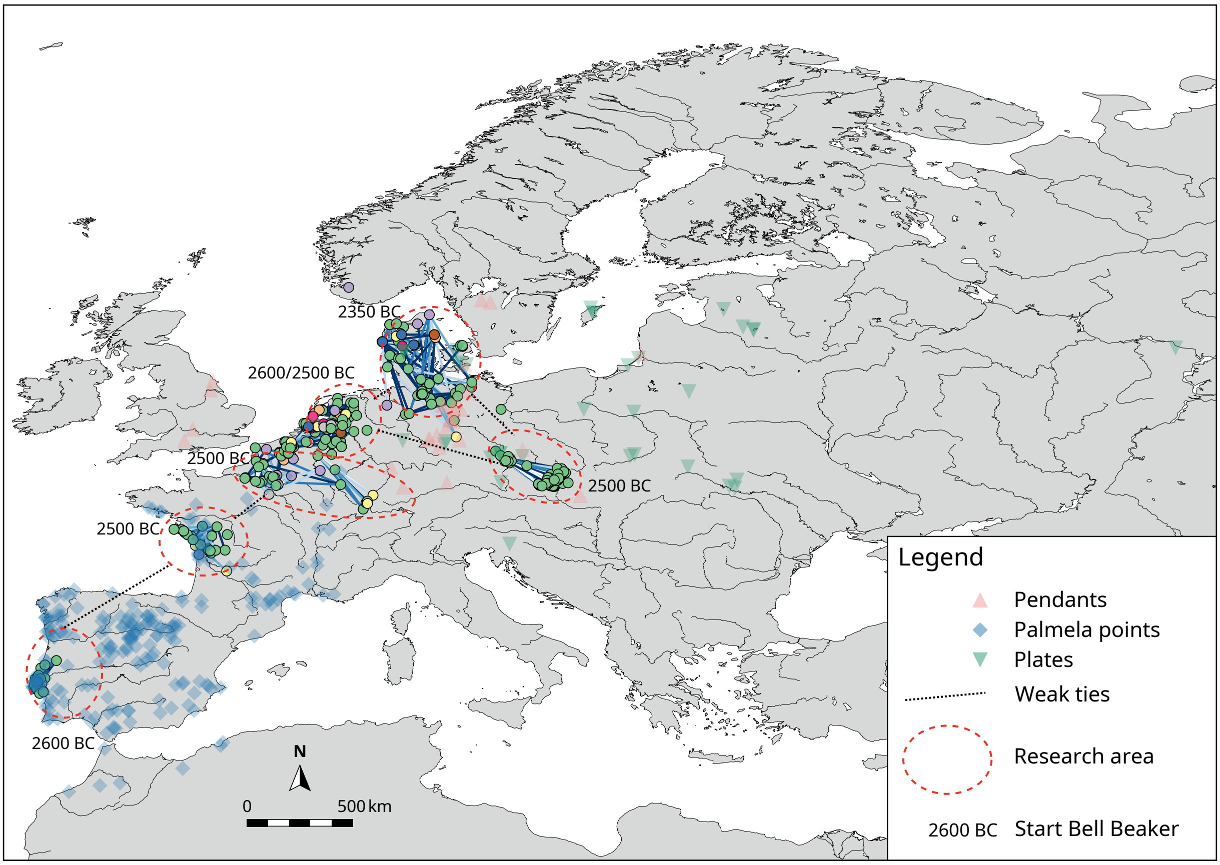


Fig. 6.28 The Bell Beaker network between the six research areas. A model in which weak social ties, exchange networks and the temporality of innovation all play a role.

domesticated horse and spelt wheat with the Bell Beaker phenomenon in certain research areas was discussed.

In terms of the communication networks, we have seen that most settlements cluster with each other on the basis of the similarities in quantity, motifs and techniques in Bell Beaker pottery. Standing out are the Gord and Deûle/Escaut settlements in Northern France and the southern parts of the Lower Rhine Area. The spread of settlements varies between tightly clustered research areas (such as the Czech Republic) and research areas where more varied pottery assemblages are found (Portuguese Estremadura and Lower Rhine Area). Regionally, focusing on the importance of certain nodes and the strength of ties within the networks and the clustering of particular nodes, has given some insights into the development, organisational structures and functioning of the communication networks. Notable is the central role of new coastal settlements in the Western France and possibly also the Lower Rhine Area, as opposed to the longevity of occupation at the early Bell Beaker settlements in the Portuguese Estremadura. Also important is the spatial and network separation between contemporaneous Bell Beaker settlements and Gord and Deûle/Escaut settlements in Northern France, which can be related to the respective ways in which their communication networks are organised and functioning. The organisation of communication networks in the Czech Republic (tightly clustered, strong links) can also be contrasted to Southern Scandinavia & Northern Germany (spread out, weak links).

Additionally we focused on three different aspects of movement that lead to these networks: the movement of pottery, the movement of ideas (illustrated by both traditional bone objects related to funerary dress and innovative copper weaponry) and the movement of people, through the critical examination of ancient DNA and isotopic evidence. We have seen that exchange of pottery in the Bell Beaker period is rare. Especially long distance exchange is virtually non-existent. Regionally, different patterns can be observed when the data is compared. In some areas of Europe, differences in clay composition found in pottery at a site could illustrate the exchange of this pottery and the gathering of people from different places related to funerary or subsistence based activities (*cf.* Salanova *et al.* 2016; see also Beckerman 2015, 211-215), while in other areas these practices have not taken place. Interestingly, the emerging dataset of strontium and oxygen isotopes on human remains seems to agree to this regional mobility pattern, whereas caveats do exist with regard to local and non-local attribution. On a different scale, genetic models of population movement seems to indicate a move away from the Iberian origin model, towards a model in which emphasis is placed on Corded Ware ancestry. This fits well with the funerary evidence from Central and Northwest Europe, but places the arrival of the Bell Beaker phenomenon in the Iberian Peninsula in a different light. Also, the position of French Bell Beaker communities, in between the Northwest European and Southwest European spheres of interaction, becomes even more interesting. The evidence from the exchange of ideas shows two very distinct mechanisms: the relatively fast and widespread distribution of Palmela points over Western Europe does indicate at the development of a loose communication network, in which local practices remain dominant. In contrast, the use of traditional bone plates and pendants in several Bell Beaker funerary contexts hints at a slow process of the exchange of ideas taking place in Central and Northwest Europe around the same time.

Finally, it is now possible to combine these networks, distribution maps and different aspects of movement into a single model, a Bell Beaker network model. This model combines the regional exchange networks of ideas, objects and people forming the reconstructed regional communication networks and the movement of individuals as a Weak Ties Model (after Granovetter 1972) beyond these regional network, possibly accounting for parts of the diffusion across Europe, following the transformation processes of innovation diffusion observed in chapter 5 (see fig. 6.28).

7 Analysis: Innovation and tradition in pottery production

7.1 Introduction

In chapter 5 we have studied the temporality and spatial developments of the adoption of the Bell Beaker phenomenon in different parts of Europe on a large scale. This was further developed in chapter 6, where we saw how different Bell Beaker communication networks were functioning and organising the flow of information. These networks were formed by various mechanisms, primarily operating on a regional scale, including pottery exchange, exchange of ideas and the mobility of people. These networks are formed by the material culture found on settlements. This material culture is ultimately formed by the choices made by people on a local scale, and the process Rogers' names 'reinvention'. This brings us to our third and final research question: "How should we understand the process of reinvention, the interplay between tradition and adoption of an innovation, when considering the Bell Beaker phenomenon?"

Thus, in order to understand this reinvention process, and the interplay between tradition and adopting an innovation, it is necessary to focus on a different level of analysis. By analysing various aspects in the pottery production process, this interplay is followed. The first analysis will focus on chronological and spatial variability in the difficult-to-change forming stage in Common Ware pottery. The second analysis focuses on the regional and local aspects of skill and creativity in adopting the Bell Beaker pottery technology innovation. Thus with these two aspects, the forming of vessels and skill and creativity in the production process, we are able to see the process of reinvention and answer this final research question.

7.2 Changing habits

7.2.1 Introduction

As we have argued before (see paragraph 2.4.1), different stages in the production process are differently affected by change or by innovation. One of the most difficult-to-change practices, as a potter, is the forming stage in the production of pottery. Gosselain (2000) states that these techniques are learned at an early life, relate to the acquisition of skills and the engraining of motor-habits, reflect deep-rooted ideas about identity and belonging. Additionally, the shape of a pottery vessel is easy recognisable and ideas about what shape is "right", and choices in defining this, are not made by the pottery him or herself but by *habitus*, the cultural norm within society.

To be able to follow the changes in these cultural norms, we study the different vessel shapes, their chronological development and spatial variation in this paragraph. Specifically, the so-called Common Ware vessels will be studied. Following the work of Besse (2003a, 164, fig. 123) who defined three distinct common ware regional groups (the *domaine septentrional*, *domaine oriental*, *domaine méridional*), we ask the following questions: are the distinctive trajectories of change, associated with the appearance of the Bell Beaker phenomenon, similar to these three *domaines*? Can we note differences in how the Bell Beaker phenomenon was adopted and reinvented within and between these *domaines*? Or more clearly: Can we see differences in how local potters changed their shaping motor habits with the adoption and reinvention of the Bell Beaker phenomenon?

The main goal of this study is to understand the variability, independent of existing typologies, in Common Ware pottery, both in spatial and chronological terms. While the spatial variability in Common Ware decoration techniques and motifs has already been commented upon in the previous chapter (see paragraph 6.2.2.1), an extended dataset of Common Ware vessels will further illuminate this aspect. The main focus of this particular study will be the *domaine septentrionale*. This area is chosen in order to test the methodology and illustrate the potential benefits of this kind of analysis, while at the same time having a relatively large and relatively well-published dataset available. This *domaine* encompasses three of the research areas that were analysed in the previous paragraph (Northern France, Lower Rhine Area and Southern Scandinavia & Northern Germany). Importantly, in these three research areas, three different ways of adopting the Bell Beaker phenomenon were discovered. In Northern France, the Bell Beaker phenomenon was largely rejected by local Late Neolithic communities. In the Lower Rhine area the adoption took the form of a reinvention, where strong links led to a uniform adoption. And finally, in Southern Scandinavia and Northern Germany the adoption process was characterised by weak links and a diverse and partial adoption. Vessels from other research areas will be taken into consideration, but play a minor role in the current analysis.

In order to study this possible variability, several distinct analyses are carried out. Preceding the analysis a brief overview of the data and its characteristics in spatial terms are given, alongside an overview of existing typological schemes. Following this, typology is confronted with the metric data that was compiled. Principal Component Analysis and Correspondence Analysis are used to answer the questions related to the relationships between metric, typological and chronological variables.

7.2.2 Dataset

Data concerning pottery vessel shapes was gathered using a method that is comparable to previous studies into Middle and Late Neolithic pottery (*e.g.* Gräner 2003; Beckerman/Raemaekers 2009, methods are discussed in detail in paragraph 3.4.2). Published data was taken mainly from settlement contexts but, in order to increase the dataset volume, other contexts such as funerary assemblages were added as well. Data from Britain, the Netherlands, Germany, Belgium, France, Denmark, the Czech Republic and Portugal was included here.

In total, a dataset of 222 selected sites provided measurements for 490 reconstructed vessels (an additional 78 sites on which only sherds were found, was also included). These sites range from excavations to observations, to loose finds and test trenches. Contextually, settlements, and specifically sites with features and cultural layers, are most prominent, whereas funerary sites and loose finds are also taken into consideration. Out of the 490 vessels from Bell Beaker contexts, 137 are defined

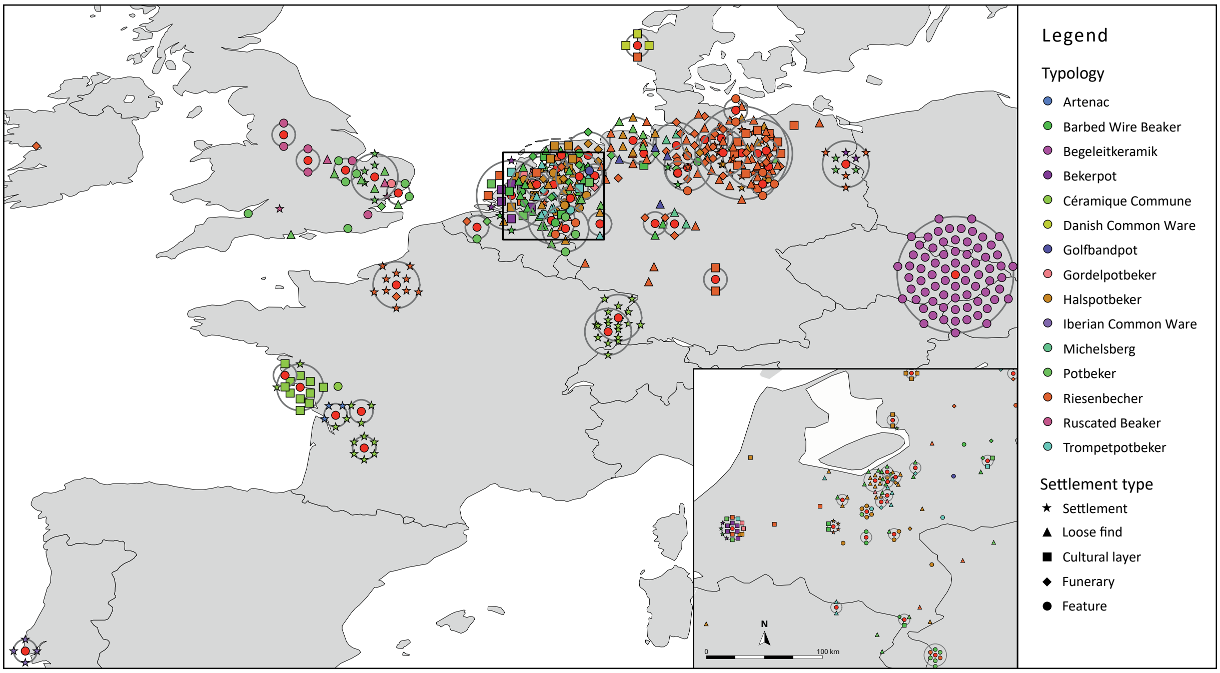


Fig. 7.1 All the sites from which vessels were analysed (red dots mark the sites).

as Riesenbecher, 128 as potbekers, 8 as indistinct bekerpot vessels, 13 vessels from Danish Common Ware, 1 from Portuguese Common Ware, 2 as French Céramique commune, and 72 as Begeleitkeramik. Most of these vessels were found on archaeological sites in Besse's *domaine septentrionale*. In the next paragraph these typological designations will be explained in more detail.

An additional dataset of 61 Late Neolithic vessels from Vlaardingen group settlements was obtained from Beckerman and Raemaekers (2009)[19].

7.2.3 Typological characterisation

The pottery vessels that make up this vessel shapes dataset are known under various different, mostly national, types. Variously the vessels are ascribed to as Begeleitkeramik (in Central Europe), bekerpot, potbeker and Riesenbecher (in the Lower Rhine Area and Germany), céramique commune (in France) and rusticated ware (in the British Isles). In this paragraph a short overview is given into the regionally specific definitions that are used to characterise these pottery types.

Begeleitkeramik pottery accompanies Bell Beakers in southern Germany, Austria, the Czech Republic and Slovakia. Heyd (2004), studying southern German settlements, mentions s-shaped vessels, sometimes decorated with horizontal applied bands or knobs on the rim or handles. Turek *et al.* (2003, 200) differentiate Begeleitkeramik vessels from the Czech Republic into groups A and B, based on the material of Slavonín. Group A consists of coarse and thick-walled S-shaped vessels, with sandy inclusions, contrastingly group B is defined by well-fired thin-walled polished vessels. Begeleitkeramik A is found in settlement features of both the Corded Ware and Bell Beaker phenomenon, while Begeleitkeramik B is only found in the latter. It is at the moment unclear whether any development can be seen in the vessel shapes of Begeleitkeramik A. Ondráček *et al.* (2005) mentions several vessel types which fall within the category of Begeleitkeramik (egg-shaped vessels, jugs, jars and amphorae), occurring on Bell Beaker settlements and in burials. In this study only

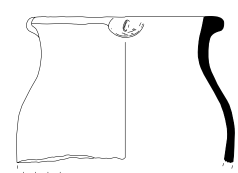


Fig. 7.2 Example of Begeleitkeramik from the Czech Republic (vessel 326).

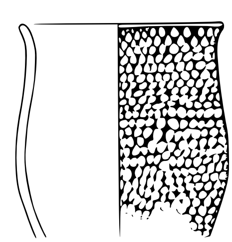


Fig. 7.3 Example of a Common Ware vessel from the Netherlands (vessel 38).

19 Many thanks to Dr. S.M. Beckerman for the original data.

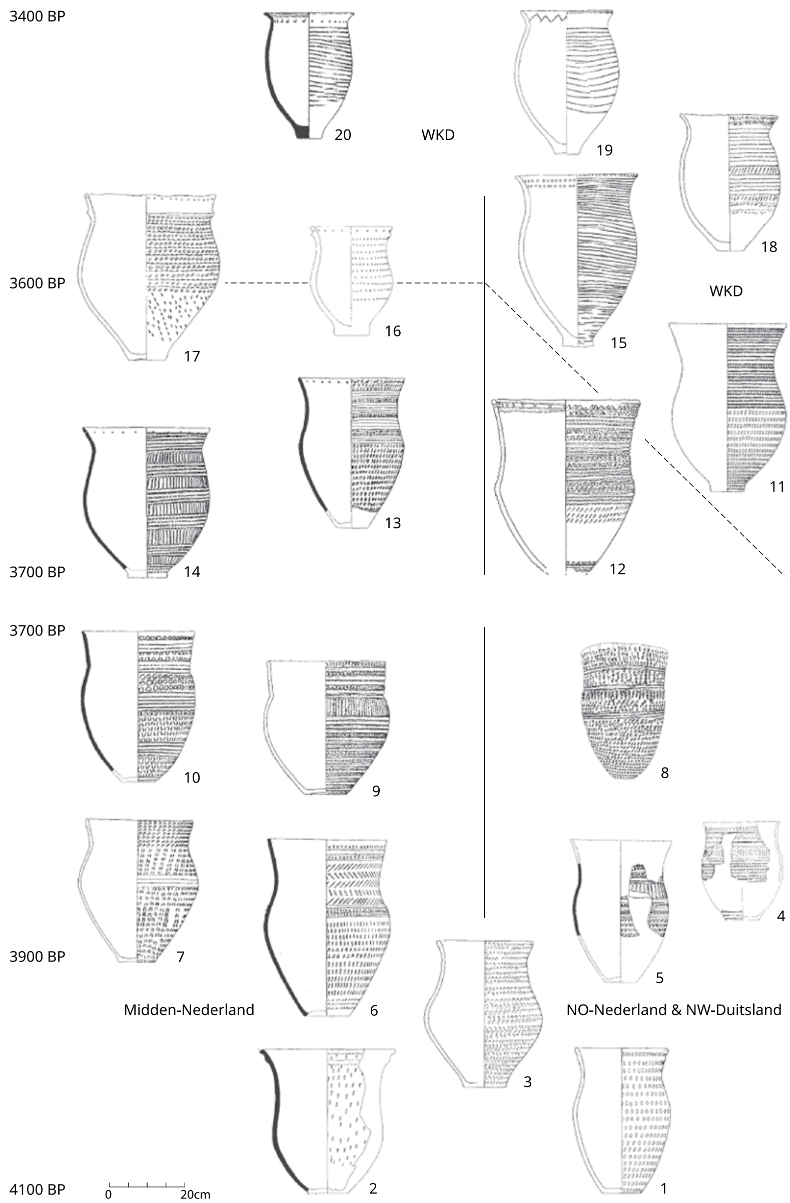


Fig. 7.4 Lanting's typochronological sequence of Riesenbecher and Potbeker vessels (after Lanting 2008, 94-95, fig. 24).

the egg-shaped vessels and jugs (see fig. 7.2), are taken into consideration and will be compared to other Common Ware pottery.[20]

Riesenbecher (or *Riesenbecher of the Bentheimer Typ*, see fig. 7.3) vessels from the Lower Rhine Area and Germany/Scandinavia were first identified by Jacob-Friesen (1939, 79). Later defined by Stegen (1954, 280) in his study of the vessel find from Bauershausen, Bentheim. These vessels are notable for their large sizes, crude thick-walled nature and S-shaped profile. Finds of Riesenbecher are known from parts of Germany (with a remarkable concentration along the lower Elbe valley, see for instance Mertens 1998) and occur as well in the Netherlands, Denmark and Poland. Studies by Moser (1994), Mertens (1998), Czebreszuk (1998) and Makarowicz (2003) present an update of the spatial distribution, different vessel forms and decoration

20 A specific aspect of this analysis was already carried out in relation to the Bayesian model for Slavonín-Horni Ián, see paragraph 5.5.2 and appendix B.

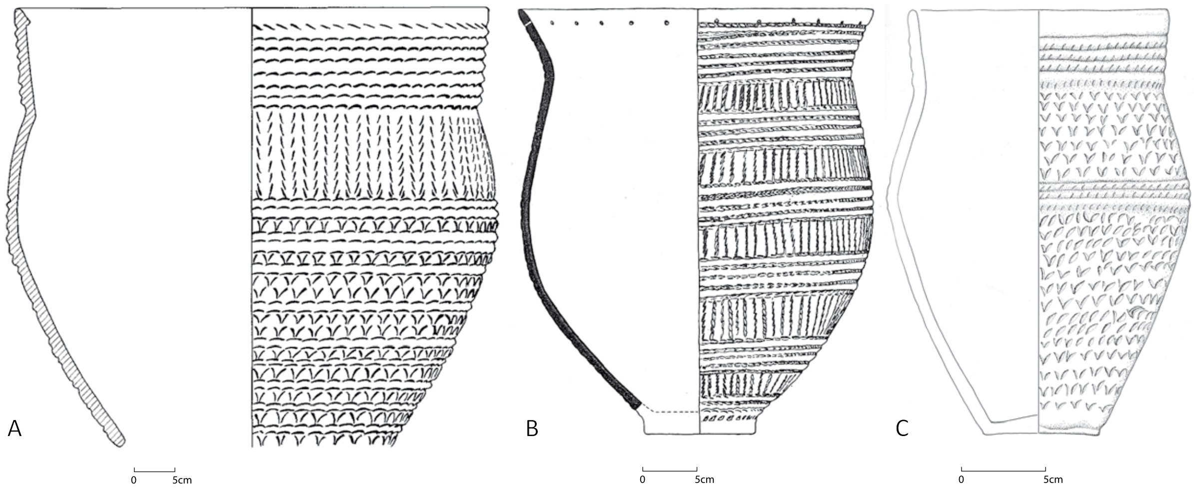


Fig. 7.5 Three potbekers from the Netherlands (A, Halspotbeker: vessel 14, B, Trompetpotbeker: vessel 15, C, Gordelpotbeker: vessel 35).

types. These authors also demonstrate a continuity into the Early and Middle Bronze Age of Central Europe, where large undecorated S-shaped vessels are more common in North-western Unetiče and Trzciniec contexts (see also Zich 1987). In the Netherlands, both Riesenbecher and potbekers are categorised as bekerpotten. This group of pottery that encompasses all Bell Beaker settlement pottery, not taking the vessel sizes as a criterium (Lanting 1973, 2008; see figure 7.4).

The Dutch group of potbeker vessels was already described by Van Giffen (1925/1927) but comprehensively catalogued by Lehmann (1965, 1967a, 1967b, 1967c) and chronologically positioned by Lanting (1973). Later discoveries of potbeker vessels include finds from Germany (Wetzel 1976) and the British Isles (Lehmann 1969). The vessels are thin to medium-thick walled, decorated with zoned and geometric motifs, often executed in crude fingernail impressions and rusticated techniques such as warts and pinched bands. Lehmann studied both the vessel decoration and vessel shapes, both aspects which have become central to defining three groups within the potbeker assemblage (see fig. 7.5): the halspotbekers (Necked Potbeakers), which carry a cylindrical neck and a distinct angle between neck and shoulder of the vessel, the trompetpotbekers (Trumpet Potbeakers), with a "…wide, flaring mouth…" (Lehmann 1965, 5) and often provided with holes beneath the rim, and finally the gordelpotbekers (Belted Potbeakers) without a clear angle between neck and shoulder, but with specific elements of decoration on the shoulder of the vessel. Lanting (2008, see fig. 7.4) argues for the development of all-over decorated Riesenbecher into Necked Potbeakers, and later into both Belted Potbeakers and Trumpet Potbeakers and finally into undecorated Riesenbecher and Barbed Wire Beakers. His analysis however, is mainly based on a study of decoration motifs irrespective of vessel shape or technological characteristics such as the vessel wall thickness and temper material and size.

Akin to potbekers in the Netherlands, there is a group called rusticated ware in the British Isles, first described by Clarke (1970, 258-259, see fig. 7.6) and later catalogued by Gibson (1982) and Bamford (1982). Gibson and Snape (2013, 131) state that all these corpora "…contain examples of comparatively large, thin-walled and profusely rusticated vessels…" With regard to shape he suggests that the variation within the S-profile is greater than in the Dutch potbeker material, while in terms of decorative techniques and motifs many parallels can be noted (Gibson/Snape 2013).

In Denmark, no real typology exists for pottery found on Bell Beaker settlements. The study of the Bell Beaker settlement pottery of Myrhøj by Jensen (1972, see fig. 7.7) is often referred to. In this study the most important different vessel shapes found are described (Jensen 1972, fig. 37). His Forms 1, 3 and 5/5a can be considered

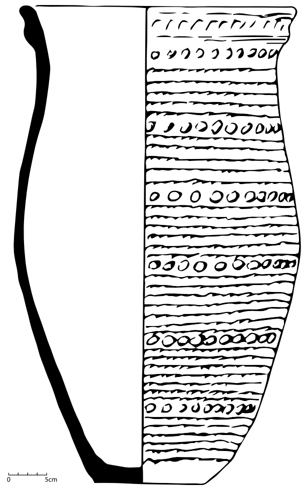


Fig. 7.6 Example of Rusticated ware from British Isles (vessel 98).

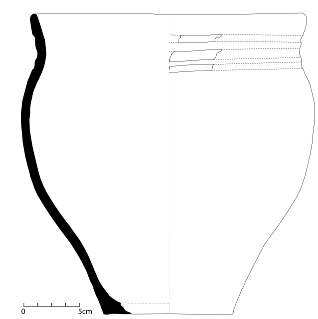


Fig. 7.7 Example of Danish common ware pottery (vessel 454).

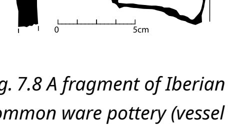


Fig. 7.8 A fragment of Iberian common ware pottery (vessel 468).

Common Ware pottery, although their technological characteristics and differences remain unstated and are thus unclear at the moment. This, combined with more recent studies, shows that S-shaped vessels, undecorated or with impressed and applied decoration (see also Liversage 2003, 41, fig. 2.8), and more straight-walled vessels and bowls, are commonly found on Bell Beaker settlements in Denmark.

For the Iberian peninsula, associated pottery on Bell Beaker settlements usually takes the form of undecorated bowls and vases with a simple shape, for instance at El Ventorro near Madrid (*cf.* Quiero/Priego 1992, 208-231). These bowls and vases are unfortunately not very suitable for this analysis, because of their very simple shapes. Recently Prieto-Martinez (2011, 358, fig. 9) published several decorated S-shaped vessels from Galician Bell Beaker settlements. Next to that several fragments of thick-walled nail impressed pottery were found on the settlement of Penha Verde (Cardoso 2011, 529, see fig. 7.8), which unfortunately could not be ascribed to a vessel shape.

The French accompanying pottery on Bell Beaker settlements is called *céramique commune* or *céramique d'accompagnement*, and this repertoire was first studied in detail by Besse (1998, 2003b). Earlier regional overviews of the Bell Beaker phenomenon have touched upon the common ware pottery, for instance Gallay (1986) for the Rhine valley and Switzerland and by Joussaume (1981, 462, see fig. 7.9) for Western Central France. However many of these studies remain anecdotal in their treatment of céramique commune as a single entity. The work of Besse (2003b) summarises céramique commune as consisting of medium-thick walled, undecorated S-shaped vessels, in many cases with cordons or handles below the (sometimes perforated) rim of the vessel (Besse 2003b, 246, figs. 40 and 41). The more recent work of Noel (2008, fig. 4) provides an additional example of céramique commune on the Breton coast.

Next to these common ware vessels, the dataset includes 61 Vlaardingen vessels, 5 vessels of short wave moulded pottery associated with the Corded Ware phenomenon (Becker 1956; Bantelmann 1986), 3 Artenac vessels of the Western French Late Neolithic site of Cordis (Burnez 1976; Salanova *et al.* 2011; Gaillard 1977), 40 Barbed Wire beaker vessels of the Early Bronze Age (Blouet *et al.* 1992, 1996), Begeleitkeramik from the Corded Ware features of Slavonín-Horni Ián in the Czech Republic (Tkáč 2012, Peška 2011, 2013) and 4 beakers of a Middle Neolithic Michelsberg date (formerly identified as Riesenbecher; see Moser 1994). These additional vessels will allow us to study chronological developments in more detail (see fig. 7.10).

Concluding, there are many different names for pottery that is clearly not thin-walled and very specifically decorated like a Bell Beaker, but found on contemporary settlements. It is evident that many of these common ware vessels share characteristics with regional pre-Bell Beaker phenomena, as Besse (2003b) already demonstrated clearly, but the main question remains. How did the adoption of the Bell Beaker phenomenon change the traditional pottery repertoire?

7.2.4 Vessel contexts

What all these different pottery styles have in common is that they are found in combination with Bell Beaker pottery in settlements and other contexts. As we have seen in the first paragraph of this chapter, many Bell Beaker settlement assemblages only contain a minor quantity of Bell Beaker pottery. In contrast, these assemblages are almost completely made up of common ware pottery. With regard to the preceding Corded Ware phenomenon, a similar situation exists where the bulk of the domestic assemblage is represented by other types of pottery, including short wave moulded vessels. In both the Corded Ware and Bell Beaker case, this does not mean that common ware pottery is only a "domestic" type of pottery and only found on settlements, as will be shown below.

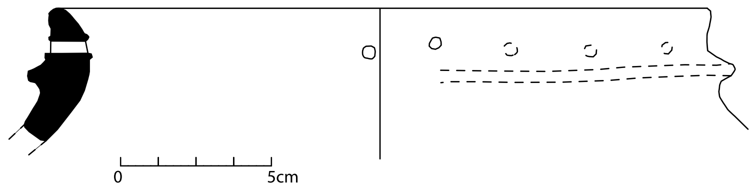


Fig. 7.9 Example of Céramique commune from Western France (vessel: 413).

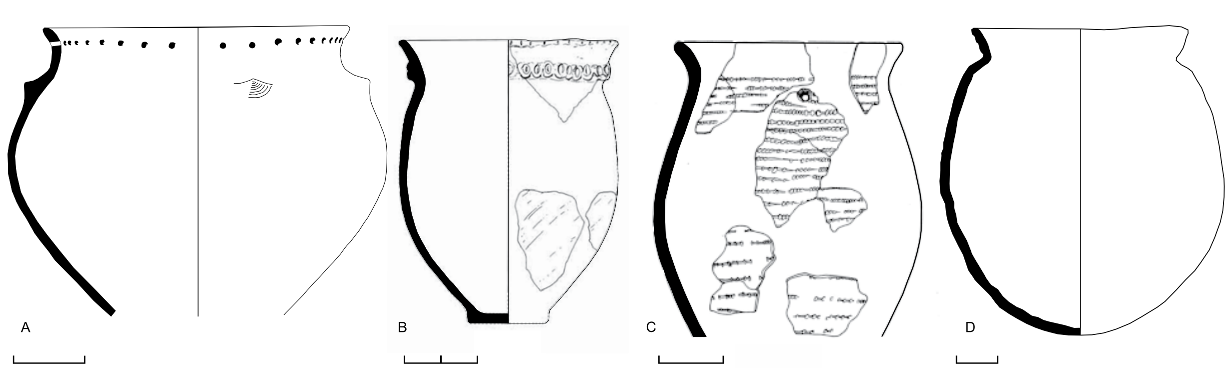
The context in which common ware was deposited, and its special significance, has been the centre of some debate over the past years, following the sometimes quite spectacular finds contexts, such as the well-known skull deposition, associated with two Riesenbecher vessels, from Metzendorf-Woxdorf (Valentijn in Fontijn 2010; Fokkens *et al.* 2016, 297-301). This special significance has sometimes been ascribed to ritual practices, while more recently Hartz/Müller (2017) see a connection to the introduction of specific metallurgical innovations. Lehmann (1965, 24) noted the find circumstances of several potbekers, in relation to barrows and megalithic tombs, however clear stratigraphic relations remained unclear. Later, Louwe Kooijmans (1974, 290-291) characterised potbekers as "… the show pieces of the domestic pottery…", having been deliberately buried in complete or nearly complete state, sometimes reverted, near burial mounds or graves.

For the Corded Ware short wave moulded vessels, Beckerman (2015, 113) critically assessed the catalogue by Floore (1991, 55). Out of the 51 sites on which this type of pottery is found, 20 are from funerary contexts (including 5 from megaliths and 15 from barrows), 22 are unknown or loose finds, and only 9 are from settlements. When we compare this to our dataset of Bell Beaker common ware, a different picture emerges. Of the 300 sites where common ware pottery was found, 140 sites were domestic contexts (51 features, 50 cultural layers, 39 unspecified settlements) and 48 were funerary contexts and 112 sites are unknown or loose finds.

When turning to the 222 vessels themselves, we see more differences. Riesenbecher vessels are found in funerary contexts on 24 sites out of 80 *versus* 16 times on settlements. Potbekers are more commonly encountered in settlement contexts, 24 *versus* 14 times in funerary contexts out of a total of 74. Barbed wire beakers show an equal distribution between funerary and settlement contexts. The other common ware pottery in our catalogue is only found on settlements (but this may well be related to the selective nature of the inventory, as common ware pottery is often found in graves in the Czech Republic, Ondráček *et al.* 2005).

Illustrative for the complexity of the issue regarding context is the settlement of Molenaarsgraaf, where, next to a low number of Bell Beaker sherds, both fragments of Halspotbekers and parts of Riesenbechers were discovered (Louwe Kooijmans 1974, see also paragraph 7.3.3.2). Valentijn (2010)'s corpus, and the potbeker found in a pit underneath the burial mound at Rhenen-Elst, sheds a bit more light on this, but makes the functional differentiation between settlement contexts and funerary contexts also more blurry. Was this pit part of the funerary context or part of a

Fig. 7.10 Example of four additional pottery vessels included in the analysis: Vlaardingen pottery, a short wave moulded vessel, a Barbed Wire Beaker and a Michelsberg vessel (A: after Beckerman/ Raemaekers 2009, fig. 16.4, B: vessel 129, C: vessel 86, D: vessel 228).



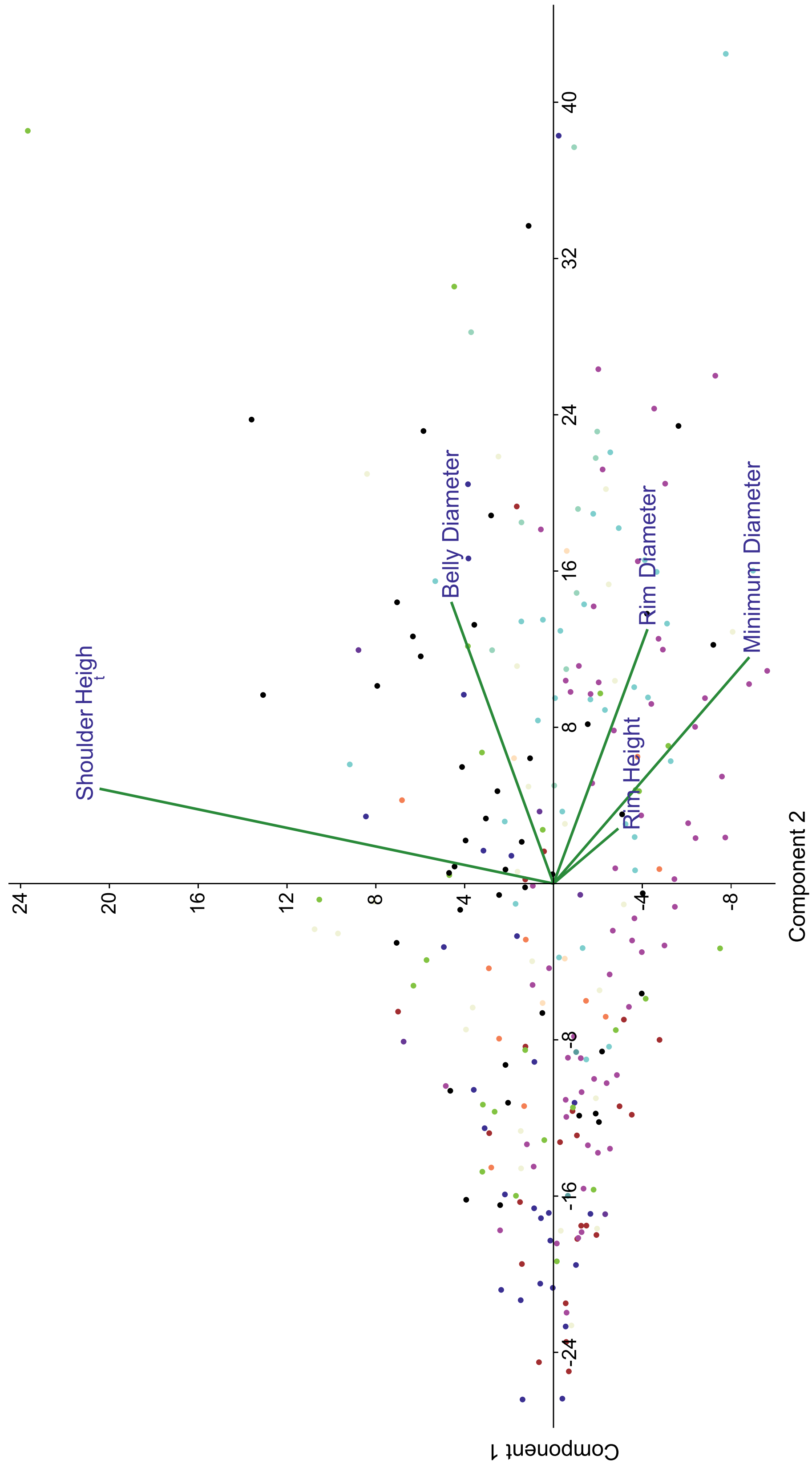


Fig. 7.11 Principal Component Analysis of vessel types and metric data.

domestic assemblage predating the funerary function? Future research can perhaps focus more on the specific landscape context and the social landscape of these finds in order to look for patterning and meaning. Also, the deposition of complete or near-complete potbekers and Riesenbecher in pits does not stand on itself in time. Other studies have come across the shared practice of Neolithic pot depositions, for instance while discussing Vlaardingen pottery (Louwe Kooijmans 2010), Funnel-beaker pottery in the Netherlands (Van Der Sanden 1997) and in Denmark (Koch 1998), while also Bronze Age pottery depositions are known (Arnoldussen 2008, 444-454). Maybe we should consider this depositional practice as a continuous tradition, of which potbekers and Riesenbechers are the next step.

The remainder of this paragraph will focus on the vessel shapes themselves and the development of vessel shapes through time as a method for answering the question posed at the start: how have local traditions changed and what was the impact of the Bell Beaker phenomenon on common ware vessel shape development between and within the different research areas?

7.2.5 Vessel shapes, typology and chronology

In order to study the relationship between vessel shape and the currently existing regional typological and chronological frameworks, several techniques were

Colour Legend PCA	Typology	Colour
Cadetblue	Artenac	
Blue	Barbed Wire Beaker	
Brown	Begeleitkeramik	
Chartreuse	Céramique commune	
Coral	Danish Common Ware	
Bisque	Gordelpotbeker	
Aqua	Halspotbeker	
Beige	Potbeker	
Black	Riesenbecher	
Blueviolet	Rusticated Beaker	
Aquamarine	Trompetpotbeker	
Fuchsia	Vlaardingen	

Table 7.1 Legend to the Principal Component Analysis.

PC	Eigenvector	% Variance
1	190.17900	85.3730
2	17.07230	7.6640
3	7.93851	3.5637
4	4.86407	2.1835
5	2.70745	1.2154

Table 7.2 Principal Components, Eigenvalues and % variance within the Principal Component Analysis.

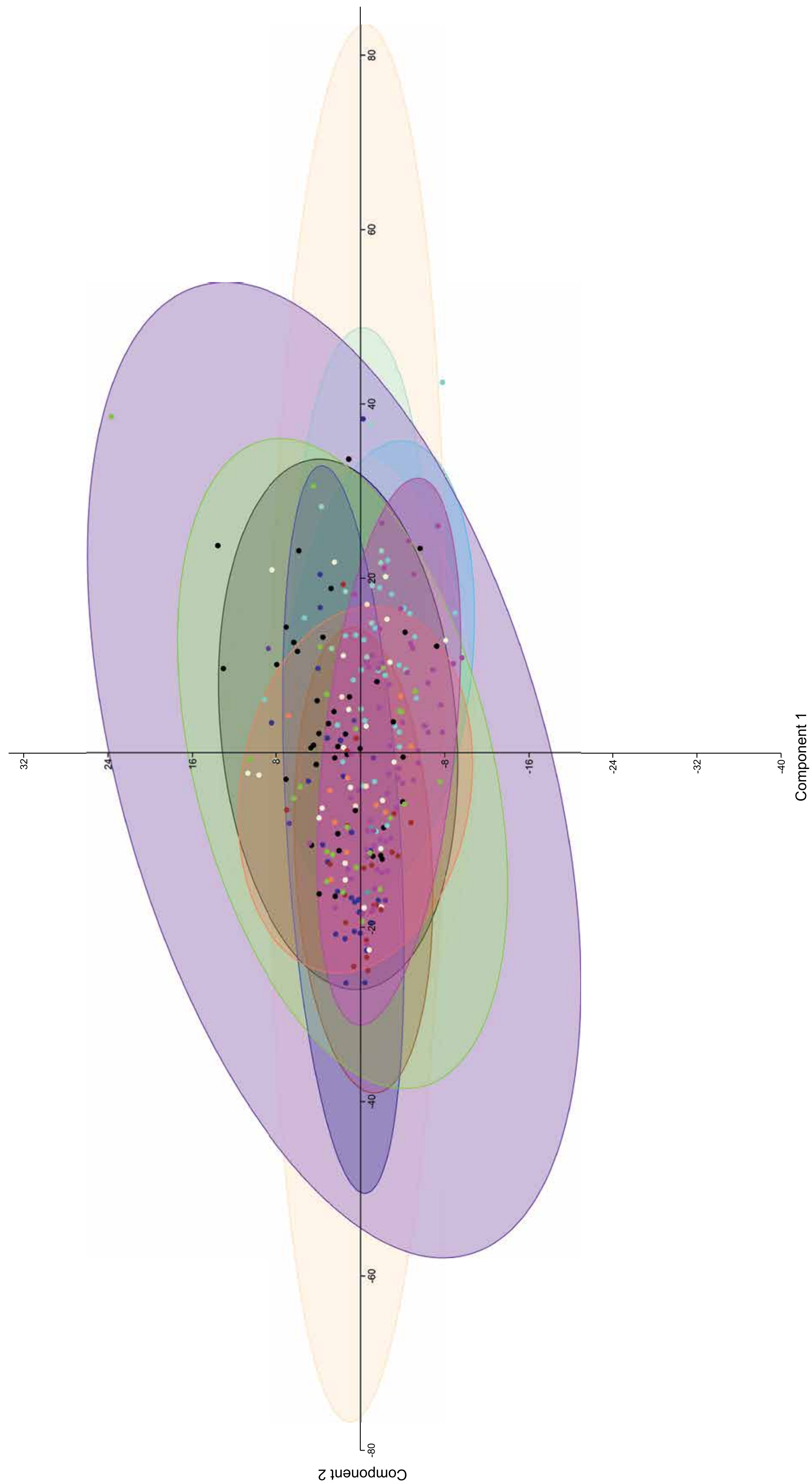


Fig. 7.12 Vessel types and Principal Component Analysis with associated convex hulls (95%).

employed. Firstly, the variables and typologies were analysed in relation to each other on a one-to-one basis. Secondly, a hierarchical cluster analysis was attempted to shed light on the relationship between shape and typology. Thirdly, a Principal Component Analysis was carried out, to see whether certain variables might hold both typological and chronological value.

The hierarchical clustering shows that the different typological characterisations are not based on differences in vessel shape, as most vessel shapes show a high degree of similarity. However, this method (the Girvan-Newman algorithm based on a Brainerd-Robinson coefficient) might not be best suited for this kind of analysis as all vessels are S-shaped and thus all vessels will show a tendency towards certain angles and proportions.

In order to study chronological developments within the dataset, a Principal Component Analysis was carried out on these vessels. These vessels include the full typological diversity as can be shown in table 7.1 and figures 7.11 and 7.12.

Table 7.3 vessels, sites and ^{14}C dates (all reliable ^{14}C dates that can be associated to complete or nearly complete vessels, vessels 60, 100 and 101 are not shown on PCA because their height is unknown).

settlementID	Toponym	Number of vessels	Vessel	Vessel type	Number of ^{14}C dates	Lab Code	BP	Sigma	Sample material
11	Carnisselande 3	3	32	Potbeker	2	GrN-21562	3675	45	charred seeds (*Prunus spinosa*)
			35	Gordelpotbeker		GrN-25914	3780	50	charcoal
			38	Riesenbecher					
42	Molenaarsgraaf	1	128	Riesenbecher	1	GrN-5177	3350	35	charcoal
46	Puttershoek Sportlaan	1	2	Halspotbeker	1	UtC-6955	3685	37	charcoal
84	Houten Hofstad Vleugel 20	1	105	Riesenbecher	1	Poz-20989	3660	35	foodcrust residue
113	Emmeloord J97	1	8	Halspotbeker	1	GrN-26495	3830	20	wood
123	Nijverdal Eversberg	1	60	Potbeker	1	KIA-37874	3655	30	wood
198	Nevele	1	64	Potbeker	1	KIA-39835	3860	30	charcoal
396	Gjævhul Bakke	1	111	Riesenbecher	1	K-1204	3560	120	charcoal (Alnus)
541	West Malling	2	98	Rusticated Beaker	2	KIA-37133	3821	29	charred seed (Corylus avellana)
			99	Potbeker		KIA-37134	3788	32	charred seed (Corylus avellana)
542	Lockington	3	100	Rusticated Beaker	1	OxA-6447	3630	55	wood
			101	Rusticated Beaker					
			102	Potbeker					

As can be seen in the accompanying table, a significant part of the variance is explained with the first two axes of the PCA plot. When analysing these two axes in the PCA scatter plot output, it is notable that all variability falls within a single point cloud cluster. This shows a similar outcome to the hierarchical cluster analysis: variability between the different typological units is low and variability within the

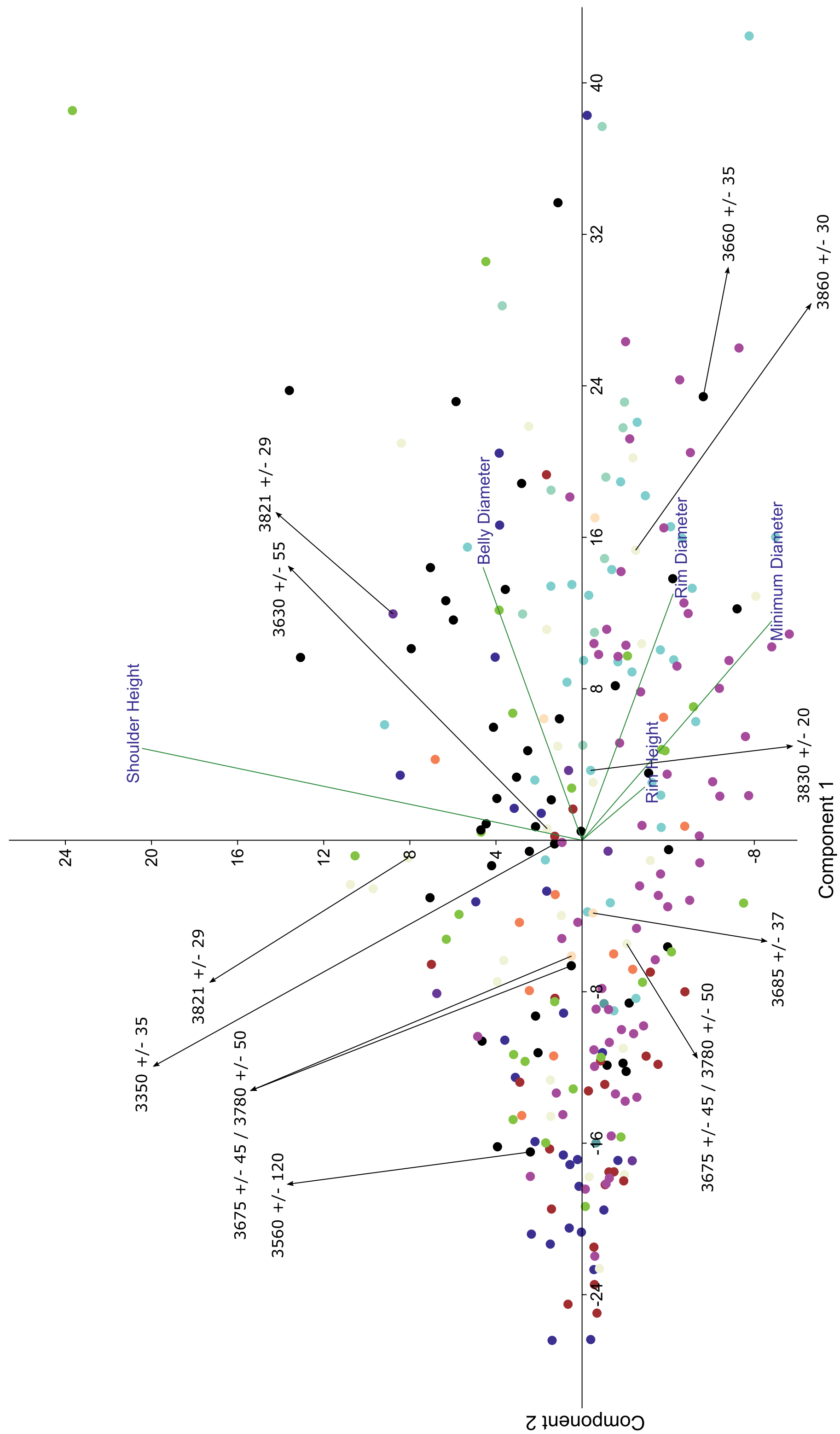


Fig. 7.13 Principal Component Analysis of vessels types and metrics data, with associated radiocarbon dates.

different typological units is high. The biplot arrows show what the contribution of the different variables is to the general spread. The major cause for the spread of values within the cloud of points along the x-axis is the rim angle degree variable. The y-axis shows a spread based mostly on the rim diameter and belly diameter variables, and to a lesser extent the value for minimum diameter.

Out of these 264 whole or nearly complete vessels, there are 15 vessels, coming from 10 from sites for which there are 12 reliably associated ^{14}C dates.

When we combine these ^{14}C dates and the several Late Neolithic pottery vessels (the Artenac and Vlaardingen vessels) with the Principal Component Analysis results, we can start looking for chronological developments from both a relative and absolute perspective (see table 7.3 and figure 7.13).

At first we can see several relative chronological developments. The first noticeable concentration, is given by the Artenac vessels on the left end of the spectrum, closely associated with the céramique commune, also from Western France. Apparently a continuity in shapes, or a tendency towards traditional shapes, can be interpreted here. This contrasts earlier hypotheses by Cormenier (2009) who proposed a break in traditions between late Artenac and Bell Beaker pottery vessel shapes. Our analysis is limited to a low number of very specific Artenac vessels, and the large spread of céramique commune does suggest that more influences were at play here. Secondly, the Vlaardingen Late Neolithic pottery is spread out in the negative part of the y-axis, while potbeker vessels (and Halspotbeker, Gordelpotbeker and Trompetpotbeker) and Riesenbecher are concentrated on the positive side of the y-axis. This shift towards more positive values on the y-axis could be caused by a change in the measured values of shoulder height (which is the main variable causing the spread along the y-axis).

Next to this, absolute dates can provide us with a further perspective on chronological developments. The chronological development was visualised through plotting the ^{14}C dates on the PCA plot, but this did not work out so clearly as will be demonstrated. The potbeker from Nevele (64), rusticated beaker and potbeker from Maxey (98, 99) and the halspotbeker from Emmeloord (8) are the oldest radiocarbon dated vessels. The Riesenbecher from Molenaarsgraaf (128) is by far the youngest radiocarbon dated vessel. In the PCA, this is illustrated by a move towards a negative value on the x-axis, possibly correlated by a decrease in vessel diameter (either rim, belly or minimum). However, the Riesenbecher vessel from Houten (105) defies this trend, as it is situated at a positive value on the x-axis.

Next to the hierarchical clustering network analysis and the principal component analysis, we can look at the relationship between individual variables. These relationships might be more informative, highlighting differences and particularities between vessel shapes that are easily skewed over within large datasets and analyses. An additional benefit for this analysis is that we can also use the partial data that was obtained and we don't necessarily have to rely on complete profiles. A single relationship that is highlighted here is the relationship between rim diameter and belly diameter (see fig. 7.14). Notable is the difference in variability between the values for Riesenbecher and céramique commune vessels on the one hand, and the different types of Potbeker vessels on the other hand. While this difference is not statistically inferred, it does highlight the possibility that rules within society governing the variability in vessel shape might have been different for potbekers than for Riesenbecher and céramique commune.

7.2.6 Vessel typology and technology

In the previous paragraphs a vessel's shape has been the main discriminant relative to typological schemes. It was made clear that variation does exist in vessel shapes between the regionally defined types of Bell Beaker common ware. This conclusion

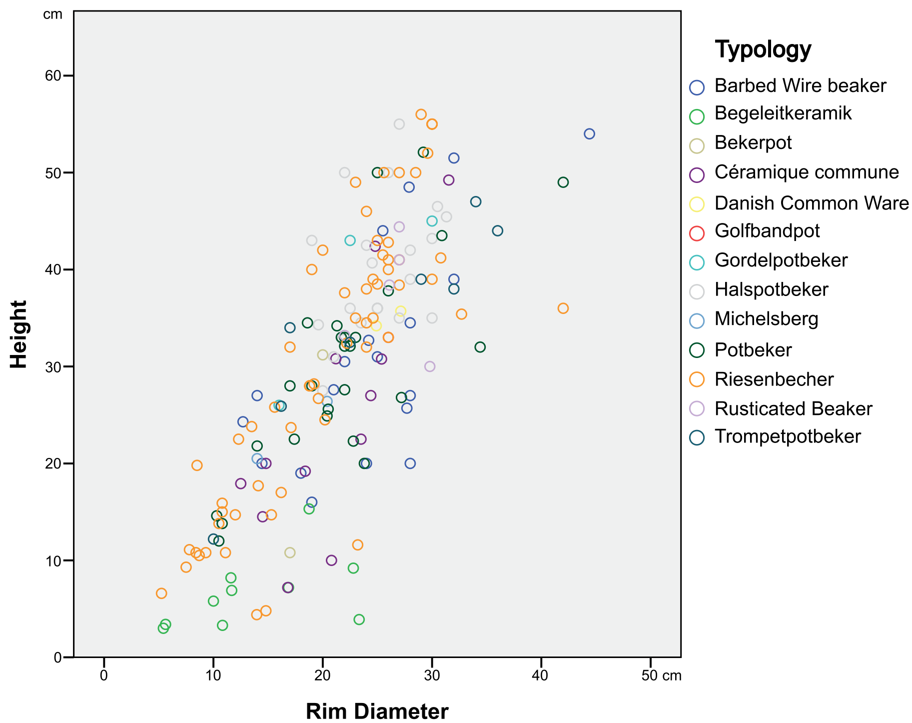


Fig. 7.14 The relationship between Rim diameter and Maximum diameter.

adds up to the comparative work of Besse, who defined three distinct zones within Western and Central Europe based mainly on the different vessel types and their decoration patterns. A further aspect that is of importance here is the distinction between typology and technology. As we have seen, several regional vessel types are also clearly distinct from a technological point of view (such as the Begeleitkeramik A and B types in the Czech Republic). When we study the vessels in our dataset for technological aspects, wherever recorded and published, several things can be noted with regard to temper (see table 7.4).

58 vessels were recorded for temper type, size and transformation (see tables 7.5, 7.6 and 7.7). All vessels were found in the Netherlands, Belgium and Germany. With regard to temper size, 14 vessels recorded a coarse type of temper, while only 6 vessels were tempered with fine materials. The coarse temper occurs on Halspotbekers, Potbekers and Riesenbecher alike. The different types of temper recorded consist mainly of quartz, chamotte, sand and stone and there is no clear distinction between the different pottery types visible. Also the mixture of two or more different temper types only occurs in 15 cases, irrespective of vessel typology.

Of course this overview is based on published sources. These sources do not always clearly define temper size (is the often recorded 'fine' always the same 'fine'?). Nevertheless, a common practice can be found in deciding how to temper pottery vessels, without taking their size, decoration or wall thickness as a criterium. This shared understanding is at least visible for the Bell Beaker common ware pottery from north western Europe. In paragraph 7.3 this will be further dealt with when our technological analysis of several case studies from the different research areas will be presented.

7.2.7 Innovation and pottery shape: discussion

In this paragraph we focused on the ways in which Common Ware pottery shapes vary through space and change through time. Pottery shapes, it was argued, represent the motor habits of the potter. From ethnography we learned that motor-habits are not easily changed. Changes therein are thus well-suited to tell us something about the impact and regional reinvention practices taking place with the adoption of the Bell Beaker phenomenon. When analysing the Common Ware pottery shapes, we follow the works of Besse (2003a, 2003b, 2004), and in particular her work on the *domain septentrionale* and *domain occidentale.* A cluster analysis of the measured metric variables shows no distinct groupings within these spatial domains. Chronologically

Vessel type	Number of vessels
Artenac	3
Barbed Wire beaker	40
Begeleitkeramik	72
Bekerpot	8
Céramique commune	45
Danish Common Ware	14
Golfbandpot	5
Gordelpotbeker	6
Halspotbeker	60
Iberian Common Ware	4
Michelsberg	4
Potbeker	45
Riesenbecher	144
Rusticated Beaker	10
Trompetpotbeker	17
Total	477

Table 7.4 number of vessels per type.

	Temper transformation		Temper size	
Vessel types	Crushed	Calcinated	Fine	Coarse
Barbed Wire Beaker	0	0	2	0
Bekerpot	0	0	0	0
Golfbandpot	0	0	0	0
Gordelpotbeker	1	0	0	0
Halspotbeker	1	0	3	7
Potbeker	0	1	0	4
Riesenbecher	1	0	1	3
Rusticated Beaker	0	1	0	0
Trompetpotbeker	0	0	0	0

Table 7.5 vessel typology and temper transformations and sizes.

there are some developments visible in the changing shapes of vessels. A Principal Component Analysis was carried out and showed two separate trends: Firstly, the development of French *céramique commune* from Artenac shapes is not unlikely, which contrasts earlier hypotheses about Artenac vessel shapes (Cormenier 2009). Secondly, the development from Vlaardingen pottery to Riesenbecher and potbeker shapes is well documented. However notable is the difference between Riesenbecher and potbeker vessel shapes, as a simple graph showed: potbeker and Riesenbecher vessels show different norms in shape variability. Potbeker vessels are more narrowly, more strictly defined, and contrast the more loose and variable shapes of Riesenbecher vessels. Other, technological, aspects do not show this difference in attitude. This does lead us to the next analysis: technology. If the choice of temper is not varied between for instance potbeker and Riesenbecher, what methods and free will do potters have in choosing their own production sequence? How does the adoption of the Bell Beaker phenomenon influence these methods and the choices made by potters?

Vessel Types	Quartz	Sand	Flint	Chamotte	Heamitite	Organic	Stone	Mica	Calcite
Barbed Wire Beaker	1	1		1			2		
Bekerpot		2		2					
Golfbandpot		1		1					
Gordelpotbeker	1	2		2					
Halspotbeker	11			2			5	2	
Potbeker	5	2	1	4		1	1		
Riesenbecher	6	4	1	2	1		3		
Rusticated Beaker	1		1	2					
Trompetpotbeker							1		2

Table 7.6 vessel typology and temper type.

	Temper mixtures		
Vessel types	Single	Double	Triple
Barbed Wire Beaker	1	2	0
Bekerpot	4	0	0
Golfbandpot	0	1	0
Gordelpotbeker	0	1	1
Halspotbeker	16	2	0
Potbeker	8	3	0
Riesenbecher	9	4	0
Rusticated Beaker	2	1	0
Trompetpotbeker	3	0	0

Table 7.7 vessel typology and temper mixture.

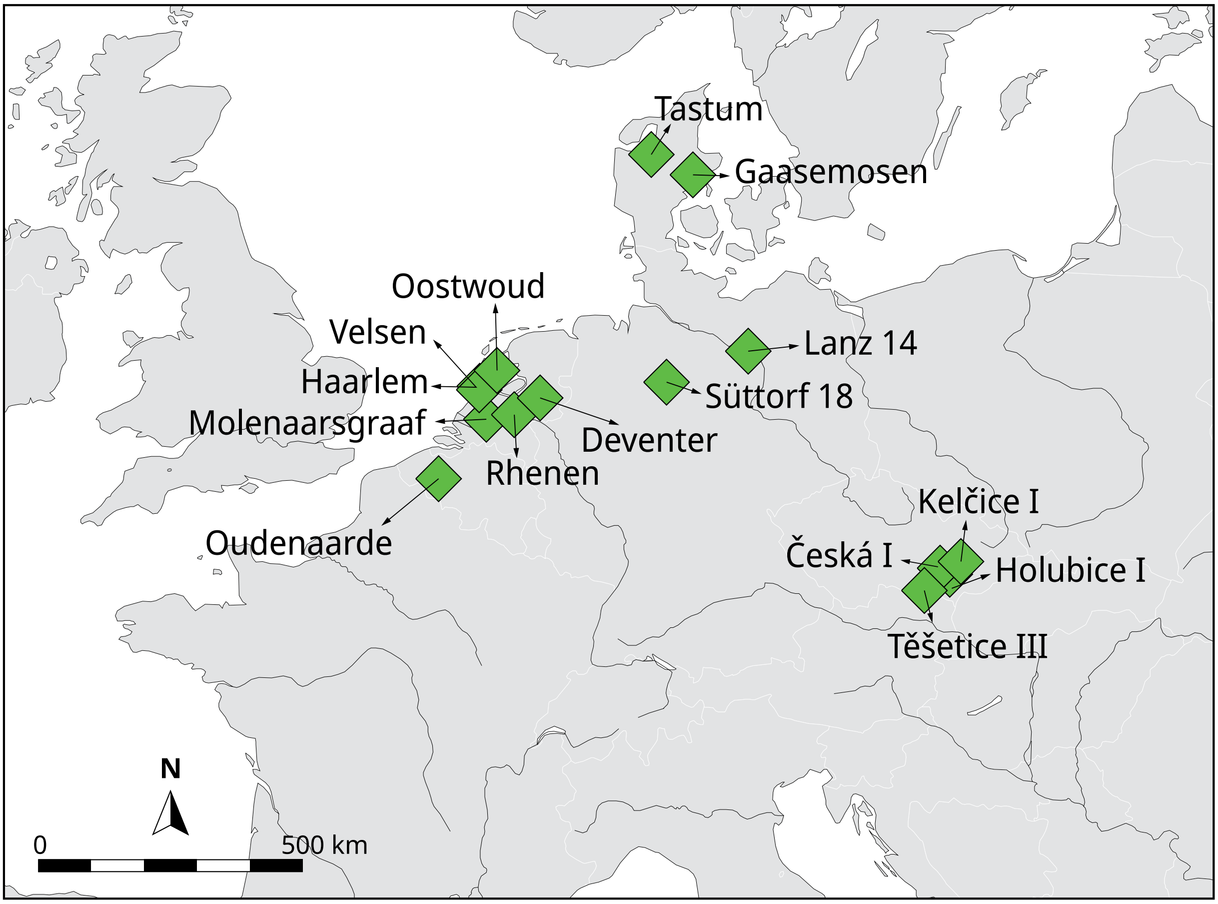


Fig. 7.15 All the studied pottery assemblages.

7.3 Changing choices

7.3.1 Introduction

We have now studied the how local communities adopted the Bell Beaker phenomenon from several different angles. We started by studying the temporal and spatial aspects of the innovation process through the reconstruction of the S-curve innovation process and the analysis of pottery and settlement assemblages in developing communication networks. After this, the development and change in existing shared traditional practices was analysed through the study of pottery vessel shapes. What we haven't yet looked at is the role of the potter in this. How did the potter, his or her skillset and the choices made, influence the innovation process? Can we identify both skill and choice within the archaeological record, when it comes to studying the innovation process?

This final analysis follows the production sequence of 13 pottery assemblages (totalling 4039 sherds analysed) from three Corded Ware and ten Bell Beaker settlement contexts across Western, Northern and Central Europe. The studied settlements are located in the Netherlands, Belgium, Germany, Denmark and the Czech Republic (see fig. 7.15 and table 7.8).[21] This spread of studied settlements will make a study possible into the different skillsets, choices and ways in which local potters both influenced, and were influenced by, the adoption of the Bell Beaker phenomenon.

21 All the grit (undecorated shers smaller than 1 cm) is left out of the analysis.

SettlementID	Country	Toponym	Cultural phenomenon	Reference	Sherds analysed
42	Netherlands	Molenaarsgraaf	Bell Beaker	Louwe Kooijmans 1974	796
23	Netherlands	Oostwoud	Bell Beaker	Van Giffen 1962, 1966; Fokkens *et al* 2017	152
5	Netherlands	Velsen Waterland	Bell Beaker/ Early Bronze Age	Vons 1971, 1975; Kleijne 2015	102
159	Netherlands	Deventer Skibaan	Corded Ware	Hermsen 2007	5
85	Netherlands	Rhenen N225	Bell Beaker	Schute 2009	40
16	Netherlands	Haarlem Schoterweg	Bell Beaker	De Jong 1970; Jelgersma *et al* 1970	36
191	Belgium	Oudenaarde Donk NEO 5	Vlaardingen/ Corded Ware	Parent *et al* 1987, 1989	357
358	Germany	Süttorf 18	Bell Beaker	Cosack 1996	237
361	Germany	Lanz 14	Bell Beaker/ Early Bronze Age	Wetzel 1969	375
431	Denmark	Gaasemoosen	Funnel Beaker/ Corded Ware	Rasmussen 2016	114
409	Denmark	Tastum	Bell Beaker	Simonsen 1983	982
592	Czech Republic	Holubice I	Bell Beaker	Ondracek *et al* 2005	42
613	Czech Republic	Česka I	Bell Beaker	Ondracek *et al* 2005	29
672	Czech Republic	Těšetice III	Bell Beaker	Ondracek *et al* 2005	50
628	Czech Republic	Kelčice I	Bell Beaker	Ondracek *et al* 2005	722

Table 7.8 All the settlements from which pottery assemblages were studied.

7.3.2 The potter's choices, or: what can we study?

The production sequence of pottery consists of several steps, in order to obtain the desired vessel. These different stages have been documented ethnographically (*e.g.* Rice 1987, Rye 1981). As argued before, the steps within the production sequence are not neutral, but are played out between the demands of society and the wishes of the potter, in various degrees related to visibility, the technical possibilities, skill, tradition and choice (*e.g.* Gosselain 2000). In this paragraph we will follow the production sequence of pottery from several Late Neolithic settlements. After this overview per settlement, the different aspects that have been influenced by skill and the potter's choices will be compared between the settlement pottery assemblages. This automatically leads to results concerning different potting traditions, different choices, different levels of skill and different ways in which potters related to the adopting of the Bell Beaker phenomenon.

The different practices within the pottery production stages are as follows: raw clay procurement, tempering, primary forming, secondary forming, decorating, finishing and baking. With regard to the influence a potter might have on the end result, and the ways potters' choices affect the outcome, several aspects are more important than others.

Clay procurement is primarily dependent on raw material availability. The study of raw clay procurement is usually carried out by analysis of thin-sections and chemical composition (*e.g.* Convertini 1996). As it is difficult to identify the potters' choices in this process of paste preparation and procurement without a deep technical study, this will not be attempted here.

Choices in tempering agent are affected by several things. The desired function of the vessel (Rice 1999), but also availability of raw materials, and the potters' choices plays an important part. As many different materials can be available, the end result can be similarly achieved with different temper materials and it is not very well visible for the consumer. For the analysis of temper, both the type and size of the temper can be observed macroscopically. The composition of the temper is taken into consideration.

The primary forming stage was treated in the previous paragraph. It was explained that the shape of a vessel is affected mainly by the society at large in which a potter is active. However a specific element in the primary shaping of a vessel is of relevance here. Wall thickness is mainly determined by the overall vessel shape, whether it is a thin-walled Bell Beaker or a thick-walled Riesenbecher makes a difference. However, also the education of a potter and the specific technological tradition that this potter was educated in and the way he is taught certain elements in the manufacturing of pottery, the motor-habits that develop during this teaching phase, affects wall thickness (Wallaert-Pêtre 2001). Most of the vessels studied were produced by a technique known as ring building or coiling. Coiling is a technique by which thin coils of clay are placed on top of each other in a particular sequence and stretched out. Several studied exist in which different ways of placing those coils are distinguished (*e.g.* Raemaekers 1999, 195; Louwe Kooijmans 1976, 255-286). Distinguished are H, N and Z/U coil-attachment techniques. For this study of forming practices both the wall thickness and the specific technique of coiling are noted.

Specific ways of finishing (such as either smoothing, polishing or roughening) the outer wall of a vessel are mainly done for the purpose of handling and use or the thermal properties of roughened surfaces (Tite *et al.* 2001; Schiffer 2003; Rye 1981). As such, this is not really indicative of the potter's choices but more related to the required functional aspects of the pottery vessel.

Decorating pottery is an aspect that has received most of the anthropologists' attention when reconstructing the pottery production practices, placing most emphasis on techniques and implements (*e.g.* David *et al.* 1988; Haour *et al.* 2010). Archaeologists in general, and particularly Bell Beaker scholars, have in the past placed an emphasis on the specific decoration motifs (*e.g.* Treinen 1970a, 1970b; Clarke 1970). With regard to decorating, we can differentiate between several things: the technique, the implement, the general motif and the particular execution of this motif. While the implements and techniques are aspects influenced by society due to their malleability and visibility, the motifs and in particular the execution of these motifs, can tell us more about potters' choices and the skill involved.

7.3.3 Pottery assemblages

7.3.3.1 Introduction

In the previous paragraph we discussed the different choices a potter has and the methods we have to analyse these choices and to study change and the way new practices can be adopted. This paragraph will shortly outline the different results from each settlement pottery assemblage, before an analysis will focus on the skills and creativity involved in the potter's choices in the production process.

7.3.3.2 Molenaarsgraaf

The settlement of Molenaarsgraaf was excavated by the National Museum of Antiquities (Louwe Kooijmans 1974) in 1966 and 1967. Remains of a cultural layer, features (from which two rectangular structures were reconstructed) and a filled up gully were excavated. A total of 796 sherds from this excavation was analysed.

The clay of these sherds is tempered with chamotte, sand and quartz mainly, while crushed stone, mica, organic and shell/bone temper is found only occasionally. Size of the temper particles is low to medium in all cases. The vessels are built up by coiling, and in 35 cases (4 times H-coils and 31 times N-coils) the specific technique was visible. The majority of the sherds are wall fragments, while also rim, foot and bottom fragments occur. Wall thickness of the sherds shows a double peaked distribution, with peaks around 6 and 12 mm. Finishing of the vessels was done by roughening in 54 instances, while smoothing took place 714 times. Most of the pottery sherds were fired in a reduced atmosphere, an oxidised exterior is noted in 28% of the sherds. Vessels include beakers, bowls, and typologically distinct Bell Beakers, Riesenbecher and Potbekers. Decoration is present on more than 50% of the sherds and mainly consists of zoned motifs, while also geometric and random motifs occur. Techniques used include impression, application and incision and in one case pinching. Specific techniques of application include the use of cordons, while incised grooves and pinched warts occur. The most frequent decoration technique is the impression, which takes many forms of which nail, spatula, oval, round and barbed wire are the most common types.

7.3.3.3 Oostwoud Tuithoorn

The site of Oostwoud, consisting of two burial monuments and a settlement beneath, was excavated in several campaigns by the University of Amsterdam in the 1950s (Van Giffen 1962) and in the 1960s (De Weerd 1966) and Groningen University in the 1970s (Lanting/van der Plicht 2000) Recently, Fokkens *et al.* re-analysed the various excavations (Fokkens *et al.* 2017). In total 152 sherds of pottery, coming from the University of Amsterdam 1950s and 1960s excavations, were analysed.

The clay of these sherds is mainly tempered with quartz or chamotte. Size of the temper particles is low to medium in most cases. The vessels are built up by coiling, and in only 3 cases (1 H-coils and 2 N-coils) the specific technique was visible. The majority of the sherds are wall fragments, while also rim, foot, shoulder and bottom fragments occur. Wall thickness of the sherds shows a single peaked distribution, with a peak around 5/6 mm. Finishing of the vessels was done by roughening in only 8 instances, while smoothing took place 142 times. Most of the pottery sherds were fired in a reduced atmosphere, an oxidised exterior is noted in 59% of the sherds. Decoration is present on a considerable 75% of the sherds. This decoration mainly consists of zoned motifs, while a low number of sherds is decorated with geometric, limited or random motifs. Techniques used include impression, incision and application. Specifically the application of a cordon is recorded on 7 occasions. Incised grooves are more frequent. The most frequent decoration technique is the impression, which takes many forms of which spatula, nail and finger and hollow are the most common types.

7.3.3.4 Velsen Waterland

The settlement of Velsen Waterland was found by local amateur archaeologists in 1970/1971 during construction works for a gas pipeline (Vons 1971, 1975). Finds come from several cultural layers interlaced between dune sand. The 102 sherds of pottery found in these layers were analysed.

The clay of these sherds is mainly tempered with quartz or sand. The size of the temper particles is almost equally distributed between small, medium and large. The vessels are built up by coiling, and in only a single case of H-coiling the specific technique was visible. The majority of the sherds are wall fragments, while also some rim fragments were recovered. Wall thickness of the sherds shows a double peaked distribution, with peaks at 10 and 12 mm. Finishing of the vessels was done by roughening in only 10 instances, while smoothing took place 83 times. Most of the pottery sherds were fired in a completely reduced atmosphere, an oxidised exterior is noted in 7% of the sherds. Decoration is present on only 13% of the sherds. This decoration mainly consists of zoned and geometric motifs. Techniques used include impression, incision and application. Specifically the application of a cordon is recorded once, and incised grooves are recorded three times. The most frequent decoration technique is impression, of which nail, spatula and cord are the most common types.

7.3.3.5 Deventer Skibaan

The site of Deventer Skibaan was excavated by the municipality of Deventer in 2004 (Hermsen 2007). On this settlement, a single Neolithic pit was found. This pit contained 5 sherds of a single pottery vessel and a large quantity of charcoal.

The clay of this vessel is tempered with medium-sized quartz and chamotte particles. The vessel is built up by an unknown coiling technique. The majority of the sherds are wall fragments, while also some rim fragments were recovered. Wall thickness of the vessel is around 8 mm, with the decorated rim being 13 mm thick. Finishing of the vessels was done by scraping on both the inside and outside of the vessel. The vessel was fired in a predominantly oxidised atmosphere. Decoration is present on the rim of the vessel. This decoration consists of an applied band in short-wave moulding technique. Thus, this vessel is characteristic of Corded Ware settlement ceramics (a bekerpot).

7.3.3.6 Rhenen N225

The Rhenen N225 site was excavated by RAAP in 2005 in a single test trench (Schute 2009). This excavation trench contained a single feature in which 40 sherds from four different vessels were carefully placed, in association with charcoal remains and several stone pebbles.

The clay of these sherds is mainly tempered with quartz or sand. The size of the temper particles is almost equally distributed between small, medium and large. The vessels are built up by coiling, and on 23 sherds the technique of N-coiling was visible. The majority of the sherds are wall fragments, while also a single rim fragment and a bottom fragment were recovered. Wall thickness of the sherds shows a single peaked distribution, peaking at 7 mm. Finishing of the vessels was mainly done by smoothing. Most of the pottery sherds were fired in a partially reduced atmosphere, as an oxidised exterior is noted in 90% of the sherds. Decoration is present on 90% of the sherds as all four vessels are heavily decorated. This decoration consists of zoned motifs. Techniques used include impression, incision and pinching. Specifically pinching of warts is recorded, in combination with incised grooves in several instances. The most frequent decoration technique however, is nail impression. All four vessels are typologically assigned to the Potbeker group. More specifically, one vessel belongs to the Trompetpobeker and another one to the Halspotbeker type.

7.3.3.7 Haarlem Schoterweg

At Haarlem Schoterweg, the Dutch Geological Service inspected a construction site in 1963 (de Jong 1970, 120; Jelgersma *et al.* 1970, 138). The investigations uncovered a cultural layer between layers of dune sand. From this cultural layer 36 pottery fragments were obtained.

The clay of these sherds is mainly tempered with quartz and chamotte. The size of the temper particles is medium to large. Construction techniques by means of coiling include both N (6 times) and H coils (possibly once). In total 2 bottom fragments, 3 rim fragments and 31 wall fragments were recovered. Wall thickness of the sherds shows a single peaked distribution, peaking at 6/7 mm. Finishing of the vessels was done by smoothing. Most of the pottery sherds were fired in a partially reduced atmosphere, as an oxidised exterior is noted in 75% of the sherds.

Decoration is present on 78% of the sherds. This decoration consists of combined geometric and zoned motifs. Techniques used include impression, incision and application. The sherds are decorated with both oval and nail impressions, incised grooves and an applied cordon. These pottery fragments belong to a single Potbeker vessel. More specifically, the vessel belongs to the Halspotbeker type.

7.3.3.8 Donk NEO 5

The settlement of Donk consists of several sites that were excavated by the museum of Oudenaarde and Ghent University prior to sand extraction (Parent *et al.* 1987, 1989) along the Scheldt river between 1983 and 1986. In addition to Mesolithic and Early Neolithic remains at MESO and NEO 1, a Late Neolithic cultural layer was excavated at the locality of NEO 5. From this settlement 357 pottery sherds were analysed.

The clay of these sherds is mainly tempered with quartz, chamotte or, to a lesser degree, sand. Size of the temper particles is small to medium in most cases. The vessels are built up by coiling, and in only 2 cases (1 H-coils and 1 N-coils) the specific technique was visible. The majority of the sherds are wall fragments, while also rim, foot, shoulder and bottom fragments occur. Wall thickness of the sherds shows a triple peaked distribution, with peaks at 8 mm, 10 mm and 15 mm. Finishing of the vessels was done by smoothing in over half of the vessels (52%), while the other half was roughened (48%). Most of the pottery sherds were fired in a partly reduced atmosphere, as an oxidised exterior is noted in 47% of the sherds. Decoration is present on 13% of the sherds. This decoration mainly consists of zoned motifs, while a low number of sherds is decorated with geometric, limited or horizontal motifs. Techniques used include application and impression, and to a minor degree also incision and pinching. Specifically the application of a cordon is recorded on 19 occasions. Impressed decoration is being done with a round object, nail or a smooth spatula. Incised grooves occur 3 times, and a single pinched wart was found. Several fragments of one or two thin-walled beakers and a bowl, and fragments of a collared flask could be identified.

7.3.3.9 Süttorf 18

The settlement of Süttorf 18 was excavated in the 1990s by the Landesamt für Denkmalpflege Niedersachsen (Cosack 1996). Uncovered were several features, containing stone, bone and pottery fragments. In total 239 pottery fragments could be analysed.

The clay of these sherds is mainly tempered with quartz and sand, while crushed stone, mica and chamotte are more infrequently found. Size of the temper particles is small to medium. The vessels are built up by coiling, however the specific coiling technique was not visible for any of the sherds. The majority of the sherds are wall fragments, while also rim, foot, shoulder and bottom fragments occur. Wall thickness of the sherds shows a single peak at 8/9 mm. Finishing of the vessels was done by smoothing on the majority of sherds (83%), while only 10% was roughened. Most of the pottery sherds were fired in a completely reduced atmosphere, as an oxidised exterior is only found on 8% of the sherds. Decoration is present on 28% of the sherds. This decoration is mainly found in zoned motifs, used with techniques of impression and incision. Decorated sherds impressed by means of barbed wire and round objects are most frequent, followed by finger and nail impressions. Incised decoration is found in both lines and grooves. Typologically, several examples of Riesenbecher could be identified.

7.3.3.10 Lanz 14

The settlement of Lanz 14 was excavated by the Landesamt für Denkmalpflege Mecklenburg-Vorpommern in the 1960s (Wetzel 1969). It consists of three cultural layers (I, II and III) in between dune sand. The cultural layers I and II contained, among others, 578 sherds of pottery that were analysed. The bottom layer, layer III (containing ca 2000 sherds), was not analysed.

The clay of these sherds is mainly tempered with quartz and sand, while crushed stone, mica and chamotte are more infrequently found. Size of the temper particles is small to medium. The vessels are built up by coiling, in 16 instances the specific N-coiling technique was visible. The majority of the sherds are wall fragments, while also rim and foot fragments occur. Wall thickness of the sherds shows a single peak at 7 mm. Finishing of the vessels was done by smoothing on the majority of sherds (98%), while only 1% of all the sherds was roughened. Most of the pottery sherds were fired in a completely reduced atmosphere, as an oxidised exterior is only found on 24% of the sherds. Decoration is present on 12% of the sherds. This decoration is mainly found in zoned motifs, used with techniques of application, impression and incision. Applied cordons are found on 17 sherds, while impression by means of *Besenstrich*, cord, nail, round, spatula, dots and *Tiefstich* (probably intrusive) and incised lines occur in a low number. A single sherd also exhibits the remains of randomly painted lines.

7.3.3.11 Gaasemoosen

The site of Gaasemosen was excavated by Moesgaard Museum (Rasmussen 2016) and consists of a single cultural layer in which two phases of habitation could be distinguished. From this cultural layer 114 sherds were analysed.

The clay of these sherds is mainly tempered with quartz and sand, while crushed stone and mica are more infrequently found. Size of the temper particles is small to medium. The vessels are built up by coiling, of which for 3 sherds H coils could be established, and in 15 instances the specific N-coiling technique was visible. The majority of the sherds are wall fragments, while also rim and bottom fragments occur. Wall thickness of the sherds shows two peaks at 6 mm and at 10 mm. Finishing of the vessels was done by smoothing on the majority of sherds (71%), while 23% of all the sherds was roughened. Most of the pottery sherds were fired in a completely reduced atmosphere, as an oxidised exterior is only found on 15% of the sherds. Decoration is present on 12% of the sherds. This decoration is mainly found in zoned motifs and limited occurrences, used with techniques of impression, application and incision. Applied cordons are found on 2 sherds in a short-wave moulded style, while cord, finger, nail and oval impressions are found in a low number. Incised lines and grooves are also encountered.

7.3.3.12 Tastum

The settlement of Tastum was excavated by Skive Museum in Northern Jutland (Simonsen 1983). At the site, several features were uncovered and a house plan with sunken floor could be reconstructed. Within the features and the sunken floor of the house plan, 992 sherds were discovered. These sherds were all analysed.

The clay of these sherds is almost solely tempered with crushed stone, mica and sand. Size of the temper particles is small to medium in most cases. The vessels are built up by coiling, however the specific coiling technique was not visible on any sherds. The majority of the sherds are wall fragments, while also rim, foot and bottom fragments occur. Wall thickness of the sherds shows two peaks at 7 mm and at 10 mm. Finishing of the vessels was done by smoothing on a large majority of sherds (97%), while only 2% of all the sherds was roughened. Most of the pottery sherds were fired in a completely reduced atmosphere, as oxidised colours are almost completely absent. Decoration is present on only 6% of the sherds. This decoration is mainly found in zoned motifs and once in a geometric motif. Techniques used include impression, application and incision. Applied cordons are found on 15 occasions, while impressions with spatula predominate. Other impressions include single occurrences of barbed wire, nail and line impression. Incised lines and grooves are also encountered.

7.3.3.13 Holubice I

The several sites at Holubice were excavated by the Vyškov Museum along the new motorway M1 from Brno to Vyškov (Čižmař 1985, 2010; Čižmař *et al.* 1980, 1981, 1987; Rakovský 1985) between 1979 and 1983. At the site of Holubice I several features of Bell Beaker occupation were uncovered, from which 43 pottery fragments could be studied. In Ondráček *et al.* (2005) their overview, this settlement is named as Holubice II.

The clay of these sherds is almost solely tempered with quartz and sand, crushed stone and chamotte are found occasionally. Size of the temper particles is small in most cases. The vessels are built up by coiling, and the specific N-coiling technique was visible on 3 sherds. The majority of the sherds are wall fragments, while also rim and bottom fragments occur. Wall thickness of the sherds shows a single peak at 5 mm. Finishing of the vessels was done by smoothing on a large majority of sherds (90%), while none of the sherds had been roughened. Most of the pottery sherds were fired in a oxidised atmosphere, as bright colours dominate the inside and outside of most sherds. Decoration is present on 98% of the sherds. This decoration is only found in zoned motifs. The sole technique used on these sherds is impression by means of a dented spatula.

7.3.3.14 Česka I

The settlement of Česka I was excavated by the Moravia Museum in Brno in 1983 (Ondráček *et al.* 2005, 47). A single feature was found, containing pottery fragments. In total, 29 sherds could be analysed.

The clay of these sherds is almost solely tempered with quartz and sand, crushed stone and chamotte are found occasionally. Size of the temper particles is in most cases small to medium. The vessels are built up by coiling, and the specific N-coiling technique was visible on 4 sherds. Surprisingly, the majority of the sherds are rim fragments, while also wall and bottom fragments occur and a single complete vessel was recorded. Wall thickness of the sherds shows a single peak at 5 mm. Finishing of the vessels was done by smoothing on a large majority of sherds (59%), while none of the sherds had been roughened. Most of the pottery sherds were fired in a oxidised atmosphere, as bright colours dominate the inside and outside of most sherds. Decoration is present on 41% of the sherds. This decoration is only found in zoned motifs. The techniques used are impression by means of a dented spatula mostly, nail impressions once and a single incised groove.

7.3.3.15 Těšetice III

The settlement of Těšetice III was excavated by Kalousek in 1955 (Kalousek 1956; Ondráček *et al.* 2005) and consists of a single feature (Obj 1/55) from which pottery, bone and charcoal could be obtained. The 50 sherds of pottery were studied.

The clay of these sherds is almost solely tempered with sand and quartz. Size of the temper particles is small to medium. The vessels are built up by coiling, however the specific N-coiling technique was on 3 sherds. The majority of the sherds are wall fragments, while also rim, foot and bottom fragments occur and a single vessel was recorded. Wall thickness of the sherds shows a single peak at 5 mm. Finishing of the vessels was done by smoothing on a large majority of sherds (66%), while only 2% of all the sherds was roughened. Most of the pottery sherds were fired in a completely reduced atmosphere, but some sherds show oxidised interiors and exteriors, providing evidence for oxidised baking atmospheres. Decoration is present on 10% of the sherds. This decoration is only found in zoned motifs. Techniques used include impression and incision. Impressions with spatula predominate, and a single incised groove is observed.

7.3.3.16 Kelčice I

The settlement of Kelčice I was uncovered during digging for a water pipeline in 1989 (Ondráček *et al.* 2005, 67-68). It consists of a single feature in which a large quantity of pottery was deposited. In total 722 sherds were analysed.

The clay of these sherds is almost solely tempered with quartz and sand. Size of the temper particles is medium to small. The vessels are built up by coiling, and the specific N-coiling technique was visible on 12 sherds. The majority of the sherds are wall fragments, while also rim, foot and bottom fragments occur. Wall thickness of the sherds shows a single peak at 7 mm. Finishing of the vessels was done by smoothing on a large majority of sherds (53%), while only 6% of all the sherds was roughened. Most of the pottery sherds were fired in a completely reduced atmosphere, as oxidised colours are almost completely absent. Decoration is present on 22% of the sherds. This decoration is mainly found in zoned motifs and twice in a limited motif. Techniques used include impression, application and incision. A single applied cordon was recorded, while zoned spatula impressions predominate. Other decoration includes single occurrences of nail impression and incised grooves.

7.3.4 Analysis of skills and creativity

7.3.4.1 Introduction

Specifically of interest here are the variables that reflect potters' own preferences and choices within the process of adopting the Bell Beaker phenomenon. These preferences and choices are reflected in both the skill and creativity involved. The variables that are of most interest to the study of skill include: wall thickness, the coiling techniques, wall finishing and the execution of decoration motifs. For the study of creativity, variability within decoration implements used and decoration motifs expressed will be analysed.

7.3.4.2 Skill

The level of skill in pottery production on Bell Beaker settlements varies between the analysed sites (see table 7.9, 7.18). On most settlements, the coiling technique is not visible, whereas finishing techniques such as smoothing and roughening are visible.

When we analyse the results of this comparison, several things stand out. Finishing is not a common feature on Bell Beaker settlement pottery from the Czech Republic, but relatively abundant in all the other research areas. Visibility of coils is generally low, but somewhat higher on Gaasemosen and Česka I (not taking into account the several sites from which the dataset is small). Mean wall thickness is relatively high on three sites, 5 and 159 and 191. These three sites all have significant components of Vlaardingen group, Corded Ware or Bronze Age occupation, which might have influenced this. When we compare the other settlements with one another, variation between mean wall thickness is low (see fig. 7.17).

With regard to the skills involved in forming pottery no clear differences can be observed between potters from different settlements across the Bell Beaker phenomenon in North-western, Central and Northern Europe. In general, all the potters were equally skilled in their craft of producing pottery despite the differential adoption of the Bell Beaker phenomenon across Europe.

As said, the forming of pottery is not the only skilful practice that could be analysed. The execution of decoration motifs also plays a role. As we have seen earlier, Cormenier (2009) identified the decorating of Artenac shaped vessels with very specific motifs that mimic Bell Beaker zoned patterns in a ‘sloppy’ way. This can be seen as a lack of skill, a lack of ‘know-how’, on behalf of the potter who still

Table 7.9 Comparison of different quantifiable elements of skill.

settlement ID	chronology	sherds (vessels)	finishing	forming	wall thickness variation				
			% none/ not visible	% coils visible	mean	sd	median	q1	q3
5	BB/EBA	102	8.8	1	11.90	2.86	12	10	14
16	BB	36 (1)	2.8	19.4	6.39	0.79	6	6	7
23	BB	152	1.3	2	5.90	1.45	6	5	7
42	BB	796	3.5	4.4	7.81	2.21	7	6	9
85	BB	40 (4)	7.5	57.5	6.23	0.90	6	6	7
159	CW	5 (1)	0	0	9.00	2.24	8	8	8
191	CW	357	0	5.9	10.05	2.98	10	8	11
358	BB	237	6.8	0	8.03	2.33	8	7	9
361	BB/EBA	375	1.3	4.5	6.61	1.24	7	6	7
409	BB	982	1.4	0.4	7.74	2.12	7	7	8
431	CW	114	6.1	15.8	8.44	2.35	8	7	10
592	BB	42	9.5	7.1	4.60	0.94	5	4	5
613	BB	29	41.4	13.8	5.41	1.32	5	4	6
628	BB	722	41	1.9	6.71	1.64	7	6	8
672	BB	50	32	6	5.22	1.39	5	5	6

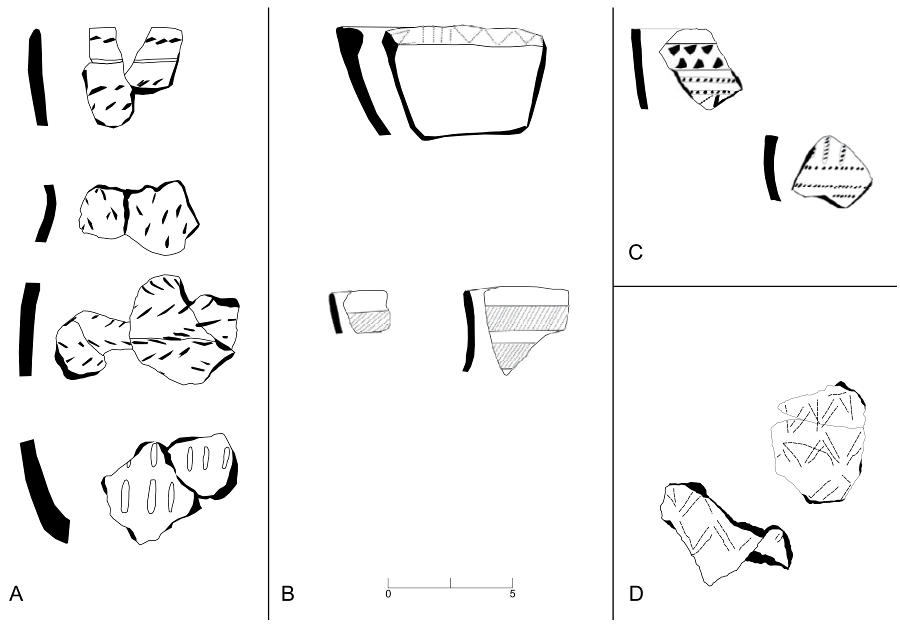


Fig. 7.16 Pottery from Haarlem (A), Těšetice III (B), Kelčice I (C) and Lanz 14 (D).

shaped vessels according to the Artenac way-of-doing. While this particular extreme example is not found in the pottery assemblages that were studied here, there are notable differences in the execution of decoration motifs.

In most case studies the Bell Beaker pottery decoration motifs are executed with care and in a precise and strict manner. See for instance the Bell Beaker sherds from Haarlem, Těšetice III, Kelčice I and Lanz 14 (see fig. 7.16). When studying these sherds, the care is exemplary in several respects: firstly, the straightness of the lines. Secondly the continuation from one spatula impression to the next spatula impression is smooth. Thirdly, all the sherds show clear temporality in their impressions, as envisaged by the depth and relief of the impression: the decoration was always applied at the same moment in the production process. The Bell Beaker sherds from Lanz 14 present a contrasting perspective. Here, Bell Beaker decoration is impressed with a dented spatula or incised. Horizontal lines are however not always horizontal, the decoration does not neatly join up, neither is it impressed or incised in a consistent manner into the clay vessel (see fig. 7.16D).

Both in Western France and Northern Germany, it appears that potters in some cases lacked the skills and know-how of decorating Bell Beakers in the same way as other potters across Europe. There is no lack of trying to decorate their thin-walled pottery with a Bell Beaker motif though, so there clearly is a conscious choice in wanting to be part and of and take part in this network of the exchange of information and objects.

7.3.4.3 Creativity

In the Czech Republic, most Bell Beaker decoration consists of zoned motifs. Within these zones however, a variety of infillings can be observed, ranging from (the traditional) horizontal, vertical and diagonal impressed lines, to creative designs such as ovals, squares, triangles, and hatched patterns. These patterns are all carried out in a very strict and orderly fashion. This kind of creativity is much lower in other research areas, as table 7.10 shows. A further argument for creativity in the Czech Republic Bell Beaker repertoire is the bowl with a T-shaped rim (Besse 2003a, type 78; Besse 2003b, fig. 33). This vessel shape is common to the Late Neolithic in Central Europe, but decorating this traditional shape with Bell Beaker motifs on the rim

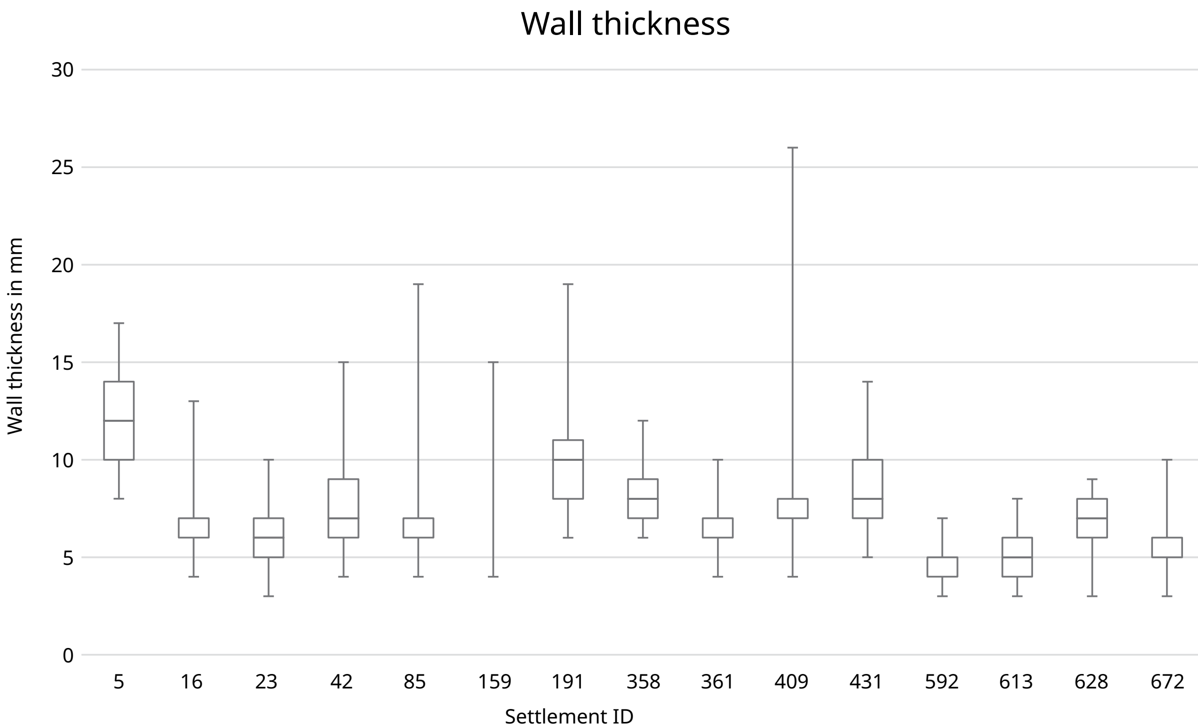


Fig. 7.17 Wall thickness of pottery sherds per settlement.

creates a combination only found in Central Europe and the Czech Republic specifically (see fig. 7.16B top).

A different form of creativity is the phenomenon of the potbeker (see fig. 7.16A), found in the Lower Rhine Area. Here, a thin to medium-thin walled vessel is decorated with geometric motifs mimicking Bell Beaker so-called 'Veluvian-style' decoration motifs (Lehmann 1965, 27). Similarly, occasional potbeker decoration techniques, such as pinched warts, are found on Veluvian Bell Beakers (Lehmann 1965, 5). The decoration on potbekers doesn't consist of common spatula impression, but of nail impressions (sometimes called 'pseudo-cord' because of their style mimicking cord impressions), applied bands and incised grooves and pinched warts. These motifs are executed in a very strict and orderly fashion.[22] Thus, while the shape of these vessels is similar to Bell Beakers, and the decoration motifs are similar to Bell Beakers, the implements are very much not Bell Beakers and stem from a local and traditional repertoire, also found in Corded Ware settlement pottery (see for instance Beckerman 2015). Clearly, there are no comparable examples for potbeker vessels outside of the Lower Rhine Area, limiting this particular creative outburst to the communities within this research area.

In Northern and Western France there are no clear indications for distinctive creativity within the pottery production process during the appearance and adoption of the Bell Beaker phenomenon. This absence also holds interpretive value for understanding how the adoption process of the Bell Beaker phenomenon took place in these regions.

7.4 Conclusion

All the potters are skilful artisans who know how to make the new thin-walled, finely tempered, smoothed and highly-decorated Bell Beaker ceramics. Variability

22 This can make it difficult for researchers to differentiate between Potbeker and Bell Beaker sherds.

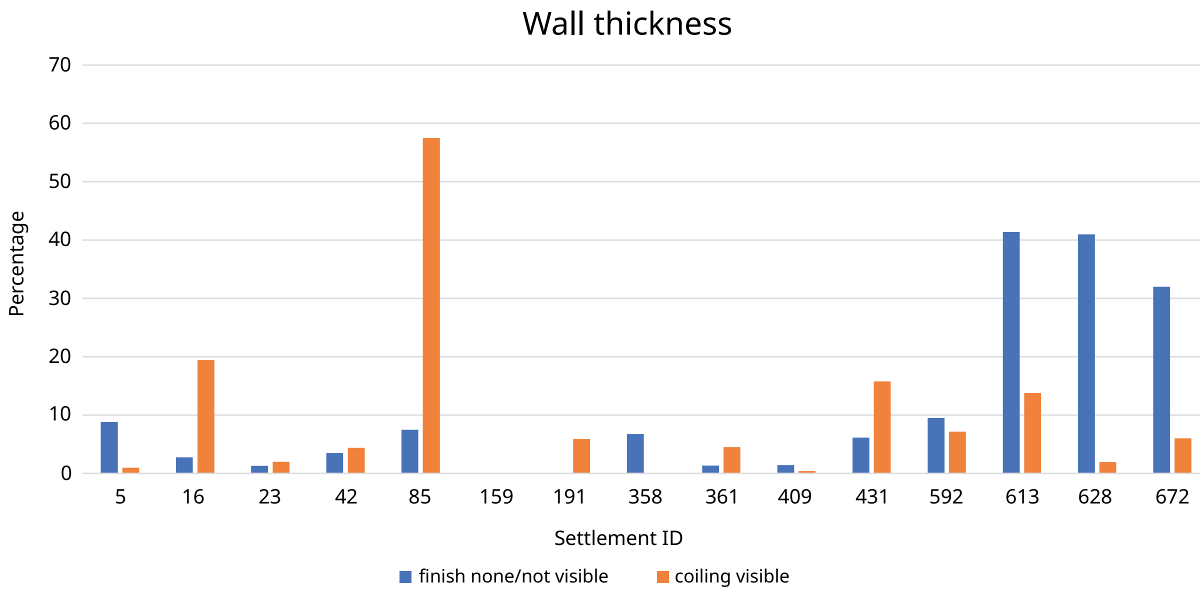


Fig. 7.18 The absence of wall finish and the visibility of coiling methods on pottery sherds per settlement.

Settlement ID	Spatula motif	Spatula motif expression
5	geometric/zone	horizontal
23	random/zone	horizontal, vertical, diagonal, herringbone, zigzag on rim
42	zone	horizontal, diagonal, vertical, zigzag
191	zone	horizontal, herringbone
361	zone	diagonal
409	zone	horizontal, diagonal
592	zone	horizontal, vertical, zigzag, diagonal, hatched
613	zone	horizontal, herringbone, diagonal, vertical, oval, zigzag
628	limited/zone	horizontal, diagonal, herringbone, vertical, zigzag, oval, square
672	zone	horizontal, zigzag, diagonal

Table 7.10 Comparison of spatula motifs and expression variability.

exists in the skills of decorating the Bell Beaker vessels with specific spatula motifs. On most of the studied settlements, Bell Beaker pottery is finely decorated, with no overlapping motifs, clean empty zones and straight lines. However this trend is not common everywhere. In both Western France and Northern Germany there are less skilful examples of decorating Bell Beaker vessels found. These examples possibly indicate an early adoption of certain visible and salient elements (*cf.* Cormenier 2009) or point to less care and less attention towards the innovation itself, maybe also reflected in a lower sustainability of the innovation process. With regard to creativity, the decoration implements and expression are compared, in order to understand the different ways of regional reinvention and the impact that arose from adopting the Bell Beaker phenomenon. There are certain decorative elements found in settlements in the Czech Republic which indicate a high level of creativity. Additionally, the presence of *Cardium* shell impressed Bell Beaker pottery, along the

Atlantic coast (*e.g.* Salanova/Prieto Martinez 2008), is a form of widely shared creativity, and shows the impact the adoption of the Bell Beaker phenomenon had on communities living in these areas. Another element of creativity shows the particular regional reinvention, in the particular decorating techniques and motifs of the various potbeker types of vessels. These particular decoration motifs are found in the Lower Rhine Area, and mimic the Bell Beaker motif, but executed in traditional nail-impressed techniques.

8 Discussion and conclusion

8.1 Introduction

Over the past three chapters we have analysed data concerning the processes, timing and pace of innovation. We have looked at the different mechanisms of diffusion involved, from the construction of regional communication networks to the moving of objects, people, ideas and practices. And we studied the different skills and aspects of creativity involved in practices of pottery production in different parts of Europe. In this chapter we combine all these different perspectives. The way in which this is done, is by recapitulating the main research question asked in chapter 1. "How have local communities across Europe adopted the Bell Beaker phenomenon?"

At first, the results from each case study are described and confronted with the current academic consensus. By summarizing our findings from the previous chapters, the different aspects of innovation will be combined into coherent interpretations of "how local communities adopt the Bell Beaker phenomenon" and how this gives us an understanding that is different from previous research.

Additionally, this makes it possible for us to generalise. In the second paragraph of this chapter the different aspects themselves and their mutual relationships are discussed. Can we for instance generalise between the pace of the adoption and the associated mechanisms or practices involved?

A third paragraph looks critically at the methodology. As our research questions are unique in their theoretical underpinnings and in their practical application, an evaluation of the different methods used, and the inspiration that led to this is much needed and can provide a basis for further studies into prehistoric innovation processes, mechanisms and practices.

8.2 Bell Beaker adoption per research area

8.2.1 Lower Rhine Area

In the Lower Rhine Area, after an initial increase, the percentage of Bell Beakers decreases slightly over time after its adoption. The adoption itself can be characterised by the availability phase in Zvelebil's model, as most pottery was still of local variety, and no substitution or consolidation took place. Despite this, the adoption itself had a high impact and high sustainability, as many sites exist with both low and relatively high percentages of Bell Beakers. The pacing of the innovation is moderate, when considering the interval between pre-Bell Beaker and Bell Beaker occupation at Vlaardingen Arij Koplaan. The adoption of the Bell Beaker phenomenon in the Low Countries starts between 2600-2500 BC, coinciding with the final phases of the Corded Ware phenomenon, such as found in the Westfrisian wetlands (*e.g.* Smit *et al.* 2012; Kleijne *et al.* 2013; Theunissen *et al.* 2014).

There are no real cliques within the Bell Beaker network in the Lower Rhine Area, but there are several coastal settlements with a higher connectedness. This leads to a relatively strong and heterogenous communication network between Bell Beaker settlements, and probably positively influencing the widespread and sustainable adoption. The division between the Veluvian and the Northeast group, as proposed by Lanting (2008) is not visible in the settlement evidence. Associated with this network are new ideas about funerary rituals, partly adopting elements, such as items of dress, from the preceding Corded Ware phenomenon, as we have seen in paragraph 6.3.2.

Other regionally innovative practices include horse domestication and local metallurgy. The practice of metallurgy enjoyed a significant status, as exemplified in the various graves of craftsmen, of which there is a concentration in the Netherlands. Horse domestication could possibly have been initiated from a local Neolithic wild population. Contrary to the common opinion, these wild horse populations might have been living in the dry and open vegetations on the ice-pushed ridges in the Central Netherlands (Laarman 2001, 19; Zeiler 2017). While most flint and stone used was found locally or acquired regionally, the long-distance exchange of high-quality objects shifted (from the various southern sources) to Scandinavian sources during the course of the Bell Beaker phenomenon.

A regional reinvention of the Bell Beaker phenomenon took place with the unique potbeker style vessels typical for the Lower Rhine Area. This combination of traditional vessel shapes and decoration techniques with innovative “Bell Beaker-like” decoration motifs and wall thickness, signifies the skill and creativity involved with the process of adopting the Bell Beaker phenomenon. At the same time a continuity in pottery vessel shapes and decoration styles, can be observed between Late Neolithic Vlaardingen vessels, Corded Ware bekerpot vessels and Bell Beaker Common Ware. This continuity in vessel shape, and the respective motor-habits, also provides evidence for a gradual adoption process.

8.2.2 Northern France

For Northern France, we stated the hypothesis that the Bell Beaker phenomenon would be completely absent. This could be seen on Europe-wide overviews, and it would seem that the communities living here had not adopted the Bell Beaker phenomenon. As it turns out several Bell Beaker settlements are known, however situated in the Seine and Rhine valleys and along the Channel coast. The Final Neolithic Gord and Deûle/Escaut communities, showing a continuous tradition from Seine-Oise-Marne, occupied the central plateau and upper Scheldt valley basin. The few settlements that have been found containing Bell Beaker pottery, all show a very low percentage, indicating a low impact and low sustainability of the Bell Beaker phenomenon. The adoption process itself can be characterised as an availability and simultaneous or consequent active rejection against the Bell Beaker phenomenon.

Settlements of the Gord and Deûle/Escaut groups are both slightly older and contemporaneous to the Bell Beaker phenomenon, but show no resemblance in terms of the practices carried out. Instead, when considering the communication networks, clear cliques are visible between settlements of the Gord and Deûle/Escaut groups. These cliques are striking for their betweenness heterogeneity and mutual link strength, which surely affected and frustrated the adoption process of the Bell Beaker phenomenon here.

When it comes to the mechanisms involved in this process, the continuous exchange and perhaps more importantly, the local reworking of Grand-Pressigny flint must be mentioned. Metal objects are found on Bell Beaker and Gord settlements, and thus probably also constitute the objects of exchanges, as evidence for local production is absent. The craft of metalworking is not attested from the excavated Gord or Deûle/Escaut settlements. A large body of evidence, however, does point to the local production of textiles on these settlements (Martial 2008). The scarce Bell Beaker evidence does present some quantity of *céramique commune*, distinct from the Gord and Deûle/Escaut vessels but resembling other Common Ware vessels.

According to recent research (Salanova *et al.* 2011, 88) the earliest Bell Beaker evidence in Northern France consists primarily of funerary activity. Several of these graves, and also later graves, are found in the areas of Gord and Deûle/Escaut settlements (Salanova *et al.* 2011, fig. 4, 5 and 6). Have these individuals deliberately and purposefully been interred in the vicinity of these settlements? Could these be their own ancestors or, contrastingly, can we speak of claims made to the land by these newcomers? The 'appropriation of Bell Beaker elements' on Gord and Deûle/Escaut settlements is envisioned by these scholars (Salanova *et al.* 2011, fig. 8). However, the present treatment of settlement evidence, communication networks and potting practices, contradicts this. In all these aspects do we see a complete separation between Gord and Deûle/Escaut on the one hand and Bell Beaker on the other hand.[23] Only a single possible fragment of Bell Beaker pottery was found on a Deûle/Escaut settlement, at a distance from the main building and habitation activities, clearly signifying the distance culturally between these two distinct entities. It appears that in Northern France, two distinct communities with distinct traditions and ancestry, lived side-by-side for several generations without much interaction.

8.2.3 Western France

In Western France, the Bell Beaker phenomenon is represented by various settlements. Also here, a low percentage of Bell Beaker pottery is frequently found, whereas any chronological trend remains inconclusive. The adoption process of the Bell Beaker phenomenon can be characterised with the availability phase in Zvelebil's model. The adoption of the Bell Beaker phenomenon in Western France does show a high impact and high sustainability. Chronologically, we can see the adoption of the Bell Beaker phenomenon starting between 2500-2450 BC, based on the stratigraphic sequence of the La Lède du Gurp settlement. Taking the habitation intervals between pre-Bell Beaker (Artenac) and Bell Beaker occupation at this site into consideration, we see a slow process of adopting the Bell Beaker phenomenon.

Most new Bell Beaker settlements are coastal, whereas the Bell Beaker occupation on inland sites is found as later elements on Late Neolithic settlements and near megaliths. This is also apparent in the two network clusters. Within these two clusters of settlements, a strong link strength is visible. But simultaneously these clusters are accompanied by some very important nodes linking the two clusters, preventing the formation of cliques and, in effect, facilitating the communication of ideas. This network itself is quite heterogenous, and, combined with this strong link strength, this might have caused the slow adoption process. But all-in-all, this did not hamper the adoption of the Bell Beaker phenomenon. These communication networks facilitated the exchange of ideas and objects. The long-distance exchange of Grand-Pressigny objects and raw materials changed to a primarily local sourcing

23 And while 'pottery does not equate people' this evidence shows a more complex relationship between the social aspects of technology and material culture on the one hand and people on the other.

of flint. A handful of Grand-Pressigny daggers and other artefacts found on three Bell Beaker settlements (Cordis, Grande Pigouille and Grand Rocher) might indicate the long use of these artefacts instead of acquisition through exchanges.

The presence of a large number of Palmela points in Western France (not only on settlements) should be noted (*cf.* Roussot-Larroque 2002). Palmela points, or more likely the ideas behind Palmela points, originated in the Iberian Peninsula and spread swiftly across Southwestern Europe between 2300 and 2000 BC. This large number of Palmela points, and the processes by which these ideas travel, contrast with the slow Bell Beaker adoption process and continuity in terms of settlement evidence and networks mentioned before. Common Ware pottery is found on Bell Beaker settlements in Western France, and it is similar in shape and decoration style to other Common Ware, found in Northern France and further beyond. It is unclear whether this represents a break from Artenac vessel forming traditions or a continuous development. Laporte and Gomez de Soto (2008) see a break in potting tradition, based partly on the differences between Artenac and Common Ware pottery vessel shapes, however the metric analyses do not yet confirm or contrast this. Notable is the adoption of certain potting elements by Artenac communities in an early stage of reinvention. These local Artenac communities mimicked Bell Beaker decoration, however crudely and poorly executed, on their own Artenac pottery vessels (so-called *Artenac Tardif*). While the Common Ware pottery points to the exchange of ideas with the northern sphere of interaction, the presence of Palmela points indicates another influence, related to a swift adoption of ideas from the Iberian Peninsula. It is in Central Western France that these two developments meet.

8.2.4 Portuguese Estremadura

In the Portuguese Estremadura, settlements show an increase in Bell Beaker pottery percentage in through time, however still maintaining the availability phase of innovation, as percentages remain below 50%. The adoption itself is shown to have a high impact and high sustainability, with a large number of settlements having quite substantial percentages of Bell Beaker pottery. Also, the adoption process itself was fast paced, when considering the settlement of Zambujal. Here only a short interval between the pre-Bell Beaker and Bell Beaker occupation phases took place. Modelling also indicate a start of this fast paced adoption process between 2600-2500 BC.

Communication networks between Bell Beaker settlements in the Portuguese Estremadura, a medium link strength and heterogenous network centrality shows the importance of certain settlements, the enclosed settlements such as Leceia, Zambujal and Vila Nova São Pedro, within the communication network. With regard to mechanisms that have aided the adoption and diffusion of the Bell Beaker phenomenon, the regional exchange of pottery is noted. Non-local and exchanged objects found on Bell Beaker settlements in the Iberian Peninsula include amber (Odriozola *et al.* 2017), ivory (*e.g.* Schuhmacher 2017) and metal (silver, gold and copper) objects. Most of the objects and raw materials made from ivory or amber probably originate in Northern African, Sardinian and Sicilian communities, or further east along the Mediterranean. Also, many of these materials are already found in earlier 5th, 4th and 3rd millennium BC contexts, illustrating the continuous and long-term nature of these exchange networks. Local metallurgy is known from the Iberian Peninsula, and particularly from the Portuguese Estremadura, from 2900 BC (De Carvalho Amaro 2012) and also evidence for the local domestication of horses and donkeys seems to have taken place in the Chalcolithic, predating the Bell Beaker phenomenon (Cardoso *et al.* 2013).

All in all, a large degree of continuity is observed on many levels. This continuity can also be apparent when considering pottery typology and technology, as respectively Kunst (1995) and De Carvalho Amaro (2012) have done. It is clear that

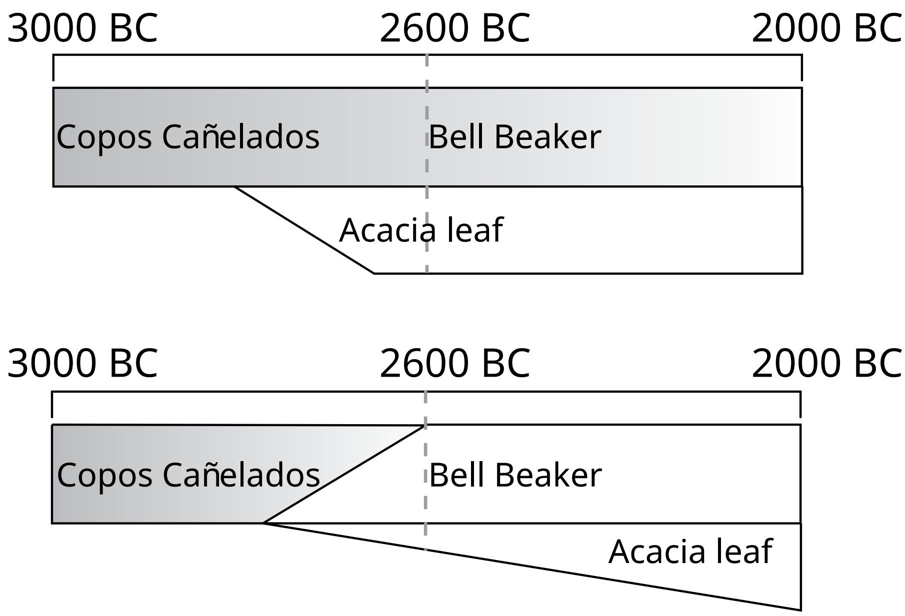


Fig. 8.1 Two different models for the Chalcolithic in the Estremadura region.

copos (or as Kunst calls it *zylindrische Gefäße*) date to the Early Chalcolithic, and Bell Beakers date to the Late Chalcolithic. De Carvalho Amaro (2012) argues for a technological development from *copos* to Bell Beaker pottery, however he is mainly focused on the raw materials present.

Acacia-leaf pottery (*Kerbblattverzierung*), besides accompanying *copos*, is also found in Bell Beaker contexts, as Kunst (1995, 145-147) explains, perhaps fulfilling the role played by Common Ware pottery in other parts of Europe. According to Kunst (1995) it exists continuous besides both *copos* and Bell Beaker pottery. However a different view is presented by Cardoso (2014), who states that a clear separation can be seen between the Chalcolithic and the Bell Beaker presence in the Estremadura region of Portugal. He sees the acacia-leaf pattern as particular and only related to the Late Chalcolithic, associated with the start of the Bell Beaker phenomenon around 2600 BC.

This debate centres on the continuity of potting traditions (see figure 8.1). On the one hand it seems, the only new Bell Beaker innovation that was adopted during this phase was the specific Bell Beaker motif, executed in a spatula or cord impressed technique. On the other hand, the development of acacia-leaf pottery from the Late Chalcolithic onwards, could be seen as a reinvention practice, akin to the Potbeker practice in the Lower Rhine Area: local vessel shapes with an international decoration style but executed in local decoration techniques. Only the detailed study of closed contexts, far away from the large enclosed settlements, can provide an answer helping us to understand the adoption process of the innovation that is the Bell Beaker phenomenon.

8.2.5 Czech Republic

For the Czech Republic, no conclusive trend is visible in the adoption of the Bell Beaker phenomenon, as most settlements only show a limited percentage of Bell Beaker sherds. The phasing in the adoption process can be characterised as the availability phase. The adoption process itself had a high impact on and high sustainability within communities. The adoption itself takes place at a moderate pace, starting between 2500-2450 BC, as indicated by the long-term occupation site of Horni Ián.

When considering communication networks, a very strong link strength can be seen between the sites. Also, the settlements themselves show a very homogenous betweenness centrality. Together these observations make for a clique. Apparently, despite this large clique, the Bell Beaker phenomenon became adopted quite intensively, with many new settlements appearing (see for the number of Corded Ware settlements: Peška 2000). This intensity and impact is also illustrated by the evidence for high levels of skill in the Bell Beaker pottery production process, and the creativity seen in the large variation of decoration motifs. Mechanisms of this exchange between settlements probably included the regional mobility of pottery, but also of humans. The changing role of metal objects and production is indicated by both the fragments of slag and metal tools found on a Bell Beaker settlement, and the 'metalworkers' graves' (see Bátora 2002). This points to somewhat comparable developments in the Lower Rhine Area (albeit that metallurgy in itself is by no means a new practice in the Czech Republic). The Bell Beaker communities in the Czech Republic were part of the exchange network of Scandinavian flint, although local production of similar tools is also attested. The exchange of ideas also included funerary customs, as indicated by both the bone pendants and bone plates found in Corded Ware and Bell Beaker graves in the Czech Republic.

Also, the shapes of Common Ware pottery in the Czech Republic are traditional and comparable to earlier Corded Ware shapes, as already Besse (2003) illustrated. Notable is the fact that most of these Common Ware vessels are thin-walled which is in contrast to the Common Ware pottery in Northwest and Western Europe. This is a traditional element in Begeleitkeramik, also found in the Corded Ware phenomenon. An example of the reinvention of the Bell Beaker phenomenon taking place is the bowl with a T-shaped rim. This vessel type is often found on Bell Beaker settlements in the Czech Republic, and can be considered a combination of traditional (shape) and innovative (decorative) elements. Apart from these examples, there appears to be a strict division in terms of decoration techniques and motifs on Common Ware or Bell Beaker pottery vessels. A particular creative element is the appearance of incrustation on Bell Beaker pottery (Všianský *et al.* 2014).

In the Czech Republic, the adoption of the Bell Beaker phenomenon had for long been seen as due to a migration of people. However, at present, due to the recognition of the Common Ware pottery and the settlement evidence, a local development is generally agreed upon. Heyd (2007) regards the adoption of the Bell Beaker phenomenon as a purely ideological change. For the Czech Republic, this might as well explain why we see such a uniformity in the settlement data, such a clique within the network, and why the transition took place only after it had already occurred in the Lower Rhine Area.

8.2.6 Southern Scandinavia & Northern Germany

In Southern Scandinavia and Northern Germany, the chronological trend of Bell Beaker adoption shows an almost constant curve. Therefore, in this case study as well, the adoption of the Bell Beaker phenomenon remains limited to the availability phase, and no substitution or consolidation taking place. A high impact but a low sustainability can be seen in the number of settlements having Bell Beaker pottery. The speed of adopting the Bell Beaker phenomenon probably was slow, starting around 2350 BC, as is generally accepted (*e.g.* Vandkilde 1996; Sarauw 2008) and agrees with the occupation interval between Corded Ware and Bell Beaker habitation at the settlement of Mortens Sande II shows us.

The communication networks between communities in Southern Scandinavia and Northern Germany show a weak link strength, and several small almost unconnected cliques, in which a heterogenous betweenness centrality is apparent. This weak link strength, and the different cliques that existed, or in other words the lack of similarities in daily life practices between communities in this region, probably influenced the impact and sustainability of the Bell Beaker adoption and mechanisms of adoption, such the exchange of ideas. In some areas of this research area, the Bell Beaker phenomenon became adopted, and highly skilful pottery production techniques developed, including long-distance contacts, such as the *Cardium* shell impressed Bell Beaker pottery. In other areas of this research area the Bell Beaker phenomenon was adopted less wholeheartedly, and a more ephemeral or flimsy influence on pottery production techniques can be demonstrated. This is, for instance, the case for (parts of) Northern Germany, where, next to a small assemblages of regular Bell Beaker pottery on settlements, local interpretations of the Bell Beaker motif exist. Details concerning the mobility of objects and people is limited to the exchange of Scandinavian flint daggers to communities in Scandinavia, the Lower Rhine Area and Central Europe from around 2300 BC. The exchange of these flint daggers was not only part of the Bell Beaker phenomenon, as some of them are found further north and east, into Norway, Sweden and Belarus. This probably reflects the quite limited impact that object exchanges might have had on the exchange of ideas and the process of adopting the Bell Beaker phenomenon in the first place. The Bell Beaker phenomenon in Denmark and Schleswig-Holstein probably also saw the appearance of local metalworking practices. While traces of metallurgy are not known from settlements themselves, the evidence from metal objects and cushion stones points into that direction. Another introduction associated with the Danish Bell Beaker phenomenon might have been the local crop cultivation of domesticated spelt wheat. Outside of Denmark this is only found in Bell Beaker contexts in Switzerland. The Common Ware pottery in Southern Scandinavia and Northern Germany consists of S-shaped vessels, not unlike the German Riesenbecher and the other Common Ware pottery. This clearly presents a continuous developments from Corded Ware settlement pottery, a phenomenon also found in the Lower Rhine Area.

So all in all, we observe two separate developments in Southern Scandinavia & Northern Germany: A Bell Beaker network has developed in Denmark, and particularly in Jutland with a concentration of settlements, creativity and the exchange of many ideas and objects. Contrastingly, this is not the case for Northern Germany, where only occasionally Bell Beaker material culture is found. Here the Bell Beaker phenomenon is a less sustainable innovation, with not as much impact and influence on the potters' practices.

Sarauw (2008) studied the appearance of Bell Beaker material culture in Southern Scandinavia most recently and focused in particular on the appearance of daggers of Lomborg's type I and Bell Beaker pottery. The latter is seen by Sarauw (2008, 38) as "…a foreign invention originating somewhere in the south west of Europe. Beakers were then copied, reinterpreted and adapted to fit into local contexts such as northern Jutland..". He relates this to the spread to new communication networks, the exploitation of flint sources, the specific geographical position, and attracting new methods of enhancing prestige by local elites. Interesting advantage of the (northern Jutland) Limfjord area over Northern Germany is its geographical position, which might have acted in favour of adopting the Bell Beaker phenomenon, and more importantly sustaining its development beyond the mere exchange of flint daggers. However this doesn't fully explain the bipartite development seen. Northern German flint is of similar high quality (Högberg/Olausson 2007, 100-103) and fit for making daggers and other implements (albeit not with as much skill as in Southern Scandinavia; Rassmann 2001). Similarly, Northern Germany formed part of the Corded Ware phenomenon (Jacobs 1991). Neither does it explain why these Southern Scandinavian communities are relatively late in adopting the Bell Beaker phenomenon, in comparison to the Lower Rhine Area. Most likely it is the combination of skill in dagger production (the parallel retouch and ornamental seams) and the geographical favourable position of Northern Denmark for maintaining exchange networks, that led to its adoption of the Bell Beaker phenomenon.

8.3 General trends in adopting Bell Beaker innovations

Having discussed the different ways in which the Bell Beaker phenomenon became adopted, the different mechanisms involved in the adoption and diffusion taking place within the various research areas and the practices and their qualities involved, it is now possible to see whether generalisations can be made as to the nature of the Bell Beaker innovation processes, mechanisms and practices. Are there any overarching elements visible, when comparing the different aspects of Bell Beaker innovation? Do processes, mechanisms and practices correlate? Does, for instance, the pace of adoption relate to the openness or heterogeneity of the networks, or

Table 8.1 Comparison of all the various aspects of innovation and the different research areas.

Chapter	Variable	Lower Rhine Area	Northern France	Western France	Portuguese Estremadura	Southern Scandinavia & Northern Germany	Czech Republic
5	availability model	availability	availability	availability	availability	availability	availability
5	process	re-invention	active rejection	re-invention	re-invention	re-invention	re-invention
5	impact	high	low	high	high	high	high
5	sustainability	high	low	high	high	low	low
5	innovation pace	medium	na	medium/slow	fast	medium/slow	fast/medium
5	innovation timing	*c.*2600 BC	na	*c.*2500-2450 BC	*c.*2600 BC	*c.*2500-2450 BC	*c.*2500-2450 BC
6	GN connected/ clusters	3/7	1/5	2/3	2/3	2/8	1/1
6	link strength	medium	strong	strong	medium	weak	strong
6	geographical focus	coastal/ riverine	riverine/inland	coastal	coastal	coastal	no concentration
6	node variability	homogenous	heterogenous	heterogenous	heterogenous	heterogenous	homogenous
6	pottery exchange	no evidence	no evidence	local	no evidence	no evidence	regional
6	ideas exchange	slow, Corded Ware network	none	fast, Iberian network	fast, Iberian network	slow, Corded Ware network	slow, Corded Ware network
6	people mobility	no evidence	no evidence	no evidence	no evidence	no evidence	regional
7	vessel shapes	continuity	discontinuity	continuity?	no evidence	continuity	continuity
7	skill	high	no evidence	varied; Artenac-tardif	no evidence	varied	high
7	creativity	Potbekers and Cardium	none	Cardium	Cardium	Cardium	Spatula variation

the skill involved in Bell Beaker potting practices? While all the mentioned correlations do not mean anything with regard to causation, let alone answer the question what becomes first, it can provide us with some interesting perspectives. Also, the absence of correlations might bring us further in a methodological way, understanding whether the variables chosen really reflect the process, mechanism or practice under study (see table 8.1).

Firstly, there appears to be a correlation between both weak and strong link strength within Girvan-Newman clusters and the late adoption of the Bell Beaker phenomenon. Here we see, on the one hand, strong cliques that are harder to convince of adopting the Bell Beaker phenomenon. On the other hand, also weak communication networks have made it more difficult to communicate and adopt the Bell Beaker phenomenon. The earliest adopters have an intermediate link strength: a relatively strong communication network, but also an network open to influence and ideas. This favours the spread of new innovations such as the Bell Beaker phenomenon.

There seems to be no correlation between the pace of adoption, how fast the Bell Beaker phenomenon became adopted within a particular region, and the impact the Bell Beaker phenomenon has had on (in this case) settlement frequencies.

What we do see is a relationship between research areas where high levels of skill are present in pottery production, and a high impact of the Bell Beaker phenomenon. When there is a more varied skillset involved, with less quality in decorating Bell Beaker pottery vessels, there in turn also appears to be a slow pace of adoption, maybe because of reasons to do with the social network and the presence of cliques, or the lack of strong communication networks.

With regard to communication networks, the continuity between the Corded Ware and Bell Beaker communication networks, as we have seen in the distribution of bone plates and pendants, in North and Central Europe, has had no direct influence on the pace of adoption, with slow, moderate and fast paces recorded in the different affected research areas. There is however a continuity visible in vessel shape for all the areas that are part of this trajectory. The exchange network in West and Southwest Europe, as we have seen in paragraph 6.3.2.3 presently defined mainly by the distribution of Palmela points, also shows no correlation to the pace of adoption. A fast adoption is described for the Portuguese Estremadura, while the Bayesian model suggests a much slower adoption pace in Western France.

8.4 Methodological observations

In the above we have witnessed different aspects of innovation matching with each other and the methodology showing consistent results across the different research areas. However, a critical perspective is necessary here as not all methods that were invented for this study of innovation processes, mechanism and practices are in agreement with one another. Especially in the study of innovation processes there is room for methodological improvement. As said, none of the research areas show an S-curve model adoption of the Bell Beaker phenomenon in terms of percentages. The inspiration of using pottery percentages stems from the studies on neolithization by Louwe Kooijmans and Zvelebil. These studies do show an availability, substitution and consolidation phases, when the percentage of wild animals drops in favour of domesticated animals. Are pottery percentages then the best way to study the adoption of the Bell Beaker phenomenon? Whatever the answer to this question, the analysis did make an important point, as it illustrates the character of this innovation: it is not a replacement of local traditions, as in the Neolithisation process, but something much more fine-grained, like a ‘veneer’ (*cf.* Gibson 2007) and swift like a fashion.

Additionally, the use of Bayesian statistics in a proxy-like manner to assess the temporality of innovations, their pace and timing, is a new method. The created models will improve when more stratigraphic sequences are treated like this. The theoretical relationship between interpreting the occupation phase as the start of an innovation is complicated by the fact that most dating evidence does not belong to the start of an occupation, but to its final moments. While this is not taken into consideration here, it might have led to an overestimation of the interval length between pre-Bell Beaker and Bell Beaker phases. Perhaps future work into soil formation processes can help define sharp boundaries and lead to estimations about the duration of occupation horizons.

A further point to stress is the specific nature of the data that was used, namely settlements and not the burial record. This is not to say that the burial record cannot inform us about the Bell Beaker innovation processes, mechanisms and practices.

Intertwined with the study of the Bell Beaker burial record, is the construction of Bell Beaker typochronologies. These typochronologies are primarily based on the analysis of burial data and use association and seriation and the earliest examples of radiocarbon dating as main methods (*e.g.* Van Der Waals/Glasbergen 1955; Clarke 1970; Gebers 1978; Lanting 1973; Treinen 1970a, 1970b). Recent examples have developed using more advanced statistical models (see for instance Grossmann 2016). As said before however, the chronological resolution of radiocarbon data is usually too low for simple strict typochronologies to be constructed and positioned in absolute terms. Besides that, a main critique presented at the start of this thesis is that clear-cut funerary-based, typochronologies do not reflect a prehistoric reality. The typological patterns observed in the funerary dataset however can still be relevant for understanding the Bell Beaker innovation process. One important consideration here is relativity: Funerary pottery typochronologies are better understood as regional temporal patterns in the deposition of particularly chosen pottery in a very particular context.

As Müller *et al.* (2015, see figure 8.2) demonstrate, some of these typochronologies, like Ullrich's for Central Germany (Ullrich 2008), do allow us another perspective on the processes of change and innovation taking place with the adoption of the Bell Beaker phenomenon. For instance, their study shows that styles of Bell Beaker pottery decoration motifs changed in ca 150-200 year intervals. While their study

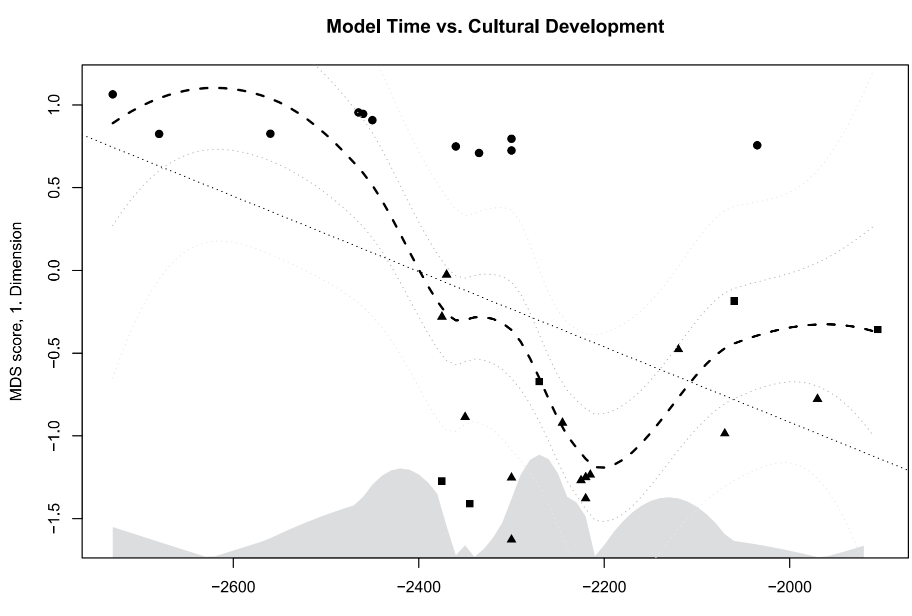


Fig. 8.2 Stylistic development (dotted line) and speed of innovation (shaded area) as studied on Bell Beaker pottery decoration from Central Germany (from Müller et al. 2015, 65, fig. 6.7).

is not comparative in nature, it can be assumed that for different areas of Europe, different intervals exist.

8.5 Why adopt?

This brings us to a final question one can ask: Why did communities all across Europe adopt the Bell Beaker phenomenon in the first place? The explanation of sociologist Rogers (2003) to this question starts with the generalising “recognising a problem or need” (Rogers 2003, 137-139). His elaboration however does not delve deeper into the underlying problems or needs that need to be recognised for innovation to become adopted.

Archaeologists have often assumed (perhaps taken for granted) that the acquisition of new materials, ‘prestigious objects’ or new practices can be the reason to adopt an innovation and become part of new exchange networks (*e.g.* Needham 2000; Kristiansen/Larsson 2005), even up to the scale of a ‘world systems theory’ in which elites control the flow of goods in order to keep their status and hierarchy in place (*e.g.* Sherratt 1993). If we are to take this model as a uniform basis for the adoption, it does not really fit the variable distribution of ‘precious’ objects we see, compared to the spread of the Bell Beaker phenomenon. There are large regional differences in the distribution of (for instance) amber, ivory or flint. Neither does it explain why, for instance, the Portuguese Estremadura adopted the Bell Beaker phenomenon, as no new precious objects appear with the advent of Bell Beakers (instead ivory, silver, gold and copper metallurgy are already present here since the Early Chalcolithic).

Another explanation is of partial genetic, partial cultural origin, following a Darwinian evolutionary perspective. Shennan (2000) proposes that cultural change, as he calls it, is driven by population pressures. He names two reasons for this, at first the strong vertical transmission of knowledge of artefact production and secondly, the small population sizes and therefore large effects of random processes such as drift affecting cultural attributes. Maybe we could even connect this with the model proposed by Vander Linden (2007), who suggested the exchange of marriage partners as a motivator for the diffusion of the Bell Beaker phenomenon. When we look at the Northern French case study, where the Late Neolithic Gord and Deûle/Escaut communities actively rejected the Bell Beaker phenomenon. When we follow the argument put forward by Shennan (2000), a drop in population size might have led to a loss of cultural attributes and cessation of the vertical transmission of knowledge.

A further explanation for the adoption of the Bell Beaker phenomenon is that it reflects certain values shared across large distances. These values are expressed most prominently in the burial record, but also in other aspects of daily life, including the production and use of Bell Beaker pottery, but also the ways in which traditional pottery changed. This line of thinking uses the concept of ‘imagined community’ that was explained by Anderson (1985) and coined in archaeology by Isbell (2000).

Whereas some communities only adopt certain elements, such as the decoration motifs on Bell Beaker pottery, and thus become part of this ‘imagined Bell Beaker community’ quite easily, others develop their own traditions of specific burial rituals (such as warrior graves) or drinking rituals (such as alcoholic beverages). What then is it that defines this shared idea in a material sense? The past chapters have made it clear that there is no easy answer.

8.6 Conclusion

Over the past eight chapters we have seen how the beginning and development Bell Beaker phenomenon is presently defined and presented. A specific unilateral picture exists. The narrative is based on a particular reading of a constrained dataset. This altogether leads in itself to an interpretative straitjacket, in which cultural change and the adoption of the Bell Beaker phenomenon is seen as swift, radical and inevitable. In this thesis we have contrasted this picture by looking at innovation processes, the social landscape of innovation, and the interplay between practices of tradition and innovation.

This study has shown that the adoption processes in relation to the Bell Beaker phenomenon are not straightforward. Instead, the timing of the adoption, the pacing and rate of innovation, the impact and sustainability vary from region to region. This study has also shown that the diffusion of Bell Beaker innovations was dependent on many different factors, and had many different mechanisms at play, ranging from pottery exchange to the movement of people. The reinvention of the Bell Beaker pottery technology, was also regional process in which not only society but also the potter played a significant part. While many regional studies into adoption processes, mechanisms and practices exist, for the first time a uniform conceptual framework links all these different aspects together.

What then is "the Bell Beaker phenomenon"? The Bell Beaker phenomenon is not a uniform or 'one-size-fits-all' phenomenon. There were many regionally different ways in which communities adopted and reinvented the various Bell Beaker innovations (such as metallurgy or specific pottery), many ways in which ideas were exchanged and particular objects and specific people were moving. All these different lines of evidence are, in a way, their own Bell Beaker phenomenon. Therefore, it might be better to speak of Bell Beaker phenomena instead.

In other words, these various Bell Beaker phenomena consist of the many exchanges of objects and ideas and the various mobilities of people in the later 3rd millennium BC. This all together is only made possible by the many communities across Europe embracing the Bell Beaker.

Bibliography

AARSLEFF, E. & CASATI, C. 2012. Bopladser fra dolktiden – nogle betragtninger. *NoMus,* 25, 24-30.

ABERCROMBY, J. 1912. *A study of the Bronze Age pottery of Great Britain and Ireland and its associated grave-goods,* Oxford: Clarendon Press.

AGACHE, R. 1968. Nord et Picardie. *Gallia Préhistoire,* 11, 267-309.

AKERET, Ö. 2005. Plant remains from a Bell Beaker site in Switzerland, and the beginnings of *Triticum spelta* (spelt) cultivation in Europe. *Vegetation History and Archaeobotany,* 14, 279-286.

ALBRECHT, H. 1965. Ein Glockenbechergrab in Mühlhausen/Thür. *Alt-Thüringen,* VII, 203-207.

ALEXANDER, D. H., NOVEMBRE, J. & LANGE, K. 2009. Fast model-based estimation of ancestry in unrelated individuals. *Genome Research,* 19, 1655-1664.

ALLEN, M. J., GARDINER, J. P. & SHERIDAN, J. A. (eds.) 2012. *Is there a British Chalcolithic? People, place and polity in the late 3rd millennium* (Prehistoric Society Research Paper 4), Oxford: Oxbow Books.

ALLENTOFT, M. E., SIKORA, M., SJOGREN, K.-G., RASMUSSEN, S., RASMUSSEN, M., STENDERUP, J., DAMGAARD, P. B., SCHROEDER, H., AHLSTROM, T., VINNER, L., MALASPINAS, A.-S., MARGARYAN, A., HIGHAM, T., CHIVALL, D., LYNNERUP, N., HARVIG, L., BARON, J., CASA, P. D., DABROWSKI, P., DUFFY, P. R., EBEL, A. V., EPIMAKHOV, A., FREI, K., FURMANEK, M., GRALAK, T., GROMOV, A., GRONKIEWICZ, S., GRUPE, G., HAJDU, T., JARYSZ, R., KHARTANOVICH, V., KHOKHLOV, A., KISS, V., KOLAR, J., KRIISKA, A., LASAK, I., LONGHI, C., MCGLYNN, G., MERKEVICIUS, A., MERKYTE, I., METSPALU, M., MKRTCHYAN, R., MOISEYEV, V., PAJA, L., PALFI, G., POKUTTA, D., POSPIESZNY, L., PRICE, T. D., SAAG, L., SABLIN, M., SHISHLINA, N., SMRCKA, V., SOENOV, V. I., SZEVERENYI, V., TOTH, G., TRIFANOVA, S. V., VARUL, L., VICZE, M., YEPISKOPOSYAN, L., ZHITENEV, V., ORLANDO, L., SICHERITZ-PONTEN, T., BRUNAK, S., NIELSEN, R., KRISTIANSEN, K. & WILLERSLEV, E. 2015. Population genomics of Bronze Age Eurasia. *Nature,* 522, 167-172.

ALMAGRO GORBEA, M. 1970. Las fechas del C-14 para la prehistoria y la arqueología peninsular. *Trabajos de Prehistoria,* 27, 9-44.

ALVARES PEREIRA DE MELLO, O., FORTUNA, V., CAMARATE FRANÇA, J., DA VEIGA FERREIRA, O. & ROCHE, J. 1961. O monumento pré-histórico da Bela Vista (Colares). *Comunicações dos Serviços Geológicos de Portugal,* 44, 237-249.

AMEELS, V., BASTIAENS, J., BATS, M., CROMBÉ, P., DEFORCE, K., HANECA, K., PARENT, J.-P. & VAN STRYDONCK, M. 2003. Recent Steentijdonderzoek in de regio Oudenaarde (Oost-Vlaanderen, België). *Notae Praehistoricae,* 23, 61-65.

AMKREUTZ, L. W. S. W. 2013. *Persistent traditions : a long-term perspective on communities in the process of Neolithisation in the Lower Rhine Area (5500-2500 cal BC),* Leiden: Sidestone Press.

AMKREUTZ, L. W. S. W. 2013. *Persistent traditions : a long-term perspective on communities in the process of Neolithisation in the Lower Rhine Area (5500-2500 cal BC). Appendices*, Leiden: Sidestone Press.
AMMERMAN, A. J. & CAVALLI-SFORZA, L. L. 1971. Measuring the Rate of Spread of Early Farming in Europe. *Man,* 6**,** 674-688.
ANDERSEN, S. H. 1983. Kalvø – A Coastal Site of the Single Grave Culture. *Journal of Danish Archaeology,* 2**,** 71-80.
ANDERSON, B. R. 1983. *Imagined Communities: Reflection on the Origin and Spread of Nationalism*, London/New York: Verso.
ANDRADE, G. E. M. & GOMES, J. J. F. 1959. Estudo preliminar da estação pré-histórica de Carnaxide. *Actas e Memórias do 1o Congresso Nacional de Arqueologia Lisboa 1958 vol 1*, Lisboa: Instituto de Alta Cultura, 137-146.
ANDREASEN, M. H. 2009. Agerbruget i enkeltgravskultur, senneolitikum og ældre bronzealder i Jylland e belyst ud fra plantemakrofossiler. *Kuml,* 2009**,** 9-55.
ANDREWS, P., EGGING DINWIDDY, K., ELLIS, C., HUTCHESON, A., PHILLPOTTS, C., POWELL, A. B. & SCHUSTER, J. 2009. *Kentish Sites and Sites of Kent. A miscellany of four archaeological excavations*, Salisbury: Wessex Archaeology.
ANTHONY, D. W. 1990. Migration in Archaeology: The Baby and the Bathwater. *American Anthropologist,* 92**,** 895-914.
ANTHONY, D. W. 2007. *The Horse, the Wheel and Language. How Bronze-Age riders from the Eurasian steppes shaped the modern world*, Princeton: Princeton University Press.
ANTHONY, D. W. & BROWN, D. R. 2000. Eneolithic horse exploitation in the Eurasian steppes: diet, ritual and riding. *Antiquity,* 74**,** 75-86.
ANTONIEWICZ, W. 1937. Z dziedziny archeologii zien Polski. Zabytki z groby kamiennego skrzynkowego w Nartach, w. pow. Gostyninskim. *Swiatowit,* 17**,** 341-422.
APEL, J. 2001. *Daggers, knowledge and power. The social aspects of flint-dagger technology in Scandinavia 2350-1500 cal BC*, Uppsala: Uppsala University.
APELLÁNIZ CASTROVIEJO, J. M. 1968. La datación por el C-14 de las Cuevas de Gobadaerra y Los Husos I en Álava. *Estudios de Arqueología Álavesa (Vitoria),* 3**,** 139-145.
APELLÁNIZ CASTROVIEJO, J. M. 1973. *Corpus de materiales de las culturas prehistóricas con cerámica de la población de cavernas del País Vasco Meridional* (Suplemento Munibe 1), San Sebastián: Sociedad de Ciencias Naturales Aranzadi.
APELLÁNIZ CASTROVIEJO, J. M. 1973. El grupo de Los Husos durante la prehistoria con cerámica en el País Vasco. *Estudios de Arqueología Álavesa (Vitoria),* 7**,** 7-409.
ARMENDÁRIZ, A. 1988. *Euskal Herrika Dolmenak*, Donostia: Kriselu.
ARNAUD, J. M. 1977. Excavaçõnes no Penedo do Lexim (Mafra) / 1975. Noticia preliminar. *O Arqueológo Português,* III**,** 398-404.
ARNAUD, J. M. & GAMITO, T. J. 1972. O povoado fortificado da Serra das Baútas. *O Arqueológo Português,* III**,** 121-161.
ARNAUD, J. M. & GONÇALVES, J. L. 1990. A fortificação pré-histórica de Vila Nova de S. Pedro (Azambuja) – balanço de meio século de investigações. 1ª parte. *Revista de Arqueologia da Assembleia Distrital de Lisboa,* 1**,** 25-48.
ARNAUD, J. M. & GONÇALVES, J. L. 1995. A fortificação pré-histórica de Vila Nova de S. Pedro (Azambuja) – balanço de meio século de investigações. 2ª parte. *Revista de Arqueologia da Assembleia Distrital de Lisboa,* 2**,** 11-40.
ARNAUD, J. M., OLIVEIRA, V. S. & OLIVEIRA JORGE, V. 1971. O povoado fortificado neo- eneolitico do Penedo de Lexim (Mafra). Campanha preliminar de escavações – 1970. *O Arqueológo Português,* III**,** 97-132.
ARNOLD, D. E. 1985. *Ceramic theory and cultural process* (New Studies in Archaeology), Cambridge: Cambridge University Press.
ARNOLD, V. 1973. Steinbronzezeitliche Siedlungsreste auf dem "Tegelbarg", Gemeinde Quern – Neukirchen, Kr. Flensburg. *Offa,* 30**,** 94-95.

ARNOLD, V. 1974. Tegelbarg, ein spatneolithischer Kiistenfangplatz an der Flensburger AuBenforde. *Die Heimat,* 81**,** 87-93.

ARNOLD, V. 1981. Ein aus Schlagabfällen rekonstruierbarer Flintdolch vom Tegelbarg, Gemeinde Quern, Kreis Schleswig-Flensburg. *Offa,* 38**,** 53-160.

ARNOLDUSSEN, S. 2000. *Covered with Clay. Man and Landscape during the Late Neolithic up to the Middle Bronze Age of the Dutch central river area.* MA Thesis, Leiden University.

ARNOLDUSSEN, S. 2008. *A Living Landscape. Bronze Age settlement sites in the Dutch river area (c. 2000-800 BC)*, Leiden: Sidestone Press.

ARNOLDUSSEN, S. & SCHEELE, E. E. 2012. The ancestors nearby. The domestic and funerary landscape of Angelslo-Emmerhout. *In:* VAN DER VELDE, H. M., JASPERS, N. L., DRENTH, E. & SCHOLTE LUBBERINK, H. B. G. (eds.) *Van graven in de prehistorie en dingen die voorbijgaan. Studies aangeboden aan Eric Lohof bij zijn pensionering in de archeologie*, Leiden: Sidestone Press, 153-185.

ARTS, N. 2010. Spoorloze boeren in Noord-Brabant? Aardewerk en andere neolithische vondsten in Meerhoven (gemeente Eindhoven). *In:* VERHART, L. B. M. & DE RIDDER, T. (eds.) *Vlaardingen-cultuur* (Westerheem Special 2), Eindhoven: AWN, 186-208.

ASHMORE, P. J. 1999. Radiocarbon dating: avoiding errors by avoiding mixed samples *Antiquity,* 73**,** 124-130.

ASINGH, P. 1987. Diverhøj – A Complex Burial Mound and a Neolithic Settlement. *Journal of Danish Archaeology,* 6**,** 130-154.

ASSENDORP, J. J. 1991. Bronzezeitliche Besiedlung in Hitzacker. *Archäologie in Deutschland,* 1991**,** 49-50.

ASSENDORP, J. J. 1997. Die bronzezeitliche Siedlung in Hitzacker, Niedersachsen. *In:* ASSENDORP, J. J. (ed.) *Forschungen zur bronzezeitlichen Besiedlung in Nord- und Mitteleuropa. Internationales Symposium vom 9.-11. Mai 1996 in Hitzacker* (Internationale Archäologie 38), Bonn: Verlag Marie Leidorf GmbH, 51-59.

ATKINSON, R. J. C. 1959. *Stonehenge and Avebury and neighbouring monuments. An Illustrated Guide*, London: Her Majesty's Stationery Office.

BACH, H. 1965. Beitrag zur Anthropologie der Glockenbecherleute. *Alt-Thüringen,* VII**,** 208-227.

BADER, O. N. 1940. Das Gräberfeld im Uročišče Karabaj bei der Stadt Balanovo in Tschuwaschien (Russ.). *Sovetskaja archeologija,* 6**,** 63-87.

BAILEY, G. N. 2007. Time perspectives, palimpsests and the archaeology of time. *Journal of Anthropological Archaeology,* 26**,** 198-223.

BAILLOUD, G. 1964. *Le Néolithique dans le Bassin Parisien* (Gallia Préhistoire supplément 2), Paris: CNRS.

BAILLOUD, G. & COIFFARD, P. 1967. Le locus 5 des Roches à Videlles (Essonne). Etude archéologique. *Bulletin de la Société Préhistorique Française – Études et Travaux,* 64**,** 371-410.

BAIONI, M., LEONINI, V., LO VETRO, D., MARTINI, F., POGGIANI KELLER, R. & SARTI, L. 2008. *Bell Beaker in Everyday Life. Proceedings of the 10th Meeting "Archéologie et Gobelets" (Florence – Siena – Villanuova sul Clisi, May 12-15, 2006)* (Studi di archeologia preistorica 6), Firenze: Museo Fiorentino di Preistoria «Paolo Graziosi».

BAKKER, J. A. 1966. Een nederzetting van de Trechterbekercultuur te Laren (N.H.). *In:* GLASBERGEN, W., GROENMAN-VAN WAATERINGE, W., VAN GIFFEN, A. E. & BAKKER, J. A. (eds.) *In het voetspoor van A.E. van Giffen,* Groningen: Wolters, 27-32.

BAKKER, J. A. 1979. *The TRB West Group: Studies in the Chronology and Geography of the Makers of Hunebeds and Tiefstich Pottery* (Cingula V), Amsterdam: Universiteit van Amsterdam.

BALFANZ, K., FRÖHLICH, M. & SCHUNKE, T. 2015. Ein Siedlungsareal der Glockenbecherkultur mit Hausgrundrissen bei Klobikau, Sachsen-Anhalt, Deutschland. *In:* MELLER, H. H., ARZ, H. W., JUNG, R. & RISCH, R. (eds.) *7th Archaeological Conference of Central Germany October 23-26, 2014 in Halle (Saale).* (Tagungen des Landesmuseums für Vorgeschichte Halle 12), Halle: Landesmuseum für Vorgeschichte Halle, 747-763.

BALL, E. A. G., ARNOLDUSSEN, S. & VAN HOOF, L. G. L. 2001. *Aanvullend Archeologisch Onderzoek in de Heeswijkse Kampen te Cuijk* (Archol Rapport 5), Leiden: Archol.

BAMFORD, M. H. 1982. *Beaker Domestic Sites in the Fen Edge and East Anglia* (East Anglian Archaeology 16), Norfolk: Norfolk Archaeology Unit.

BANTELMANN, N. 1986. Eine schnurkeramische Siedlungsgrube in Speyer. *Offa,* 43**,** 13-27.

BARABASI, A. L. 2003. *Linked. How Everything Is Connected to Everything Else and What It Means for Business, Science, and Everyday Life*, New York: Plume.

BARABASI, A. L. 2011. *Bursts. The Hidden Patterns Behind Everything We Do, from Your E-mail to Bloody Crusades*, New York: Plume.

BARBOSA, E. 1956. O castro da Ota (Alenquer). *O Arqueológo Português,* II**,** 117-124.

BARBOSA-FILHO, H., BARTHELEMY, M., GHOSHAL, G., JAMES, C. R., LENORMAND, M., LOUAIL, T., MENEZES, R., RAMASCO, J. J., SIMINI, F. & TOMASINI, M. 2017. Human Mobility: Models and Applications. *Physics Reports***,** arXiv:1710.00004 [physics.soc-ph].

BARCLAY, A., GRAY, M. & LAMBRICK, G. 1995. *Excavations at the Devil's Quoits, Stanton Harcourt, Oxfordshire 1972-1973 and 1988* (Thames Valley Landscapes: the Windrush Valley Volume 3), Oxford: Oxford Archaeology Unit.

BARFIELD, L. H. 2001. Final Discussion. *In:* NICOLIS, F. (ed.) *Bell beakers today. Pottery, people, culture, symbols in prehistoric Europe. Proceedings of the International Colloquium Riva del Garda (Trento, Italy), 11-16 May 1998*, Trento: Provincia autonoma di Trento, Servizio beniculturali, Ufficio beni archeologici, 617-622.

BARLEY, N. 1994. *Smashing Pots. Feats of Clay from Africa*, London: British Museum.

BARRAUD, C., DE COPPET, D., ITEANU, A. & JAMOUS, R. 1994. *Of relations and the dead. Four societies viewed from the angle of their exchanges*, Oxford/Providence: Oxford University Press.

BARTON, C. M. 1997. Stone Tools, Style, and Social Identity: an Evolutionary Perspective on the Archaeological Record. *In:* BARTON, C. M. & CLARK, G. A. (eds.) *Rediscovering Darwin: Evolutionary Theory in Archaeological Explanation* (Archaeological Papers of the American Anthropological Association 7), Washington DC: American Anthropological Association, 141-156.

BAR-YOSEF, O. & ALON, D. 1988. Excavations at Nahal Hemar Cave. *'Atiqot,* 18**,** 1-30.

BATISTA, C. 2003. Cerâmicas Campaniformes no Povoado da Serra das Éguas. *ARQA – patromónio em revista,* 1.

BÁTORA, J. 2002. Contribution to the problem of "craftsmen" graves at the end of the Aeneolithic and in the Early Bronze Age in Central, Western and Eastern Europe. *Slovenská Archeológia,* 50**,** 179-228.

BÁTORA, J., MARKOVÁ, K. & VLADÁR, J. 2003. Die Glockenbecherkultur im Kontext der kulturhistorischen Entwicklung der Südwestslowakei. *In:* CZEBRESZUK, J. & SZMYT, M. (eds.) *The Northeast Frontier of Bell Beakers. Proceedings of the symposium held at the Adam Mickiewicz University, Poznań (Poland), May 26-29 2002* (British Archaeological Reports: International Series 1155), Oxford: Archaeopress, 255-264.

BÁTORA, J. & VLADÁR, J. 2002. Die Besiedlungsproblematik der Glockenbecherkultur in der Südwestslowakei. Beitrag zu den Anfängen der Bronzezeit. *Budapest Régiségei,* XXXVI**,** 199-209.

BAUCH, W. 1988. Eine Nachbestattung der Einzelgrabkultur mit Pferdeschädel in einem Megalithgrab von Borgstedt, Kreis Rendsburg-Eckernförde. *Offa,* 45, 43-74.

BAYLISS, A., BRONK RAMSEY, C., VAN DER PLICHT, J. & WHITTLE, A. W. R. 2007. Bradshaw and Bayes: Towards a Timetable for the Neolithic. *Cambridge Archaeological Journal,* 17, 1-28.

BECKER, C. J. 1936. Enkeltgravskulturen på de danske øer. *Aarbøger for Nordisk Oldkyndighed og Historie,* 1936, 145-231.

BECKER, C. J. 1956. Coarse Beakers with 'Short-Wave Moulding'. *Proceedings of the Prehistoric Society,* 21, 65-71.

BECKER, C. J. 1963. Neolithic Bracers in Denmark. *Munera archaeologica Iosepho Kostrzewski quinquagesimum annum optimarum artium studiis deditum peragenti ab amicis, collegis, discipulis oblata.*, Poznan: Poznańskie Towarzystwo Przyjaciół Nauk, 97-102.

BECKER, D. 1982. Mittelsteinzeitliches bis frühkaiserzeitliches Fundgut von der Inselsiedlung im Trenntsee auf der Gemarkung Pastin, Kreis Sternberg. *Bodendenkmalpflege in Mecklenburg Jahrbuch,* 1981, 8-31.

BECKER, D. 2002. Die neolithische Inselsiedlung am Löddigsee bei Parchim. *In:* BECKER, D. & BENECKE, N. (eds.) *Die neolithische Inselsiedlung am Löddigsee bei Parchim. Archäologische und archäozoologische Untersuchungen* (Beiträge zur Ur- und Frühgeschichte Mecklenburg-Vorpommerns 40), Lübstorf: Archäologisches Landesmuseum Mecklenburg-Vorpommern, 9-79.

BECKER, D. & BENECKE, N. 2002. *Die neolithische Inselsiedlung am Löddigsee bei Parchim. Archäologische und archäozoologische Untersuchungen* (Beiträge zur Ur- und Frühgeschichte Mecklenburg-Vorpommerns 40), Lübstorf: Archäologisches Landesmuseum Mecklenburg-Vorpommern.

BECKERMAN, S. M. 2012. Dutch Beaker chronology re-examined. *Palaeohistoria,* 53/54, 25-64.

BECKERMAN, S. M. 2015. *Corded Ware Coastal Communities. Using ceramic analysis to reconstruct third millennium BC societies in the Netherlands,* Leiden: Sidestone Press.

BECKERMAN, S. M. & RAEMAEKERS, D. C. M. 2009. Vormvariatie van Vlaardingen-aardewerk. Een nieuwe typochronologie van het aardewerk van de Vlaardingengroep (ca. 3400-2500 v. Chr.). *Archeologie,* 13, 63-82.

BEHN, F. 1928. Spätneolithische Gräber bei Darmstadt. *Germania,* 10, 101-102.

BELO, A. R. 1955. Subsídios para o estudo da época do bronze na região de Torres Vedras. *Estremadura. Boletim da Junta de Província,* 38-40, 109-121.

BENDREY, R. 2011. Identification of metal residues associated with bit-use on prehistoric horse teeth by scanning electron microscopy with energy dispersive X-ray microanalysis. *Journal of Archaeological Science,* 38, 2989-2994.

BENDREY, R. 2012. From wild horses to domestic horses: a European perspective. *World Archaeology,* 44, 135-157.

BENDREY, R., THORPE, N., OUTRAM, A. K. & VAN WIJNGAARDEN-BAKKER, L. H. 2013. The Origins of Domestic Horses in North-west Europe: New Direct Dates on Horses of Newgrange, Ireland. *Proceedings of the Prehistoric Society,* 79, 91-103.

BENECKE, N. 1994. Zur Domestikation des Pferdes in Mittel- und Osteuropa. Einige neue archäozoologische Befunde. *In:* HÄNSEL, B. & ZIMMER, S. (eds.) *Die Indogermanen und das Pferd. Akten des Internationalen interdisziplinären Kolloquiums, Freie Universität Berlin, 1.-3. Juli 1992*, Budapest: Archaeolingua, 123-144.

BENEŠOVÁ, A. 1955. Spätneolithische Gürtelplatten aus Knochen. *Mitteilungen der Anthropologischen Gesellschaft in Wien,* 84/85, 70-75.

BENKOVSKY-PIVOVAROVÁ, Z. & CHROPOVSKÝ, B. 2015. *Grabfunde der frühen und der beginnenden mittleren Bronzezeit in der Westslowakei* (Archaeologica Slovaca monographiae 22), Nitra: Archeologický ústav.

BENZ, M. & STADELBACHER, A. (eds.) 1995. *Das Glockenbecher-Phänomen. Ein Seminar* (Freiburger Archäologische Studien 2), Freiburg: Institut für Ur- und Frühgeschichte der Universität Freiburg i. Br.

BENZ, M. & VAN WILLIGEN, S. 1998. *Some New Approaches to The Bell Beaker 'Phenomenon'. Lost Paradise…?, Proceedings of the 2nd Meeting of the « Association Archéologie et Gobelets », Feldberg (Germany), 18th-20th avril 1997* (British Archaeological Reports: International Series 690), Oxford: Archaeopress.

BERAN, J. 1990. *Funde der Einzelgrabkultur im Bezirk Magdeburg* (Neolithische Studien IV), Halle: Martin-Luther-Universität Halle-Wittenberg.

BERTEMES, F. & HEYD, V. 2002. Der Übergang Kupferzeit/Frühbronzezeit am Nordwestrand des Karpatenbeckens – Kulturgeschichtliche und paläometallurgische Betrachtung. *In:* BARTELHEIM, M., PERNICKA, E. & KRAUSE, R. (eds.) *Die Anfänge der Metallurgie in der Alten Welt. The Beginnings of Metallurgy in the Old World* (Forschungen zur Archäometrie und Altertumswissenschaft 1), Rahden: Verlag Marie Leidorf GmbH, 185-228.

BESSE, M. 1998. L'apport de l'étude de la céramique commune à la compréhension du Campaniforme. *Bulletin de la Société Préhistorique Française,* 95**,** 327-331.

BESSE, M. 2003. *L'Europe du 3e millénaire avant notre ère. Les céramiques communes au Campaniforme*, Lausanne: Cahiers d'archéologie romande.

BESSE, M. 2003. Les céramiques communes des Campaniformes européens. *Gallia préhistoire,* 45**,** 205-258.

BESSE, M. 2004. Bell Beaker Common Ware during the third Millennium BC in Europe. *In:* CZEBRESZUK, J. (ed.) *Similar but different. Bell beakers in Europe*, Poznań: Adam Mickiewicz University, 127-148.

BESSE, M. (ed.) 2014. *Around the Petit-Chasseur Site in Sion (Valais, Switzerland) and New Approaches to the Bell Beaker Culture. Proceedings of the International Conference held at Sion (Switzerland) October 27th-30th, 2011*, Oxford: Archaeopress.

BESSELSEN, E. A. & VAN DER HEIDEN, M. J. (eds.) 2009. *Vindplaats VleuGel 20. Archeologisch onderzoek naar een cultuurlandschap uit de Bronstijd* (AAC Publicaties 49), Amsterdam: Universiteit van Amsterdam: Amsterdam Archeologisch Centrum.

BEUKER, J. R. & DRENTH, E. 2006. Scandinavian type flint daggers from the province of Drenthe, the Netherlands. *Vorträge des 8. Internationalen Flint-Symposiums, Bochum 1999. Stone Age – Mining Age – Der Anschnitt*, Bochum: Deutsches Bergbaumuseum Bochum, 285-300.

BILLARD, C., CHAMBON, P. & GUILLON, M. 1995. L'ensemble des sépultures collectives de Val-de-Reuil et de Portejoie (Eure): présentation. *Revue Archéologique de Picardie. Numéro spécial,* 9**,** 147-154.

BILLARD, C., CHANCEREL, A. & MANTEL, E. 1991. Nouveaux sites campaniformes de la basse vallée de la Seine. *Gallia Préhistoire,* 33**,** 137-206.

BILLARD, C., COTTIAUX, R. & DUCROCQ, T. 1985. Un site d'habitat chalcolithique à Grands Laviers (Somme). *Revue Archéologique de Picardie,* 3-4**,** 15-26.

BILLARD, C. & PENNA, B. 1995. Les sites de Poses "Les Quatre Chemins" et "La Plaine de Poses" (Eure): transition Neolithique Moyen-Recent et Campaniforme. *Revue Archéologique de l'Ouest Supplément,* 7**,** 273-291.

BINK, M. (ed.) 2006. *Warmond, Park Klinkenberg: Archeologisch onderzoek* (BAAC Rapport 05.004), Den Bosch: BAAC.

BLANCE, B. M. 1959. Cerâmica estriada. *Revista de Guimarães,* 69**,** 459-464.

BLANCE, B. M. 1971. *Die Anfänge der Metallurgie auf der Iberischen Halbinsel* (Studien zu den Anfängen der Metallurgie 4), Berlin: Römisch-Germanisches Zentralmuseum.

BLANCHET, J.-C. 1984. *Les Premiers Métallurgistes en Picardie et dans la Nord de la France*, Paris: CTHS.

BLANCHET, J.-C. & LAMBOT, B. 1985. Quelques aspects du Chalcolithique et du Bronze ancien en Picardie. *Revue Archéologique de Picardie,* 12, 79-118.

BLANCO GARCÍA, J. F. 2012. El Clacolítico y la Edad del Bronce en Coca (Segovia). *Lucentum,* 31, 15-30.

BLECKMANN, C. 2006. Eguisheim und Burnhaupt-le-Bas – zwei schnurkeramische Siedlungen im Elsaß und ihre Stellung im Endneolithikum. *Archäologische Informationen,* 29, 211-220.

BLOEMERS, J. H. F. 1968. Flintdolche vom skandinavischen Typus in den Niederlanden. *Berichten van de Rijksdienst voor het Oudheidkundig Bodemonderzoek,* 18, 49-112.

BLOEMERS, J. H. F. 1973. Archeologische kroniek van Limburg over de jaren 1969-1970. *Publications de la Société Historique en d'Archéologique dans le Limbourg,* 107/108, 7-79.

BLOM, E., VAN DER FEIJST, L. & VELDMAN, H. A. P. (eds.) 2012. *Plangebied Keizershoeve I. Archeologisch onderzoek op 'De Grote Aalst' te Ewijk (gemeente Beuningen)* (ADC Rapport 2000), Amersfoort: ADC Archeoprojecten.

BLOO, S. B. C., ZUIDHOFF, F. S., WALLINGA, J. & JOHNS, C. A. 2009. Dating a pot beaker and the surrounding landscape using OSL dating. *In:* BERG, I. (ed.) *Breaking the Mould: Challenging the Past through Pottery* (British Archaeological Reports: International Series 1861), Oxford: Archaeopress, 117-123.

BLOUET, V., BUZZI, P., DREIDEMY, C., FAYE, C., FAYE, O., GEBUS, L., KLAG, T., KOENIG, M.-P., MAGGI, C., MANGIN, G., MERVELET, P. & VANMOERKERKE, J. 1992. Données récentes sur l'habitat de l'age du Bronze en Lorraine. *In:* MORDANT, C. & RICHARD, A. (eds.) *l'Habitat et l'occupation du sol à l'Âge du Bronze en Europe*, Paris: CTHS, 177-193.

BLOUET, V., KOENIG, M.-P. & VANMOERKERKE, J. 1996. L'Âge du Bronze Ancien en Lorraine. *In:* MORDANT, C. & GAIFFE, O. (eds.) *Cultures et sociétés du Bronze ancien en Europe, Actes du colloque international de Clermont-Ferrand 1992*, Paris: CTHS, 403-457.

BOAS, N. A. 1986. Tidlige senneolitiske bosættelser på Djursland. *In:* ADAMSEN, C. & EBBESEN, K. (eds.) *Stridsøksetid i Sydskandinavien: beretning fra et symposium 28.-30.X. 1985 i Vejle* (Arkæologiske skrifter 1), København: Forhistorisk Arkæologisk Institut, København Universitet, 318-324.

BOAS, N. A. 1989. Bronze Age Houses at Hemmed Church, East Jutland. *Journal of Danish Archaeology,* 8, 88-107.

BOAS, N. A. 1991. Late Neolithic and Bronze Age Settlement at Hemmed Church and Hemmed Plantation, East Jutland. *Journal of Danish Archaeology,* 10, 119-135.

BOCQUET-APPEL, J.-P., NAJI, S., VANDER LINDEN, M. & KOZLOWSKI, J. K. 2009. Detection of diffusion and contact zones of early farming in Europe from the space-time distribution of 14C dates. *Journal of Archaeological Science,* 36, 807-820.

BODEN, M. 1998. What is Creativity? *In:* MITHEN, S. (ed.) *Creativity in Human Evolution and Prehistory* (Theoretical Archaeology Group), London/New York: Routledge, 15-43.

BOERSMA, J. W. 1988. Een voorlopig overzicht van het archeologisch onderzoek van de wierde Heveskesklooster (Gr.). *In:* BIERMA, M., CLASON, A. T., KRAMER, E. & DE LANGEN, G. J. (eds.) *Terpen en wierden in het Fries-Groningse kustgebied*, Groningen: Wolters-Noordhoff/Forsten, 61-87.

BOHM, W. 1937. *Die Vorgeschichte des Kreises Westprignitz*, Leipzig: Kabitzsch.

BOIRAL, M. & JOUSSAUME, R. 1986. Sites Campaniformes à la Tranche-sur-Mer (Vendée). *In:* JOUSSAUME, R. (ed.) *Cultures campaniformes dans le centre ouest de la France*, La Roche sur Yon: Groupe Vendéen d'Études Préhistoriques, 67-76.

BOKBOT, Y. & BEN-NÇER, A. 2008. Découvertes campaniformes récentes dans les plateaux de Zemmour (Maroc). *In:* BAIONI, M., LEONINI, V., LO VETRO, D.,

MARTINI, F., POGGIANI KELLER, R. & SARTI, L. (eds.) *Bell Beaker in Everyday Life. Proceedings of the 10th Meeting “Archéologie et Gobelets” (Florence – Siena – Villanuova sul Clisi, May 12-15, 2006)* (Studi di archeologia preistorica 6), Firenze: Università degli Studi di Siena, 327-330.

BŐKŐNYI, S. 1978. The earliest waves of domestic horses in East Europe. *Journal of Indo-European Studies,* 6, 17-73.

BOSMAN, W. J. & POLDERMANS, M. 1995. Haarlem: Veer- en Waarderpolder. *In:* HAGERS, J.-K. A. & HESSING, W. A. M. (eds.) *Archeologische Kroniek van Noord-Holland over 1994*, Amersfoort: ROB, 319-322.

BOSTYN, F. & PRAUD, I. 2000. Le site néolithique de Raillencourt-Sainte-Olle « Le Grand Camp » (Nord). *Internéo,* 3, 119-130.

BÖTTCHER, G. 1982. Ein “Gefäßdepot” der Aunjetitzer Kultur aus Gerwisch, Kr. Burg. *Ausgrabungen und Funde,* 27, 172-175.

BOUCHET, J.-M. & BURNEZ, C. 1992. La civilisation des Matignons. *Recherches Archéologiques en Saintonge,* 1992, 3-34.

BOUCHET, J.-M., BURNEZ, C. & FOUÉRÉ, P. 1990. La grande Pigouille à Belluire (Charente-Maritime). *Bulletin de la Société Préhistorique Française,* 87, 153-160.

BOUCHET, J.-M., BURNEZ, C. & FOUÉRÉ, P. 1993. La grande Pigouille à Belluire (Charente-Maritime). *Bulletin de la Société Préhistorique Française,* 90, 436-442.

BOUCHET, J.-M., BURNEZ, C. & FOUÉRÉ, P. 1995. Un site de transition du Néolithique récent-final: la fosse du Peuchin à Pérignac (Charente-Maritime). *Bulletin de la Société Préhistorique Française,* 92, 332-345.

BOUCHET, J.-M., BURNEZ, C., ROUSSOT-LARROQUE, J. & VILLES, A. 1990. Le Bronze ancien de la vallée de la Seugne : La Palut à Saint Léger (Charente-Maritime). *Gallia Préhistoire,* 32, 237-273.

BOUGEANT, P. 2009. Le mobilier céramique du site Campaniforme de l’Écuissière. *In:* LAPORTE, L. (ed.) *Des Premiers Paysans aux Premiers Métallurgistes sur la Façade Atlantique de la France (3500-2000 av. J.-C.)* (Mémoire de la Société de recherches archéologiques de Chauvigny 33), Chauvigny: Association des Publications Chauvinoises, 309-313.

BOURA, F. 1993. Découverte d’un site d’habitat campaniforme à Vandières (Meurthe-et-Moselle): premiers résultats. *Le Néolithique du nord-est de la France et des régions limitrophes. Actes du XIIIe colloqie interrégional sur le Néolithique*, Paris: La maison des sciences de l’homme, 165-172.

BOURGEOIS, Q. P. J. 2013. *Monuments on the Horizon. The formation of the barrow landscape throughout the 3rd and 2nd millennum BC*, Leiden: Sidestone Press.

BRADLEY, R. J. 1970. Where have all the houses gone? Some approaches to Beaker Settlement. *Current Archaeology,* 11, 264-266.

BRADLEY, R. J. 1984. *The Social Foundations of Prehistoric Britain. Themes and variations in the archaeology of power*, London: Longman.

BRAINERD, G. W. 1951. The Place of Chronological Ordering in Archaeological Analysis. *American Antiquity,* 16, 301-313.

BRANCO, M. G. 2007. *A Pedra de Ouro (Alenquer); uma leitura actual da Colecção Hipólito Cabaço* (Trabalhos de Arqueológia 49), Lisboa: Instituto Português de Arqueologia.

BRANDES, U. & WAGNER, D. 2004. Analysis and Visualization of Social Networks. *In:* JÜNGER, M. & MUTZEL, P. (eds.) *Graph Drawing Software*, New York: Springer, 321-340.

BRANDT, G., SZECSENYI-NAGY, A., ROTH, C., ALT, K. W. & HAAK, W. 2014. Human paleogenetics of Europe – The known knowns and the known unknowns. *Journal of Human Evolution*, 1-20.

BRAYNE, J. 2016. *Archer, Journey to Stonehenge*, Salisbury: Small Boat Books.

BRENDOW, V. 1977. Ein spätneolithisches Hockergrab mit Gürtelplatte von Edertal-Bergheim, Kreis Waldeck-Frankenberg. *Fundberichte aus Hessen,* 15, 55-61.

BRIARD, J. 1965. *Les dépôts bretons de l'Age du Bronze atlantique*, Rennes: Université de Rennes.

BRINK, K. 2004. The palisade enclosure at Hyllie, SW Scania. *Journal of Nordic Archaeological Science,* 14**,** 35-44.

BRINK, K. 2009. *I palissadernas tid. Om stolphål och skärvor och sociala relationer under yngre mellanneolitikum* (21), Malmö: Malmö Museer.

BRINK, K. 2013. Houses and Hierarchies: Economic and Social Relations in the Late Neolithic and Early Bronze Age of Southernmost Scandinavia. *European Journal of Archaeology,* 16**,** 433-458.

BRINKKEMPER, O. 2009. *Palynologisch onderzoek aan Rhoon – Het Land van Poortugaal (gem. Albrandswaard)* (BIAXiaal 433), Zaandam: BIAX Consult.

BRODIE, N. J. 1997. New perspectives on the Bell Beaker Culture. *Oxford Journal of Archaeology,* 16**,** 297-314.

BRODIE, N. J. 2001. Technological frontiers and the emergence of the Beaker culture. *In:* NICOLIS, F. (ed.) *Bell beakers today. Pottery, people, culture, symbols in prehistoric Europe. Proceedings of the International Colloquium Riva del Garda (Trento, Italy), 11-16 May 1998*, Trento: Provincia autonoma di Trento, Servizio beniculturali, Ufficio beni archeologici, 487-496.

BRONGERS, J. A. 1976. *Air Photography and Celtic Field Research in the Netherlands* (Nederlandse Oudheden 6), Amersfoort: ROB.

BRONK RAMSEY, C. 2008. Deposition Models for Chronological Records. *Quaternary Science Reviews,* 27**,** 42-60.

BRONK RAMSEY, C. 2009. Bayesian analysis of radiocarbon dates. *Radiocarbon,* 51**,** 337-360.

BROWN, C. T., LIEBOVITCH, L. S. & GLENDON, R. 2007. Lévy Flights in Dobe Ju/'hoansi Foraging Patterns. *Human Ecology,* 35**,** 129-138.

BROWN, D. R. & ANTHONY, D. W. 1998. Bit Wear, Horseback Riding and the Botai Site in Kazakstan. *Journal of Archaeological Science,* 25**,** 331-347.

BRÜCK, J. 2004. Material metaphors: The relational construction of identity in Early Bronze Age burials in Ireland and Britain. *Journal of Social Archaeology,* 4**,** 307-333.

BRUGHMANS, T. 2010. Connecting the Dots: Towards Archaeological Network Analysis. *Oxford Journal of Archaeology,* 29**,** 277-303.

BRUGHMANS, T. 2013. Thinking Through Networks: A Review of Formal Network Methods in Archaeology. *Journal of Archaeological Method and Theory,* 20**,** 623-662.

BRUGHMANS, T. & POBLOME, J. 2015. Pots in space: understanding Roman pottery distribution from confronting exploratory and geographical network analyses. *In:* BARKER, E., BUZAROVSKI, S., PELLING, C. & ISAKSEN, L. (eds.) *New worlds out of old texts: developing techniques for the spatial analysis of ancient narratives*, Oxford: Oxford University Press, 255-280.

BRUNET, P., ANDRE, M.-F., BEMILLI, C., BRUNET, V., COTTIAUX, R., DURAND, J. C., GOSSELIN, R., LE JEUNE, Y. & RENARD, C. 2004. Deux sites de la fin du Néolithique en Vallee de Marne: lesches "Les Près du Refuge" et Meaux "Route de Varreddes" (Seine-et-Marne), résultats préliminaires. *Internéo,* 5**,** 101-113.

BUBNER, T. 1979. Die Äneolithische Siedlung auf dem Miradouro dos Capuchos. *Madrider Mitteilungen,* 20**,** 11-42.

BUCK, C. E., KENWORTHY, J. B., LITTON, C. D. & SMITH, A. F. M. 1991. Combining archaeological and radiocarbon information: A Bayesian approach to calibration. *Antiquity,* 65**,** 808-821.

BÜCKE, S., BARTHEL, H.-J. & GALL, W. 1989. Beiträge zur Kultur der mitteldeutschen Schnurkeramik III. *Alt-Thüringen,* XXIV**,** 33-116.

BUDDEN, S. A. 2009. Skill amongst the sherds: understanding the role of skill in the Early to Late Middle Bronze Age in Hungary. *In:* BERG, I. (ed.) *Breaking the*

Mould: Challenging the Past through Pottery (British Archaeological Reports: International Series 1861), Oxford: Archaeopress, 1-17.

BUENO RAMÍREZ, P., BARROSO BERMEJO, R. & DE BALBÍN BEHRMANN, R. 2005. Ritual campaniforme, ritual colectivo: la necrópolis de cuevas artificiales del Valle de las Higueras, Huecas, Toledo. *Trabajos de Prehistoria,* 62, 67-90.

BUENO RAMÍREZ, P., GONZÁLEZ CORDERO, A. & ROVIRA LLORENS, S. 2000. Áreas de habitación y sepulturas de falsa cúpula en la cuenca extremeña del Tajo. Acerca del poblado con necrópolis del Canchal en Jaraíz de la Vera (Caceres). *Extremadura Arqueológica,* 8, 209-242.

BULTEN, E. E. B. 1998. *Aanvullend Archeologisch Onderzoek in het tracé van de Betuweroute, vindplaats 34 Dodewaard/Peyenkampse Veldweg* (Rapportage Archeologische Monumentenzorg 30), Amersfoort: ROB.

BULTEN, E. E. B. 2010. Vlaardingen in de Hofstad. *In:* VERHART, L. B. M. & DE RIDDER, T. (eds.) *Vlaardingen-cultuur* (Westerheem Special 2), Eindhoven: AWN, 90-95.

BULTEN, E. E. B. & SMITS, E. 1998. *Aanvullend Archeologisch Onderzoek in het tracé van de Betuweroute, vindplaats 24 Valburg/De Vergulde Bodem-Zuid* (Rapportage Archeologische Monumentenzorg 18), Amersfoort: ROB.

BULTEN, E. E. B., VAN DER HEIJDEN, F. J. G. & HAMBURG, T. 2002. *Prehistorische Visweren en Fuiken bij Emmeloord* (ADC Rapport 140), Amersfoort: ADC Archeoprojecten.

BULTEN, E. E. B., VAN DER HEIJDEN, F. J. G. & HAMBURG, T. 2009. Prehistorische visweren en fuiken op kavel J97 bij Emmeloord. *Archeologie,* 13, 47-62.

BURGESS, C. B. & SHENNAN, S. J. 1976. The Beaker Phenomenon: some suggestions. *In:* BURGESS, C. B. & MIKET, R. (eds.) *Settlement and Economy in the Third and Second Millennia B.C.* (British Archaeological Reports: British Series 33), Oxford: Oxbow books, 309-331.

BURNEZ, C. 1965. La station de Soubérac à Gensac-la-Pallue (Charente). *Bulletin de la Société Préhistorique Française – Études et Travaux,* 62, 289-315.

BURNEZ, C. 1976. *Le néolithique et le chalcolithique dans le centre-ouest de la France* (Mémoires de la Société Préhistorique Française 12), Paris: Société Préhistorique Française.

BURNEZ, C. 1996. Au sujet de l'article Boujot C. et Cassen S., avec la collaboration de Philippe Chambon et Yves Gruet Matignons et Moulin-de-Vent à Montagant/Le Brandart. *Bulletin de la Société Préhistorique Française,* 93, 268-275.

BURNEZ, C. (ed.) 1996. *Le site des Loups à Échiré – Deux-Sèvres*, Bougon: Musée des Tumulus de Bougon.

BURNEZ, C. 2006. *Font Rase à Barbezieux et Font-Belle à Segonzac (Charente). Deux sites du Néolithique récent saintongeais Matignons/Peu-Richard* (British Archaeological Reports: International Series 1562), Oxford: Archaeopress.

BURNEZ, C., BRAGUIER, S., SICAUD, F. & TUTARD, J. 1999. Les enceintes du Néolithique récent et final de la Mercière à Jarnac-Champagne (Charente-Maritime). *Bulletin de la Société Préhistorique Française,* 96, 295-328.

BURNEZ, C., DASSIÉ, J. & SICAUD, F. 1995. L'enceinte artenacienne du « Camp » à Challignac (Charente). *Bulletin de la Société Préhistorique Française,* 92, 463-478.

BURNEZ, C., FISCHER, F. & FOUÉRÉ, P. 1991. Le Gros-Bost à Saint-Méard-de-Drône (Dordogne). *Bulletin de la Société Préhistorique Française,* 88, 291-340.

BURNEZ, C. & GABET, C. 1967. La céramique fine du camp de Saint-Severin-sur-Boutonne (Charente-Maritime). *Bulletin de la Société Préhistorique Française,* 64, 114-118.

BURSCH, F. C. 1933. Die Becherkultur in den Niederlanden. *Oudheidkundige Mededelingen uit het Rijksmuseum van Oudheden te Leiden,* 14, 39-123.

BUTLER, J. J., LANTING, J. N. & VAN DER WAALS, J. D. 1972. Anner Tol III: A four-period Bell Beaker and Bronze Age barrow at Schuilingsoord, gem. Zuidlaren, Drente. *Helinium,* 12, 225-241.

BUTTER, J., VAN GIFFEN, A. E., KLEIWEG DE ZWAAN, J. P., OPPENHEIM, R., RUTTEN, L. & TESCH, P. 1936. L'homme préhistorique et protohistorique aux Pays-Bas. *Report of the XVI International Geological Congress Washington, 1933*, Washington DC: Geological Society of America, 1219-1229.

CABRÉ AGUILÓ, J. 1923. Espoli funerari, amb diadema d'or, d'una sepultura de la primera Edat del bronze de Montilla (Córdova). *Anuari,* 6, 539-546.

CAEMMERER, E. 1956. *Vor- und Frühgeschichte Arnstadts und seiner weiteren Umgebung bis zur Mitte des 10. Jahrhunderts*, Jena: Gustav Fischer Verlag.

CAHEN, D. & DE LAET, S. J. 1980. Persistance de la civilisation de Seine-Oise-Marne a l'âge du bronze dans certaines régions de Belgique. *Helinium,* 20, 114-135.

CALLMER, J. 1973. Preliminary report on a complex of buildings from the Late Neolithic-Early Bronze Age at Norrvidinge, Scania. *Meddelanden från Lunds Universitets Historiska Museum,* 1971-1972, 120-143.

CARDOSO, G. 1991. *Carta Arqueológia do concelho de Cascais*, Cascais: Câmera Municipal de Cascais.

CARDOSO, J. L. 1994. Leceia 1983-1993. Escavações do povoado fortificado pré-histórico. *Estudos Arqueológicos de Oeiras,* especial, 1-164.

CARDOSO, J. L. 1996. Materiais arqueológicos inéditos do povoado pré-histórico de Carnaxide (Oeiras). *Estudos Arqueológicos de Oeiras,* 6, 27-45.

CARDOSO, J. L. 1997. *O povoado de Leceia (Oeiras): sentinela do Tejo no terceiro milénio a C.*, Lisboa: Museu Nacional de Arqueológia.

CARDOSO, J. L. 2000. The Fortified Settlement of Leceia (Oeiras) in the context of the Chalcolithic in Portuguese Estremadura. *Oxford Journal of Archaeology,* 19, 37-55.

CARDOSO, J. L. 2000. O calcolítico da Baixa Estremadura: contributos para um ensaio, a propósito de Leiceia (Oeiras). *Estudos Arqueológicos de Oeiras,* 8, 325-353.

CARDOSO, J. L. 2011. O povoado calcolítico da Penha Verde (Sintra). *Estudos Arqueológicos de Oeiras,* 18, 467-551.

CARDOSO, J. L. 2014. Absolute chronology of the Beaker phenomenon North of the Tagus estuary: demographic and social implications. *Trabajos de Prehistoria,* 71, 56-75.

CARDOSO, J. L., CANINAS, J. C. & HENRIQUES, F. 2003. Investigações recentes do megalitismo funerário na região do Tejo Internacional (ldanha-a-Nova). *O Arqueólogo Português,* IV, 151-207.

CARDOSO, J. L. & CARREIRA, J. R. 2003. O povoado Calcolítico do Outeiro de São Mamede (Bombarral). Estudo do espólio das escavações de Bernardo de Sá. *Estudos Arqueológicos de Oeiras,* 11, 87-228.

CARDOSO, J. L., NORTON, J. & CARREIRA, J. R. 1996. Ocupação Calcolitica do Monte do Castelo (Leceia, Oeiras). *Estudos Arqueológicos de Oeiras,* 6, 287-299.

CARDOSO, J. L., VILSTRUP, J. T., EISENMANN, V. & ORLANDO, L. 2013. First evidence of Equus asinus L. in the Chalcolithic disputes the Phoenicians as the first to introduce donkeys into the Iberian Peninsula. *Journal of Archaeological Science,* 40, 4483-4490.

CARREIRA, J. R. 1996. A ocupação da Pré-História recente do Alto de Chibanes (Palmela), Setúbal. *Trabalhos de Arqueológia da E.A.M.,* 3/4, 123-213.

CASSEN, S. 1992. Le Néolithique Récent sur la Façade Atlantique de la France. La différenciation stylistique des groupes céramiques. *Zephyrus,* 44, 167-182.

CASSEN, S. & SCARRE, C. J. 1997. *Les enceintes néolithiques de La mastine et Pied-Lizet (Charente-Maritime). Fouilles archéologiques et études paléo-environnementales dans le Marais poitevin (1984-1988)*, Chauvigny: Association des Publications Chauvinoises.

CASTRO, P. V., LULL, V. & MICÓ, R. 1996. *Cronología de la Prehistoria Reciente de la Península Ibérica y Baleares (c. 2800-900 cal ANE)* (British Archaeological Reports: International Series 652), Oxford: Tempus Reparatum.

CHAMBON, P. & SALANOVA, L. 1996. Chronologie des sépultures du IIIe millénaire dans le bassin de la Seine. *Bulletin de la Société Préhistorique Française,* 93, 103-118.
CHAMPÈME, L.-M. 1998. Le bâtiment sur poteaux du Fief Baudouin, commune d'Airvault (Deux-Sèvres). *In:* JOUSSAUME, R. (ed.) *Le Néolithique du centre-ouest de la France: actes du XXIe Colloque Inter-régional sur le Néolithique ; Poitiers, 14, 15 et 16 octobre 1994*, Chauvigny: Association des Publications Chauvinoises, 297-306.
CHIARADIA, M., GALLAY, A. & TODT, W. 2003. Different contamination styles of prehistoric human teeth at a Swiss necropolis (Sion, Valais) inferred from lead and strontium isotopes. *Applied Geochemistry,* 18, 353-370.
CHILDE, V. G. 1925. *The Dawn of European Civilization*, London: Routledge.
CHILDE, V. G. 1929. *The Danube in Prehistory*, Oxford: Oxford University Press.
ČIŽMÁŘ, M. 1985. Hroby kultury se šňůrovou keramikou z Holubic a Tvarožné. *Archeologické rozhledy,* 37, 403-412.
ČIŽMÁŘ, M. 2010. Das Gräberfeld von Holubice. *In:* TEJRAL, J. (ed.) *Langobardische Gräberfelder in Mähren* (Spisy Archeologického ústavu av ČR Brno 39), Brno: Archeologický ústav AV ČR, 129-224.
ČIŽMÁŘ, M. & GEISLER, M. 1980. Rettungsgrabungen auf der Autobahnstrasse Brno – Holubice im Jahre 1979 (Bez. Brno-venkov und Vyškov). *Přehled výzkumů AÚ ČSAV*, 68-70.
ČIŽMÁŘ, M. & GEISLER, M. 1987. Rettungsgrabungen auf dem Bau der Autobahn im Abschnitt Holubice-Tučapy im Jahre 1985 (Bez. Vyškov). *Přehled výzkumů AÚ ČSAV*, 65-66.
ČIŽMÁŘ, M., GEISLER, M., HIMMELOVÁ, Z. & RAKOVSKÝ, I. 1981. Rettungsgrabungen auf der Autobahnabschnitt Brno – Holubice im Jahre 1980 (Bez. Brno-venkov und Vyškov). *Přehled výzkumů AÚ ČSAV*, 60-61.
CLAASSEN, A. 1975. Een Hilversum-urne te Maaseik. *Limburg,* 55, 119-125.
CLARK, J. G. D. 1963. Neolithic Bows from Somerset, England, and the Prehistory of Archery in North-western Europe. *Proceedings of the Prehistoric Society,* 29, 50-92.
CLARKE, D. L. 1970. *Beaker Pottery of Great Britain and Ireland* (Gulbenkian Archaeological Series 1), Cambridge: Cambridge University Press.
CLARKE, D. L. 1976. The Beaker Network – Social and Economic Models. *In:* LANTING, J. N. & VAN DER WAALS, J. D. (eds.) *Glockenbecher Symposion Oberried 1974*, Bussum/Haarlem: Fibula-Van Dishoeck, 459-477.
CLASON, A. T. 1974. The Antler, Bone and Tooth Objects from Velzen: A Short Description. *Berichten van de Rijksdienst voor het Oudheidkundig Bodemonderzoek,* 24, 119-131.
CLASON, A. T. 1990. Ewijk, an inland Vlaardingen settlement. Archaeozoology and the amateur archaeologist. *In:* SCHIBLER, J., SEDLMEIER, J. & SPYCHER, H. (eds.) *Beiträge zur Archäozoologie, Archäologie, Anthropologie, Geologie und Paläontologie. Festschrift für Hans R. Stampfli*, Basel: Helbing & Lichtenhahn, 63-75.
CLASON, A. T. 1991. Horse remains from Swifterbant, the Netherlands. *In:* MEADOW, R. H. & UERPMANN, H.-P. (eds.) *Equids in the Ancient World. Volume II*, Wiesbaden: Dr. Ludwig Reichert Verlag, 226-232.
CLAUSEN, I. 1985. Neolithische Fundplätze am Großen Plöner See. *Offa,* 42, 113-186.
CLAUSEN, I. 1996. Seedorf, Kr. Segeberg. Zehnter Arbeitsbericht des Archäologischen Landesamtes Schleswig-Holstein. Grabungsberichte der Jahre 1988-1993. *Offa,* 53, 410-431.
COFFYN, A. 1969. Bronzes protohistoriques du site gallo-romain de Pépiron à Saint-Just (Charente-Maritime). *Bulletin de la Société Préhistorique Française,* 66, 56-57.
COMENDADOR REY, B. 1997. *Los inicios de la Metalurgia en el noroeste de la Península Ibérica*, Santiago de Compostela: Universidad de Santiago de Compostela.

CONVERTINI, F. 1996. *Production et signification de la céramique campaniforme à la fin du 3ème millénaire av. J.-C. dans le Sud et le Centre-Ouest de la France et en Suisse occidentale* (British Archaeological Reports: International Series 656), Oxford: Tempus Reparatum.

CONVERTINI, F. 1997. Origine des ressources argileuses. *In:* OTHENIN-GIRARD, B. (ed.) *Le Campaniforme d'Aile, Noir Bois (Jura, Suisse)* (Cahier d'Archéologie jurassienne 7), Porrentruy: Office du Patrimoine historique et Société jurassienne d'Émulation, 70-84.

CORDIER, G. 1976. Les Civilisations de l'âge du bronze dans le Centre-Ouest et les pays de la Loire moyenne. *La Préhistoire française : les civilisations néolithiques et protohistoriques de la France*, Paris: CNRS, 543-560.

CORMENIER, A. 2009. Les interactions entre Artenacien et Campaniforme dans le Centre-Ouest de la France – L'apport des décors céramiques. *In:* LAPORTE, L. (ed.) *Des Premiers Paysans aux Premiers Métallurgistes sur la Façade Atlantique de la France (3500-2000 av. J.-C.)* (Mémoire de la Société de recherches archéologiques de Chauvigny 33), Chauvigny: Association des Publications Chauvinoises, 314-328.

COSACK, E. 1996. Siedlungsspuren der Einzelgrabkultur bei Süttorf, Stadt Neustadt a. Rbge., Ldkr. Hannover. *Nachrichten aus Niedersachsens Urgeschichte,* 65**,** 73-98.

COTTIAUX, R. 1995. La céramique du site éponyme du "Gord" à Compiègne (Oise). *Bulletin de la Société Préhistorique Française,* 92**,** 97-106.

COTTIAUX, R., LIMONDIN, N., PROST, D. C. & TALON, M. 1995. Un habitat de la fin du Néolithique: Le Parc Tertiaire sur la commune de La Croix-Saint-Ouen (Oise). *In:* BILLARD, C. & LEMERCIER, M. (eds.) *Evreux 1993. Actes du 20ème colloque interregional sur le Néolithique* (Revue Archéologique de l'Ouest Supplément 7), Rennes: R.A.O., 213-232.

COTTIAUX, R. & SALANOVA, L. (eds.) 2014. *La Fin du IVe Millénaire dans le Bassin Parisien. le Néolithique Récent entre Seine, Oise et Marne (3500-2900 avant notre ère)* (Revue Archéologique de l'Est supplement 34), Dijon/Paris: Société Archéologique de l'Est.

COURTIN, J. & ONORATINI, G. 1976. L'habitat campaniforme du Fortin du Sault (Châteauneuf-les-Martigues, Bouches-du-Rhône). *Congrès Préhistorique de France, 20e session, Provence 1974*, Paris: CNRS, 109-121.

COURTY, M.-A. & ROUX, V. 1995. Identification of Wheel Throwing on the Basis of Ceramic Surface Features and Microfabrics. *Journal of Archaeological Science,* 22**,** 17-50.

COWGILL, G. L. 1990. Why Pearson's r is Not a Good Similarity Coefficient for Comparing Collections. *American Antiquity,* 55**,** 512-521.

CREMA, E. R. 2011. Modelling Temporal Uncertainty in Archaeological Analysis. *Journal of Archaeological Method and Theory,* 19**,** 440-461.

CREMA, E. R., KANDLER, A. & SHENNAN, S. 2016. Revealing patterns of cultural transmission from frequency data: equilibrium and non-equilibrium assumptions. *Nature Scientific Reports,* 6**,** 39122.

CROMBÉ, P. 1986. Een prehistorische site te Kerkhove (Mesolithicum – Neolithicum). *West-Vlaamse Archeologica,* 2**,** 3-39.

CROUTSCH, C., TEGEL, W. & PASCUTTO, E. 2010. Le site d'Erstein Grassweg/PAE: un habitat campaniforme dans le sud de la Plaine du Rhin supérieur. *In:* JEUNESSE, C. & DENAIRE, A. (eds.) *Du Néolithique final au Bronze ancien dans le Nord-Est de la France. Actualité de la recherche. Actes de la table ronde internationale de Strasbourg organisée par l'UMR 7044 du CNRS Maison Interuniversitaire des Sciences de l'Homme – Alsace (MISHA), 9 juin 2009*, Zimmersheim: Association pour la Promotion de la Recherche Archéologique en Alsace, 43-56.

CUNLIFFE, B. W. 2001. *Facing the Ocean. The Atlantic and its peoples*, Oxford: Oxford University Press.

CZEBRESZUK, J. 1996. *Społeczności Kujaw w początkach epoki brązu*, Poznań: Wydawnictwo Poznanskie.

CZEBRESZUK, J. 1998. "Trzciniec", an alternative view. *Baltic-Pontic Studies,* 6, 165-189.

CZEBRESZUK, J. 2000. Osadnictwo społeczności kultury ceramiki sznurowej. *In:* KOŚKO, A. (ed.) *Archeologiczne badania ratownicze wzdłuż trasy gazociągu tranzytowego. Tom III: Kujawy. Część 4: Osadnictwo kultur późnoneolitycznych oraz interstadium epok neolitu i brązu: 3900-1400/1300 przed Chr.*, Poznań: Wydawnictwo Poznanskie, 423-454.

CZEBRESZUK, J. & KRYVALTSEVICH, M. 2003. Der Dolch aus Mesha, nördliches Weissrussland: Glockenbechereinflüsse in Osteuropa. *Archäologisches Korrespondenzblatt,* 33, 51-56.

CZEBRESZUK, J. & ŁOŚ, J. 1999. Grób kultury ceramiki sznurowej w Żernikach, gm. Kruszwica, woj. kujawsko-pomorskie. *Sprawozdania Archeologiczne,* 51, 97-113.

CZEBRESZUK, J. & SZMYT, M. 2001. The 3rd Millenium BC in Kujawy in the light of 14C Dates. *In:* CZEBRESZUK, J. & MÜLLER, J. (eds.) *Die absolute Chronologie in Mitteleuropa 3000-2000 v. Chr.*, Rahden: Verlag Marie Leidorf GmbH, 177-208.

CZEBRESZUK, J. & SZMYT, M. (eds.) 2003. *The Northeast Frontier of Bell Beakers. Proceedings of the symposium held at the Adam Mickiewicz University, Poznań (Poland), May 26-29 2002* (British Archaeological Reports: International Series 1155), Oxford: Archaeopress.

DA CUNHA SERRÃO, E. 1983. A estação pré-histórica de Parede. Documentos inéditos sobra estratigrafia e estruturas (Campanha de 1956). *O Arqueológo Português,* IV, 119-147.

DA CUNHA SERRÃO, E. & PRESCOTT VICENTE, E. 1956. Note preliminaire sur la station eneolithique de Negrais. *IV Congreso Internacional de Ciências Prehistoricas y Protohistoricas (Madrid, 1954). Actas*, Zaragoza: Librería General, 601-611.

DA CUNHA SERRÃO, E. & PRESCOTT VICENTE, E. 1958. O Castro Eneolítico de Olelas. Primeiras escavações. *Comunicações dos Serviços Geológicos de Portugal,* 40, 87-125.

DA VEIGA FERREIRA, O. 1971. Algumas considerações sobre os chamados vasos de largo bordo horizontal ou chapéu invertido e sua distribuição em Portugal. *Arqueología e História,* III, 9-20.

DA VEIGA FERREIRA, O. 1971. Um escondrijo de fundidor encontrado no Castro de São Bernardo (Moura), Alentejo. *O Arqueológo Português,* III, 139-145.

DA VEIGA FERREIRA, O., ZBYSZEWSKI, G., LEITÃO, M., NORTH, C. T. & REYNOLDS DE SOUSA, M. 1975. The megalithic tomb of Pedra Branca, Portugal. Preliminary report. *Proceedings of the Prehistoric Society,* 41, 167-178.

DAVID, N., STERNER, J. & GAVUA, K. 1988. Why Pots Are Decorated. *Current Anthropology,* 29, 365-389.

DAVIDSEN, K. 1982. Bronze Age Houses at Jegstrup, near Skive, Central Jutland. *Journal of Danish Archaeology,* 1, 65-75.

DE BAAR, P.-P. 2012. Amsterdams gebied al in Steentijd bewoond. *Ons Amsterdam,* 2012, 32-51.

DE CARVALHO AMARO, G. 2012. *La cerámica con decoración acanalada y bruñida en el contexto pre-campaniforme del Calcolítico de la Extremadura portuguesa* (British Archaeological Reports: International Series 2348), Oxford: Archaeopress.

DE CLERCQ, W. & VAN STRYDONCK, M. 2002. Final report from the rescue excavation at the Aquafin RWZI plant Deinze (prov. East-Flanders, Belgium); radiocarbon dates and interpretation. *Lunula,* 10, 3-6.

DE JONG, J. D. 1970. Geologische geschiedenis en vroegere bewoning van Haarlem. *Haerlem Jaarboek,* 1970, 110-149.

DE KONING, J. & VAARS, J. P. L. 2003. *Archeologische opgravingen te Rosmalen. Nederzettingssporen uit Neolithicum, Bronstijd, Vroege IJzertijd en Midden IJzertijd in de noordelijke Maasvallei* (Hollandia Reeks 3), Zaandijk: Hollandia.

DE KONING, M. W. A. (ed.) 2010. *Onder de rook van Wijchen. Vondsten van de Vlaardingen-groep, de klokbekercultuur, sporen van ovens en resten van een mogelijk grafveldje uit de late bronstijd – Romeinse tijd* (Archeologische Berichten Wijchen – Rapport 11), Nijmegen: Gemeente Nijmegen.

DE LAET, S. J. 1963. Un gobelet Campaniforme à Huise (Flandre Orientale) et la distribution des vases Campaniformes en Belgique. *Helinium,* 3, 235-241.

DE LAET, S. J. & ROGGE, M. 1972. Une tombe à incinération de la civilisation aux gobelets Campaniformes trouvée à Kruishoutem (Flandre Orientale). *Helinium,* 12, 209-224.

DE LEEUWE, R. 2007. *Een vindplaats uit het Neolithicum en de IJzertijd aan de Dorpstraat te Macharen. Archeologisch Inventariserend Veldonderzoek (IVO-proefsleuven)* (Archol Rapport 75), Leiden: Archol.

DE LEEUWE, R., BAETSEN, S., BAKELS, C. C., BOSMAN, A. V. A. J., KNIPPENBERG, S., LANGE, S., MEURKENS, L. & VERBAAS, A. 2008. *Prehistorie tussen de loopgraven. Nederzettingssporen en vondstcomplexen in Bennekom-Streekziekenhuis uit de midden-bronstijd tot de midden-ijzertijd, ca. 1500 tot 500 v.Chr.* (Archol Rapport 81), Leiden: Archol.

DE MELLO NOGUEIRA, A. & ZBYSZEWSKI, G. 1943. Túmulo da Época do Bronze. *Comunicações dos Serviços Geológicos de Portugal,* 24, 95-98.

DE TARDE, G. 1903. *The Laws of Imitation*, London: H. Holt.

DE VRIES-METZ, W. H. 1993. *Luchtfoto-archeologie in Oostelijk West-Friesland. Mogelijkheden en resultaten van archeologische Remote Sensing in een verdwijnend prehistorisch cultuurlandschap.* PhD Thesis, Universiteit van Amsterdam.

DE WEERD, M. D. 1966. Nederzettingssporen van de vroege klokbekercultuur bij Oostwoud (N.H.). Voortgezet onderzoek 1964. *In:* GLASBERGEN, W., GROENMAN-VAN WAATERINGE, W., VAN GIFFEN, A. E. & BAKKER, J. A. (eds.) *In het voetspoor van A.E. van Giffen*, Groningen: Wolters, 174-175.

DE WIT, M. J. M. 2002. *Een Definitief Onderzoek te Vasse 'De Steenbrei', gemeente Tubbergen (Ov.)* (ARC Publicaties 66), Groningen: ARC.

DEEBEN, J. H. C. & DE KORT, J. W. (eds.) 2013. *Archeologisch onderzoek in de omgeving van het prehistorische vuursteenmijnveld te Rijckholt – St. Geertruid. De resultaten van 2010* (Rapportage Archeologische Monumentenzorg 218), Amersfoort: Rijksdienst voor het Cultureel Erfgoed.

DEICHMÜLLER, J. 1959. Ein neolithischer Becher aus Farven, Kreis Bremervörde. *Die Kunde NF,* 10, 220-223.

DEICHMÜLLER, J. 1969. Die neolithische Moorsiedlung Hüde I am Dümmer, Kreis Grafschaft Diepholz. *Neue Ausgrabungen und Forschungen in Niedersachsen,* 4, 28-36.

DEICHMÜLLER, J. 1974. Ein Glockenbechergrab bei Wallhöfen, Gemeinde Vollersode, Kr. Osterholz. *Die Kunde NF,* 25, 53-69.

DEL CASTILLO, A. 1928. *La cultura del vaso campaniforme. Su origen y extensión en Europa*, Barcelona: Universidad de Barcelona.

DELCOURT, M., SIMON, C. & VLAEMINCK, J. 1987. *Le Complexe S.O.M. de Brunehaut* (Numéro Special du Bulletin de La S.T.G.P.A.), Tournai: Société Tournaisienne de Géologie, Préhistoire et Archéologie.

DELCOURT-VLAEMINCK, M. 2004. Les exportations du silex du Grand-Pressigny et du matériau tertiaire dans le nord-ouest de l'Europe au Néolithique final/Chalcolithique. *In:* VANDER LINDEN, M. & SALANOVA, L. (eds.) *Le troisième millénaire dans le nord de la France et en Belgique. Actes de la journée d'études SRBAP-SPF, 8 mars 2003, Lille* (Anthropologica et Praehistorica 115), Brussel: SRBAP, 139-154.

DELIBES DE CASTRO, G. 1977. *El Vaso Campaniforme en la Mestea Norte española* (Studia Archaeologica 46), Valladolid: Universidad de Valladolid.

DELIBES DE CASTRO, G. & FERNÁNDEZ MANZANO, J. 1981. El castro protohistórico de la Plaza en Cogeces del Monte (Valladolid). Reflexiones sobre el origen de la fase Cogatas I. *Boletín del Seminario de Estudios de Arte y Arqueologia,* 47, 51-68.

DELIBES DE CASTRO, G. & FERNÁNDEZ MIRANDA, M. 1981. La tumba de Celada de Roblecedo (Palencia) y los inicios del Bronce antiguo en el valle medio y alto del Pisuerga. *Trabajos de Prehistoria,* 38, 153-188.

DEMEYERE, F., BOURGEOIS, J. & CROMBÉ, P. 2004. Plan d'une maison du groupe de Deûle-Escaut à Waardamme (Oostkamp, Flandre occidentale). *Notae Praehistoricae,* 24, 167-173.

DEMEYERE, F., BOURGEOIS, J., CROMBÉ, P. & VAN STRYDONCK, M. 2006. New evidence of the (Final) Neolithic occupation of the sandy lowlands of Belgium: the Waardamme "Vijvers" site, West Flanders. *Archäologisches Korrespondenzblatt,* 36, 179-195.

DENAIRE, A., ZEHNER, M. & MAMIE, A. 2010. Les habitats de Colmar/Houssen «Base de Loisirs/Gravière», Didenheim «Zac des Collines» et Houssen «Le Château» (Haut-Rhin): trois nouveaux sites de lafin du Néolithique final et du Bronze ancien. *In:* JEUNESSE, C. & DENAIRE, A. (eds.) *Du Néolithique final au Bronze ancien dans le Nord-Est de la France. Actualité de la recherche. Actes de la table ronde internationale de Strasbourg organisée par l'UMR 7044 du CNRS Maison Interuniversitaire des Sciences de l'Homme – Alsace (MISHA), 9 juin 2009*, Zimmersheim: Association pour la Promotion de la Recherche Archéologique en Alsace, 73-102.

DESITTERE, M. 1970. Laatneolithisch aardewerk uit Harelbeke (Prov. Westvlaanderen). *Helinium,* 10, 31-38.

DEUNHOUWER, P. 1986. *Ottoland – Oosteind. Een grondsporen-aardewerkanalyse van een in 1969 opgegraven nederzetting in de Alblasserwaard, met bewoningssporen uit het Laat-Neolithicum en de Bronstijd.* MA Thesis, Leiden University.

DICKSON, J. H. 1978. Bronze Age Mead. *Antiquity,* 52, 108-113.

DIEPENDAELE, S. 2007. *Archeologisch onderzoek ter plaatse van het voormalig bisschoppelijk seminarie te Heemstede. 5000 jaar bewoningsgeschiedenis Heemstede-Hageveld* (ArcheoMedia Rapport A05-209-R), Nieuwerkerk aan den IJssel: ArcheoMedia.

DIEPENDAELE, S. & DRENTH, E. 2010. *Archeologisch onderzoek langs de rijksweg N11 (Spookverlaat) ten behoeve van de aanleg van het windturbinepark Rijnwoude te Hazerswoude-Rijndijk (gem. Rijnwoude, prov. Zuid-Holland). Een Neolithische vindplaats langs de Oude Rijn* (ArcheoMedia Rapport A06-286-R en A06-359-R), Nieuwerkerk aan den IJssel: ArcheoMedia.

DIJKMAN, W. 1987. Maastricht-Randwyck. *Notae Praehistoricae,* 7, 6-7.

DO PAÇO, A. 1952. Castro de Vila Nova de S. Pedro. I – 15ª Campanha de escavações. *Brotéria,* 54, 289-309.

DO PAÇO, A. 1954. Castro de Vila Nova de S. Pedro. VI – Campanhas arqueológicas de 1943 a 1950 (n.º 7 a n.º 14). *Arqueología e História,* VIII, 31-80.

DO PAÇO, A. 1955. Castro de Vila Nova de S. Pedro. VII – considerações sobre o problema da metalurgia. *Zephyrus,* 6, 27-40.

DO PAÇO, A. 1957. Castro de Vila Nova de S. Pedro. IX – Forno de cozer cerâmica. *Revista de Guimarães,* 67, 83-94.

DO PAÇO, A. 1958. Castro de Vila Nova de S. Pedro. XI – Nota sobre un tipo de cerámica del estrato Vila Nova I. *Ampurias,* 21, 252-260.

DO PAÇO, A. 1964. Castro de Vila Nova de S. Pedro. XIV – Vida económica. XV – O problema campaniforme. XVI – Metalurgia e análises espectrográficas. *Anais da Academia Portuguesa da História* 14, 133-165.

DO PAÇO, A. & DE LOURDES COSTA ARTHUR, M. 1953. Castro de Vila Nova de S. Pedro. III – Perfis de bordos de vasos não ornamentados. *O Instituto Coimbra,* 115**,** 399-412.

DO PAÇO, A. & DE LOURDES COSTA ARTHUR, M. 1953. Castro de Vila Nova de S. Pedro. IV – sementes pré-históricas de Linho. *Archivo de Prehistoria Levantina,* 4**,** 151-157.

DO PAÇO, A. & DE LOURDES COSTA ARTHUR, M. 1953. Castro de Vila Nova de S. Pedro. V – Notas sobre sementes pré-históricas. *I Congreso Arqueológico del Marruecos Español (Tetuán, 1953). Actas.* , Tetuan: Servicio de Arqueología, 183-187.

DO PAÇO, A. & DE LOURDES COSTA ARTHUR, M. 1956. "Castro" de Vila Nova de S. Pedro. Le problème de la métallurgie. *IV Congreso Internacional de Ciências Prehistoricas y Protohistoricas (Madrid, 1954). Actas*, Zaragoza: UISPP, 535-541.

DO PAÇO, A. & JALHAY, E. 1942. A póvoa eneolítica de Vila Nova de S. Pedro: notas sôbre a 3, 4.ª e 5.ª campanhas de escavações – 1939, 1940 e 1941. *Brotéria,* 34**,** 635-663.

DO PAÇO, A. & SANGMEISTER, E. 1956. Vila Nova de S. Pedro – eine befestigte Siedlung der Kupferzeit in Portugal. *Germania,* 34**,** 211-230.

DOBEŠ, M. & VOJTECHOVSKÁ, I. 2008. Řivnačské sídliště v Úholičkách, okr. Praha-západ. *Archeologické rozhledy,* 60**,** 261-297.

DÖHLE, H.-J. & SCHUNKE, T. 2014. Der erste neolithische Pferdeschädel Mitteldeutschlands – ein frühes Hauspferd? *In:* MELLER, H. & FRIEDERICH, S. (eds.) *Salzmünde-Schiepzig – ein Ort, zwei Kulturen. Ausgrabungen an der Westumfahrung Halle (A 143)* (Archäologie in Sachsen-Anhalt Sonderband 21/I), Halle: Landesamt für Denkmalpflege und Archäologie Sachsen-Anhalt – Landesmuseum für Vorgeschichte, 257-261.

DORENBOS, O. & KOOT, J. M. 2010. Wonen bij de kust. Vlaardingen bewoners van de strandwal. *In:* VERHART, L. B. M. & DE RIDDER, T. (eds.) *Vlaardingen-cultuur* (Westerheem Special 2), Eindhoven: AWN, 96-113.

DRENTH, E. 2005. Het Laat-Neolithicum in Nederland. *In:* DEEBEN, J. H. C., DRENTH, E., VAN OORSOUW, M.-F. & VERHART, L. B. M. (eds.) *De Steentijd van Nederland* (Archeologie 11/12), Zutphen: Stichting Archeologie, 333-365.

DRENTH, E. 2015. A parallel-flaked Scandinavian type flint dagger from Lent; an indicator of contacts between the Central Netherlands and Northern Jutland during Bell Beaker times. *In:* FRIEMAN, C. J. & ERIKSEN, B. V. (eds.) *Flint daggers in prehistoric Europe*, Oxford: Oxbow Books, 83-91.

DRENTH, E. 2016. Klokbeker-cultuur. *In:* AMKREUTZ, L. W. S. W., BROUNEN, F. T. S., DEEBEN, J. H. C., MACHIELS, R., VAN OORSOUW, M. F. & SMIT, B. I. (eds.) *Vuursteen verzameld. Over het zoeken en onderzoeken van steentijdvondsten en -vindplaatsen* (Nederlandse Archeologische Rapporten 50), Amersfoort: Rijksdienst voor het Cultureel Erfgoed, 183-186.

DRENTH, E. & FREUDENBERG, M. 2008. Een bijzondere ontdekking bij Eext: twee stenen voor metaalbewerking van de klokbekercultuur. *Nieuwe Drentse Volksalmanak,* 127**,** 161-167.

DRENTH, E., HEYMANS, H. & KEIJERS, D. 2003. Sporen van de Stein-groep te Ittervoort, gemeente Hunsel, provincie Limburg, Nederland. *Notae Praehistoricae,* 23**,** 135-140.

DRENTH, E. & HOGESTIJN, J. W. H. 1999. De klokbekercultuur in Nederland: De stand van onderzoek anno 1999. *Archeologie,* 9**,** 99-149.

DRENTH, E. & HOGESTIJN, J. W. H. 2001. The Bell Beaker Culture in the Netherlands: the state of research in 1998. *In:* NICOLIS, F. (ed.) *Bell beakers today. Pottery, people, culture, symbols in prehistoric Europe. Proceedings of the International Colloquium Riva del Garda (Trento, Italy), 11-16 May 1998*, Trento: Provincia autonoma di Trento, Servizio beniculturali, Ufficio beni archeologici, 309-332.

DRENTH, E. & HOGESTIJN, J. W. H. 2006. Bekers voor Bakker. Nieuwe ideeën over de oorsprong en ontwikkeling van klokbekers in Nederland. *In:* BLOEMERS, J. H. F. (ed.) *Tussen D26 en P14. Jan Albert Bakker 65 jaar*, Amsterdam: Amsterdam Archeologisch Centrum, 33-146.

DRENTH, E. & SALANOVA, L. 2012. Three maritime bell beakers decorated with shells from the Netherlands. *In:* RAEMAEKERS, D. C. M., ESSER, E., LAUWERIER, R. C. G. M. & ZEILER, J. T. (eds.) *A bouquet of archaeozoological studies. Essays in honour of Wietske Prummel* (Groningen Archaeological Studies 21), Groningen: Barkhuis, 79-84.

DRENTH, E. & WILLIAMS, G. L. 2011. Het geheim van de smid? Een opmerkelijk depot van de Klokbekercultuur uit Hengelo (Gld.). *In:* VAN DER VELDE, H. M., JASPERS, N. L., DRENTH, E. & SCHOLTE LUBBERINK, H. B. G. (eds.) *Van graven in de prehistorie en dingen die voorbijgaan. Studies aangeboden aan Eric Lohof bij zijn pensionering in de archeologie*, Leiden: Sidestone Press, 87-113.

DRIESSEN, M. J. & BESSELSEN, E. A. (eds.) 2014. *Voorburg-Arentsburg. Een Romeinse havenstad tussen Rijn en Maas* (Themata 7), Amsterdam: Diachron.

DVOŘÁK, F. 1931. Nálezy zvoncové keramiky na Kolínsku a Českobrodsku. *Památky archeologické,* 37, 36-45.

EBBESEN, K. 1977. Sikar og klokkebægerkultur. *Holstebro Museums Årsskrift,* 1977, 51-64.

EDWARDS, A. M., PHILLIPS, R. A., WATKINS, N. W., FREEMAN, M. P., MURPHY, E. J., AFANASYEV, V., BULDYREV, S. V., DA LUZ, M. G. E., RAPOSO, E. P., STANLEY, H. E. & VISWANATHAN, G. M. 2007. Revisiting Lévy flight search patterns of wandering albatrosses, bumblebees and deer. *Nature,* 449, 1044-1049.

ÉGÜEZ, N., ZERBONI, A. & BIAGETTI, S. 2018. Microstratigraphic analysis on a modern central Saharan pastoral campsite. ovicaprine pellets and stabling floors as ethnographic and archaeological referential data. *Quaternary International,* 483, 180-193.

EGUILETA FRANCO, J. M. 2011. El Campaniforme en el contexto de la prehistoria reciente en la Baixa Limia: apuntes para una propuesta. *In:* PRIETO MARTÍNEZ, M. P. & SALANOVA, L. (eds.) *Las Comunidades Campaniformes en Galicia. Cambios sociales en el III y II Milenios BC en el NW de la Península Ibérica*, Pontevedra: Diputación de Pontevedra, 275-283.

EINSTEIN, A. 1905. Über die von der molekularkinetischen Theorie der Wärme geforderte Bewegung von in ruhenden Flüssigkeiten suspendierten Teilchen. *Annalen der Physik,* 322, 549-560.

ELLEBOODE, E., COUBRAY, S. & MARTIAL, E. 2008. Un batiment daté du IIIe Millénaire ac. J.-C. découvert à Arques (Pas-de-Calais). *Internéo,* 7, 153-162.

ENDRŐDI, A. 1998. Results of Settlement Archaeology in Bell Beaker Research in Hungary. *In:* BENZ, M. & VAN WILLIGEN, S. (eds.) *Some New approaches to The Bell Beaker 'Phenomenon'. Lost Paradise…?, Proceedings of the 2nd Meeting of the « Association Archéologie et Gobelets », Feldberg (Germany), 18th-20th avril 1997* (British Archaeological Reports: International Series 690), Oxford: Archaeopress, 141-160.

ENDRŐDI, A. 2002. New data on the Late Copper Age and Early Bronze Age settlement history of Budapest – Csepel Island. *Budapest Régiségei,* 36, 115-129.

ENDRŐDI, A. & PÁSZTOR, E. 2006. Symbolism and Traditions in the Society of the Bell Beaker – Csepel Group. *Archaeologiai Értesitő,* 131, 7-25.

ENDRŐDI, A. & REMÉNYI, R. 2016. *A Bell Beaker settlement in Albertfalva, Hungary (2470-1950 BC)*, Budapest: Budapesti Történeti Múzeum.

ENGEL, C. 1935. Jüngere Steinzeit. *In:* ENGEL, C. (ed.) *Vorgeschichte der altpreussischen Stämme. Untersuchungen über Siedlungsstetigkeit and Kulturgruppen im vorgeschichtlichen Ostpreussen.*, Köningsberg: Gräfe und Unzer, 146-196.

ENGHOFF, I. B. 2011. *Regionality and biotope exploitation in Danish Ertebølle and adjoining periods* (Scientia Danica Series B: Biologica, vol. 1), København: Det Kongelige Danske Videnskabernes Selskab.

ERIKSSON, G. 2004. Part-time farmers or hard-core sealers? Västerbjers studied by means of stable isotope analysis. *Journal of Anthropological Archaeology,* 23, 135-162.

ETHELBERG, P. 1986. Early Bronze Age Houses at Højgård, Southern Jutland. *Journal of Danish Archaeology,* 5, 152-167.

ETHELBERG, P. 1991. Two more House Groups with Three-aisled Long-houses from the Early Bronze Age at Højgård, South Jutland. *Journal of Danish Archaeology,* 10, 136-155.

ETHELBERG, P. 2000. Spätneolithische Häuser aus Schleswig. *In:* KELM, R. (ed.) *Vom Pfostenloch zum Steinzeithaus. Archäologische Forschung und Rekonstruktion jungsteinzeitlicher Haus- und Siedlungsbefunde im nortwestlichen Mitteleuropa*, Heide: AÖZA, 101-110.

ETHELBERG, P., JØRGENSEN, E. & ROBINSON, D. E. 2000. *Det Sønderjyske Landbrugs Historie. Sten- og Bronzealder*, Haderslev: Museum Sønderjylland – Arkæologi Haderslev.

EVANS, J. A., CHENERY, C. A. & FITZPATRICK, A. P. 2006. Bronze Age childhood migration of individuals near Stonehenge, revealed by strontium and oxygen isotope tooth enamel analysis. *Archaeometry,* 48, 309-321.

EVANS, J. A., CHENERY, C. A. & MONTGOMERY, J. 2012. A summary of strontium and oxygen isotope variation in archaeological human tooth enamel excavated from Britain. *Journal of Analytical Atomic Spectrometry,* 27, 754-764.

FAGNART, J.-P. V., J. 1979. Les industries postglaciaires de la basse terrasse de Long-pré-les-Corps-Saints (Somme). *Bulletin de la Société Préhistorique Française,* 76, 15-18.

FERNÁNDEZ DOMÍNGUEZ, E. 2018. Comment on: Massive Migrations? The Impact of Recent aDNA Studies on our View of Third Millennium Europe. *European Journal of Archaeology*.

FERNÁNDEZ MIRANDA, M. & DE BALBÍN BEHRMANN, R. 1971. Piezas de la Edad del Bronce en el Museo Arqueológico Provincial de Soria. *Trabajos de Prehistoria,* 28, 289-304.

FISCHER, U. 1956. *Die Gräber der Steinzeit im Saalegebiet: Studien über neolithische und frühbronzezeitliche Grab- und Bestattungsformen in Sachsen-Thüringen* (Vorgeschichtliche Forschungen 15), Berlin: Walter de Gruyter.

FITZPATRICK, A. P. 2002. 'The Amesbury archer' A well-furnished Early Bronze Age burial in southern England. *Antiquity,* 76, 629-630.

FITZPATRICK, A. P. 2009. In his hands and in his head: The Amesbury Archer as a metalworker. *In:* CLARK, P. (ed.) *Bronze Age Connections: Cultural Contact in Prehistoric Europe*, Oxford: Oxbow books, 176-188.

FITZPATRICK, A. P. 2013. *The Amesbury Archer and the Boscombe Bowmen. Bell Beaker burials at Boscombe Down, Amesbury, Wiltshire* (Wessex Archaeology Report 27), Salisbury: Wessex Archaeology.

FLADE-BECKER, A.-S. & SCHACHT, C. 2014. Sanft umflossen von der Warnow – Neolithische Befunde in Kladrum, Lkr. Ludwigslust-Parchim. *In:* JANTZEN, D., SAALOW, L. & SCHMIDT, J.-P. (eds.) *Pipeline: Archäologie. Ausgrabungen auf den großen Ferngastrassen in Mecklenburg-Vorpommern*, Schwerin: Landesamt für Kultur und Denkmalpflege Mecklenburg-Vorpommern, 77-80.

FLANNERY, K. V. 1976. *The Early Mesoamerican Village* (Studies in Archaeology), New York: Academic Press.

FLOORE, P. M. 1991. *Golfbandpotten van de Enkelgrafcultuur.* MA Thesis, Universiteit van Amsterdam.

FOKKENS, H. 1982. Late Neolithic occupation near Bornwird. *Palaeohistoria,* 24**,** 92-113.

FOKKENS, H. 1998. *Drowned Landscape. The Occupation of the Western Part of the Frisian-Drenthian Plateau, 4400 BC – AD 500*, Amersfoort: ROB.

FOKKENS, H. 1999. Cattle and martiality. Changing relations between man and landscape in the Late Neolithic and the Bronze Age. *In:* FABECH, C. & RINGTVED, J. (eds.) *Settlement and landscape. Proceedings of a conference in Århus, Denmark, May 4-7 1998*, Århus: Jutland Archaeological Society, 31-38.

FOKKENS, H. 2005. *Voorbeeldige voorouders: graven naar de ideeënwereld van prehistorische boerengemeenschappen*, Leiden: Leiden University Press.

FOKKENS, H. 2008. The temporality of culture change. *In:* FOKKENS, H., COLES, B. J., VAN GIJN, A. L., KLEIJNE, J. P., PONJEE, H. H. & SLAPPENDEL, C. G. (eds.) *Between Foraging and Farming: An extended broad spectrum of papers presented to Leendert Louwe Kooijmans* (Analecta Praehistorica Leidensia 40), Leiden: Faculty of Archaeology, Leiden, 15-24.

FOKKENS, H. 2012. Background to Dutch Beakers. A critical review of the Dutch model. *In:* FOKKENS, H. & NICOLIS, F. (eds.) *Background to Beakers. Inquiries into regional cultural backgrounds of the Bell Beaker complex*, Leiden: Sidestone Press, 9-35.

FOKKENS, H. 2012. Dutchmen on the move? A discussion of the adoption of the Beaker package. *In:* ALLEN, M. J., GARDINER, J. P., SHERIDAN, J. A. & MCOMISH, D. (eds.) *Is there a British Chalcolithic? People, Place and Polity in the late 3rd millennium* (Prehistoric Society Research Papers 4), Oxford: Oxbow books, 115-125.

FOKKENS, H., ACHTERKAMP, Y. & KUIJPERS, M. H. G. 2008. Bracers or bracelets? About the functionality and meaning of Bell beaker wrist guards. *Proceedings of the Prehistoric Society,* 74**,** 109-140.

FOKKENS, H. & ARNOLDUSSEN, S. 2008. Towards new models. *In:* ARNOLDUSSEN, S. & FOKKENS, H. (eds.) *Bronze Age settlements in the Low Countries*, Oxford: Oxbow books, 1-16.

FOKKENS, H., BOURGEOIS, Q. P. J., VESELKA, B., OLALDE, I. & REICH, D. 2017. Excavations of Late Neolithic arable, burial mounds and a number of well-preserved skeletons at Oostwoud-Tuithoorn: a re-analysis of old data. *Analecta Praehistorica Leidensia,* 47**,** 95-150.

FOKKENS, H. & NICOLIS, F. (eds.) 2012. *Background to Beakers. Inquiries into regional cultural backgrounds of the Beaker Complex*, Leiden: Sidestone Press.

FOKKENS, H., STEFFENS, B. J. W. & VAN AS, S. F. M. 2016. *Farmers, fishers, fowlers, hunters. Knowledge generated by development-led archaeology about the Late Neolithic, the Early Bronze Age and the start of the Middle Bronze Age (2850-1500 cal BC) in the Netherlands* (Nederlandse Archeologische Rapporten 053), Amersfoort: Rijksdienst voor het Cultureel Erfgoed.

FONTIJN, D. R. 2002. *Sacrificial Landscapes. Cultural biographies of persons, objects and 'natural' places in the Bronze Age of the southern Netherlands, c. 2300-600BC* (Analecta Praehistorica Leidensia 33/34), Leiden: Leiden University Press.

FONTIJN, D. R. 2009. Land at the other end of the sea? Metalwork circulation, geographical knowledge and the significance of British/ Irish imports in the Bronze Age of the Low Countries. *In:* CLARK, P. (ed.) *Bronze Age Connections: Cultural Contact in Prehistoric Europe*, Oxford: Oxbow books, 129-148.

FONTIJN, D. R. (ed.) 2010. *Living near the Dead. The barrow excavations of Rhenen-Elst: two millennia of burial and habitation on the Utrechtse Heuvelrug*, Leiden: Sidestone Press.

FORSSANDER, J. E. 1936. *Der ostskandinavische Norden während der ältesten Metallzeit Europas* (Skrifter Utgivna av kungl. Humanistiska Vetenskapssamfundet Lund XXII), Lund: Gleerup.

FOX, C. F. 1928. *The archaeology of the Cambridge region: A Topographical Study of the Bronze, Early Iron, Roman, and Anglo-Saxon Ages*, Cambridge: The University Press.

FREUDENBERG, M. 2009. Steingeräte zur Metallbearbeitung – Einige Neue Aspekte zum Spätneolithischen und Frühbronzezeitlichen Metallhandwerk vor dem Hintergrund des Schleswig-Holsteinischen Fundmaterials. *Archäologisches Korrespondenzblatt*, 39, 1-20.

FREUDENBERG, M. 2010. Stone Age or Bronze Age? Cushion stones and other stone tools used for early metalworking in Schleswig-Holstein. *In:* ERIKSEN, B. V. (ed.) *Lithic technology in metal using societies. Proceedings of a UISPP Workshop, Lisbon, September 2006*, Aarhus: Jutland Archaeological Society, 23-32.

FRIEMAN, C. J. 2015. Making a point: Re-evaluating British flint daggers in their cultural and texchnological contexts. *In:* FRIEMAN, C. J. & ERIKSEN, B. V. (eds.) *Flint daggers in prehistoric Europe*, Oxford: Oxbow Books, 103-115.

FURHOLT, M. 2003. *Die absolutchronologische Datierung der Schnurkeramik in Mitteleuropa und Südskandinavien* (Universitätsforschungen zur Prähistorischen Archäologie 101), Bonn: Verlag Dr. Rudolf Habelt GmbH.

FURHOLT, M. 2011. Materielle Kultur und räumliche Strukturen sozialer Identität im 4. und 3. Jt. v. Chr. in Mitteleuropa. Eine methodische Skizze. *In:* HANSEN, S. & MÜLLER, J. (eds.) *Sozialarchäologische Perspektiven: Gesellschaftlicher Wandel 5000-1500 v. Chr. zwischen Atlantik und Kaukasus. Internationale Tagung in Kiel 15.-18. Oktober 2007 in Kiel* (Archäologie in Eurasien 24), Berlin: Deutsches Archäologisches Institut, 243-267.

FURHOLT, M. 2014. Upending a 'Totality': Re-evaluating Corded Ware Variability in Late Neolithic Europe. *Proceedings of the Prehistoric Society,* 80, 1-20.

FURHOLT, M. 2018. Massive Migrations? The Impact of Recent aDNA Studies on our View of Third Millennium Europe. *European Journal of Archaeology*, 159-178.

GABET, C. & DAVID, P. 1975. Le gisement de Piédemont (commune de Port-des-Barques). Rapport préliminaire. *Rocafortis 2e série,* III, 177-193.

GAILLARD, J. 1977. Sondage à Cordis, commune de Marignac (Charente-Maritime). *Bulletin d'information de association archéologique et historique Jonzacaise,* 18, 1-11.

GALLAY, A. 1986. Autonomie du Campaniforme rhodano-rhénan. La question de la céramique domestique. *In:* DEMOULE, J. P. & GUILAINE, J. (eds.) *Le Néolithique dans la France. Hommage à Gérard Bailloud*, Paris: Picard, 431-446.

GANDRIAU, O. 2008. *Le Bois des Jarries à Saint-Mars-la-Réorthe (Vendée). Un site mésolithique et chalcolithique sur les Collines du Haut-Bocage*, La Roche sur Yon: Groupe Vendéen d'Etudes Préhistoriques.

GARCÍA ALÉN, A. 1970. Objectos Arqueológicos. *El Museo de Pontevedra,* 24, 37-46.

GARCÍA-DÍAZ, V. 2013. The use of flint, stones, amber and bones. *In:* KLEIJNE, J. P., BRINKKEMPER, O., LAUWERIER, R. C. G. M., SMIT, B. I. & THEUNISSEN, E. M. (eds.) *A Matter of Life and Death at Mienakker (the Netherlands). Late Neolithic Behavioural Variability in a Dynamic Landscape* (Nederlandse Archeologische Rapporten 45), Amersfoort: Rijksdienst voor het Cultureel Erfgoed, 59-98.

GARDINER, J. P. 2008. On the production of discoidal flint knives and changing patterns of specialist flint procurement in the Neolithic of the South Downs, England. *In:* FOKKENS, H., COLES, B. J., VAN GIJN, A. L., KLEIJNE, J. P., PONJEE, H. H. & SLAPPENDEL, C. G. (eds.) *Between Foraging and Farming: An extended broad spectrum of papers presented to Leendert Louwe Kooijmans* (Analecta Praehistorica Leidensia 40), Leiden: Faculty of Archaeology, Leiden, 235-246.

GARRIDO-PENA, R. 2000. *El campaniforme en la Meseta central de la península ibérica : (c. 2500-2000 AC)* (British Archaeological Reports: International Series 892), Oxford: Hadrian Books.

GÄRTNER, G. 1969. *Die ur- und frühgeschichtlichen Denkmäler und Funde des Kreises Sternberg* (Beiträge zur Ur- und Frühgeschichte der Bezirke Rostock, Schwerin und Neubrandenburg 4), Berlin: Museum für Ur- und Frühgeschichte Schwerin.

GEBERS, W. 1978. *Endneolithikum und Frühbronzezeit im Mittelrheingebiet* (Saarbrücker Beiträge zur Altertumskunde 28), Bonn: Verlag Dr. Rudolf Habelt GmbH.

GEISLEROVA, K. & ONDRAČEK, J. 1981. Objekt kultury zvoncovitých pohárů z Bořitova. *Přehled výzkumů AÚ ČSAV,* 1979**,** 19.

GEISLEROVA, K. & VITULA, P. 1985. Únětické sídliště a pohřebiště u Tvarožné. *Archeologické rozhledy,* XXXVII**,** 489-497.

GERRETS, D. A., OPBROEK, M. & WILLIAMS, G. L. (eds.) 2012. *Onvoltooid verleden. Sporen van meer dan 10.000 jaar menselijke activiteiten langs de Regge bij Nijverdal* (ADC Monografie 13), Amersfoort: ADC Archeoprojecten.

GESCHWENDT, F. 1960. *Kreis Geldern* (Archäologische Funde und Denkmäler des Rheinlandes 1), Köln: Boehlau.

GESCHWINDE, M. 2000. *Die Hügelgräber auf der Großen Heide bei Ripdorf im Landkreis Uelzen. Archäologische Beobachtungen zu den Bestattungssitten des Spätneolithikums und der Bronzezeit in der Lüneburger Heide*, Neumünster: Wachholtz.

GIBSON, A. M. 1982. *Beaker Domestic Sites. A study of the domestic pottery of the late third and early second millennia B.C. in the British Isles* (British Archaeological Reports: British Series 107), Oxford: Archaeopress.

GIBSON, A. M. 1987. Beaker domestic sites across the North Sea: a review. *In:* BLANCHET, J.-C. (ed.) *Les relations entre le continent et les Iles Brittaniques à l'Age du Bronze, Actes du colloque de Lille dans le cadre du 22ème Congrès Préhistorique de dare d'édition, 2-7 Septembre 1984.,* Paris: Société Préhistorique Française, 7-16.

GIBSON, A. M. 2007. A Beaker veneer? Some evidence from the burial record. *In:* LARSSON, M. & PARKER PEARSON, M. (eds.) *From Stonehenge to the Baltic* (British Archaeological Reports: International Series 1692), Oxford: Archaeopress, 47-64.

GIBSON, A. M. & GILL, D. 2013. Beaker occupation at Cavenham Quarry, Suffolk. *In:* PRIETO MARTINEZ, M. P. & SALANOVA, L. (eds.) *Current researches on Bell Beakers. Proceedings of the 15th International Bell Beaker Conference: From Atlantic to Ural. 5th-9th May 2011. Poio (Pontevedra, Galicia, Spain),* Santiago de Compostela: Galician Archaeopots, 251-264.

GIBSON, A. M. & SNAPE, N. 2013. Two Beaker vessels from Maxey Quarry, Cambridgeshire. *In:* PRIETO MARTINEZ, M. P. & SALANOVA, L. (eds.) *Current researches on Bell Beakers. Proceedings of the 15th International Bell Beaker Conference: From Atlantic to Ural. 5th-9th May 2011. Poio (Pontevedra, Galicia, Spain),* Santiago de Compostela: Galician Archaeopots, 129-137.

GIBSON, A. M. & WOODS, A. J. 1997. *Prehistoric Pottery for the Archaeologist*, Leicester: Leicester University Press.

GIMBUTAS, M. 1965. *Bronze Age cultures in Central and Eastern Europe*, The Hague: Mouton.

GIRVAN, M. & NEWMAN, M. E. J. 2002. Community structure in social and biological networks. *Proceedings of the National Academy of Sciences,* 99**,** 7821-7826.

GLASBERGEN, W. & ADDINK-SAMPLONIUS, M. 1965. Laat-Neolithicum en Bronstijd te Monster (Z.H.). *Helinium,* 5**,** 97-117.

GLASBERGEN, W., GROENMAN-VAN WAATERINGE, W. & HARDENBERG-MULDER, G. M. 1967. Settlements of the Vlaardingen Culture at Voorschoten and Leidschendam (I). *Helinium,* 7**,** 3-31.

GLASBERGEN, W., GROENMAN-VAN WAATERINGE, W. & HARDENBERG-MULDER, G. M. 1967. Settlements of the Vlaardingen Culture at Voorschoten and Leidschendam (II). *Helinium,* 7**,** 97-120.

GLOB, P. V. 1945. *Studier over den Jyske Enkeltgravskultur*, København: Gyldendalske Boghandel.

GLOB, P. V. 1952. *Yngre stenalder* (Danske oldsager 2), København: Gyldendalske Boghandel.

GOLITKO, M., MEIERHOFF, J., FEINMAN, G. M. & WILLIAMS, P. R. 2015. Complexities of collapse: the evidence of Maya obsidian as revealed by social network graphical analysis. *Antiquity,* 86, 507-523.

GOMART, L. 2014. *Traditions techniques et production céramique au Néolithique ancien. Étude de huit sites rubanés du nord est de la France et de Belgique*, Leiden: Sidestone Press.

GOMEZ DE SOTO, J. 1975. Le rempart artenacien du camp de Pierre-Dure à Vœuil-et-Giget (Charente) [Quelques réflexions au sujet d'Artenac]. *Bulletin de la Société Préhistorique Française,* 72, 117-124.

GOMEZ DE SOTO, J. 1980. *Les cultures de l'Âge du Bronze dans le bassin de la Charente*, Perigeux: Éd. Fanlac.

GOMEZ DE SOTO, J. 1995. *Le bronze moyen en occident: la culture des Duffaits et la civilisation des Tumulus* (L'âge du bronze en France 5), Paris: Picard.

GOMEZ DE SOTO, J. & JOUSSAUME, R. 1978. Analyse de deux points de Palmela du Centre-Ouest. *Bulletin de la Société Préhistorique Française,* 75, 121-123.

GONÇALVES, J. L. 1979. Os povoados Neo e Calcolíticos da península de Lisboa. *Boletím Cultural da Assambleia Distritál de Lisboa, série III,* 85, 137-162.

GONÇALVES, J. L. 1991. Cerâmica Calcolítica da Estremadura. *Actas das IV Jornadas Arqueológicas*, Lisboa: Associação dos Arqueólogos Portugueses, 215-226.

GONÇALVES, J. L. 1992. Grutas artificiis da Quinta das Lapas (Monte Redondo, Torres Vedras). *Setúbal Arqueológica,* IX-X, 247-276.

GONÇALVES, J. L. 1993. Os Ídolos cornos de Olelas e Serra de Éguas. *Al madan 2nd série*, 38-40.

GONÇALVES, J. L. 1994. Castro da Columbeira um primeira fase do Calcolítico médio estremenho. *Al madan 2nd série*, 5-7.

GONÇALVES, J. L. 1994. O Castro da Fórnea (Matacães – Torres Vedras). *In:* KUNST, M. (ed.) *Origens, Estruturas e Relações das Culturas Calcolíticas da Península Ibérica* (Trabalhos de Arqueologia 7), Lisboa: Instituto Português de Arqueologia, 149-158.

GONÇALVES, J. L. 1997. O Povoado de Olelas (Sintra). Breve Notícia Sobre Materiais e Datações. *Setúbal Arqueológica,* XI-XII, 221-223.

GONÇALVES, J. L. & DA CUNHA SERRÃO, E. 1978. O povoado Calcolítico do Alto do Dafundo. *Actas da 1.ª Mesa-Redonda sobre o Neolítico e o Calcolítico em Portugal*, Porto: Grupo de Estudos Arqueológicos do Porto, 121-143.

GONÇALVES, V. S. 1971. *O Castro da Rotura e o vaso campaniforme*, Setúbal: Assembleia Distrital de Sétubal.

GONÇALVES, V. S. 1990. Sítios, 'Horizontes' e Artefactos: o caso da Parede (Cascais, Lisboa). *Boletím Cultural do Municipio de Cascais,* 9, 13-44.

GONZALEZ, M. C., HIDALGO, C. A. & BARABASI, A. L. 2008. Understanding individual human mobility patterns. *Nature,* 453, 779-82.

GOOSSENS, A. 1964. Lommel: bekercultuur. *Archeologie,* 1964, 67-68.

GOOSSENS, T. A. 2009. *Opgraving Hellevoetsluis-Ossenhoek. Een nederzetting van de Vlaardingen-groep op een kwelderrug in de gemeente Hellevoetsluis* (Archol Rapport 87), Leiden: Archol.

GOSSELAIN, O. P. 2000. Materializing Identities: An African Perspective. *Journal of Archaeological Method and Theory,* 7, 187-217.

GÖTZE, A. 1891. *Die Gefässformen un Ornamente der neolithischen schnurverzierten Keramik in Flussgebiete der Saale*, Jena: Hermann Pohle.

GÖTZE, A. 1896. Über Neolitischen Handel. *In:* ACHELIS, T. (ed.) *Adolf Bastian als Festgruß zu seinem 70. Geburtstage, 26 Juni 1896*, Berlin: Dietrich Reimer, 339-353.

GOUTBEEK, A. 1979. Prehistorische vondsten langs de Overijsselse Vecht. *Westerheem*, 28, 95-105.

GOUTBEEK, A. & VERLINDE, A. D. 1980. Rechteren, gem. Dalfsen. *In:* VERLINDE, A. D. (ed.) *Archeologische Kroniek van Overijssel over 1982*, Amersfoort: ROB, 198-203.

GRAHAM, S. 2006. Networks, agent-based models and the Antonine itineraries: implications for Roman archaeology. *Journal of Mediterranean Archaeology*, 19, 45-64.

GRANER, G. 2003. From sherds to shape. Early Neolithic funnel beakers in Eastern Central Sweden – what did they look like? *In:* SAMUELSSON, C. & YTTERBERG, N. (eds.) *Uniting Sea. Stone Age Societies in the Baltic Sea Region. Proceedings from the First Uniting Sea Workshop at Uppsala University, Sweden, January 26-27, 2002*. (Occasional Papers in Archaeology 33), Uppsala: Uppsala University, 50-61.

GRANOVETTER, M. S. 1973. The Strength of Weak Ties. *American Journal of Sociology*, 78, 1360-1380.

GRANOVETTER, M. S. 1983. The Strength of Weak Ties: A Network Theory Revisited. *Sociological Theory*, 1, 201-233.

GRAŠIS, N. 1996. Auklas keramikas kultūras apbedljumi Sarkanos un Selgäs. *Zinätniskäs atskaitęs sesijas materiali par arheologu 1994. un 1995. gada peffjumu rezultätiem*, Riga, 60-65.

GRIMES, W. F. 1944. Excavations at Stanton Harcourt, Oxon. 1940. *Oxoniensia*, 8-9, 19-63.

GRIMM, P. 1932. Gräberfeld, Siedlung und Menhir der Endsteinzeit bei Nohra, Kr. Grafschaft Hohenstein. *Mannus*, 24, 244-256.

GROENENDIJK, H. A. & WATERBOLK, H. T. 1994. *Urnen en essen* (De Geschiedenis van Westerwolde 7), Groningen: Stichting Gebroeders Hesse Fonds.

GROENEWOUDT, B. J., SCHUT, P. A. C., VAN DER HEIJDEN, F. J. G., PEETERS, J. H. M. & WISPELWEY, M. H. 2006. *Een inventariserend veldonderzoek bij de Hunneschans (Uddel, Gelderland). Nieuwe gegevens over de steentijdbewoning bij het Uddelermeer en een beknopt overzicht van de onderzoeksgeschiedenis van de Hunneschans.* (Rapportage Archeologische Monumentenzorg 143), Amersfoort: RACM.

GRÖMER, K. & KERN, D. 2010. Technical Data and Experiments on Corded Ware. *Journal of Archaeological Science*, 37, 3136-3145.

GROSSMANN, R. 2016. *Das dialektische Verhältnis von Schnurkeramik und Glockenbecher zwischen Rhein und Saale* (Universitätsforschungen zur Prähistorischen Archäologie 287), Bonn: Verlag Dr. Rudolf Habelt GmbH.

GRUPE, G., PRICE, T. D. & SCHRÖTER, P. 2001. Zur Mobilität in der Glockenbecherkultur. Eine archäometrische Analyse südbayerischer Skelettfunde. *In:* LIPPERT, A., SCHULTZ, M., SHENNAN, S. J. & TESCHLER-NICOLA, M. (eds.) *Mensch und Umwelt während des Neolithikums und der Frühbronzezeit in Mitteleuropa*, Rahden: Verlag Marie Leidorf GmbH, 207-213.

GRUPE, G., PRICE, T. D., SCHRÖTER, P., SÖLLNER, F., JOHNSON, C. M. & BEARD, B. L. 1997. Mobility of Bell Beaker people revealed by strontium isotope ratios of tooth and bone: a study of southern Bavarian skeletal remains. *Applied Geochemistry*, 12, 517-525.

GRUPE, G., PRICE, T. D. & SÖLLNER, F. 1999. Mobility of Bell Beaker people revealed by strontium isotope ratios of tooth and bone: a study of southern Bavarian skeletal remains. A reply to the comment by Peter Horn and Dieter Müller-Sohnius. *Applied Geochemistry*, 14, 271-275.

GRUŻDŹ, W., MIGAL, W. & PYŻEWICZ, K. 2015. Bifacial flint daggers from the Early Bronze Age in Volhynia – Lesser Poland. *In:* FRIEMAN, C. J. & ERIKSEN, B. V. (eds.) *Flint daggers in prehistoric Europe*, Oxford: Oxbow Books, 116-132.

GUIBERT, P., SZEPERTYSKI, B., SCHVOERER, M. & ROUSSOT-LARROQUE, J. 1996. Datation par thermoluminescence d'un niveau néolithique ancien à la Lède du

Gurp (Gironde), comparaison avec les dates radiocarbone. *Bulletin de la Société Préhistorique Française,* 93, 217-224.
GUILAINE, J. 1972. *L'Âge du Bronze en Languedoc Occidental, Roussillon, Ariège* (Mémoires de la Société Préhistorique Française 9), Paris: Société Préhistorique Française.
GUILAINE, J. & SOLIER, Y. 1966. Quelques pointes de flèches et de javelots en bronze de l'Aude et de l'Ariège. *Bulletin de la Société scientifique de l'Aude,* 66, 75-85.
GÜNTHER, K. 1970. *Steinzeit und Altere Bronzezeit im Landesmuseum für Vor- und Frühgeschichte Münster*, Münster: Landesmuseum für Vor- und Frühgeschichte.
GUTIERREZ, C., JULIEN, M., MARTIAL, E., MONCHABLON, C. & PRAUD, I. 2012. De nouvelles donées sur la fin du Néolithique dans la vallée de la Sensée: l'étude d'une fosse à Arleux. *Revue du Nord,* 17, 51-66.
GUTIÉRREZ SÁEZ, C., LÓPEZ DEL ESTAL, A., SIMÓN MARTÍN, Á., MUÑOZ MORO, P., BASHORE ACERO, C., CHAMÓN FERNÁNDEZ, J., MARTÍN LERMA, I., SANZ SALAS, E., PARDO NARANJO, A. I. & MARÍN DE ESPINOSA, J. A. 2011. Puntas de palmela: procesos tecnológicos y experimentación. *Trabajos de Prehistoria,* 67, 405-418.
GUTIÉRREZ SÁEZ, C. & MARTÍN LERMA, I. 2015. Traceology on Metal. Use-Wear Marks on Copper-Based Tools and Weapons. 171-188.
GUTIÉRREZ SÁEZ, C., MARTÍN LERMA, I., LÓPEZ DEL ESTAL, A. & BASHORE ACERO, C. 2014. The Functionality of Palmela Points as Throwing Weapons and Projectiles: Use-Wear Marks. *In:* MARREIROS, J., BICHO, N. & GIBAJA BAO, J. (eds.) *International Conference on Use-Wear Analysis. Use-Wear 2012*, Cambridge: Cambridge Scholars Press, 442-456.
HAAK, W. 2018. Comments on Furholt's Massive Migrations? *European Journal of Archaeology*.
HAAK, W., BRANDT, G., DE JONG, H. N., MEYER, C., GANSLMEIER, R., HEYD, V., HAWKESWORTH, C., PIKE, A. W. G., MELLER, H. & ALT, K. W. 2008. Ancient DNA, Strontium isotopes, and osteological analyses shed light on social and kinship organisation of the Later Stone Age. *Proceedings of the National Academy of Sciences of the United States of America,* 105, 18226-18231.
HAAK, W., LAZARIDIS, I., PATTERSON, N., ROHLAND, N., MALLICK, S., LLAMAS, B., BRANDT, G., NORDENFELT, S., HARNEY, E., STEWARDSON, K., FU, Q., MITTNIK, A., BÁNFFY, E., ECONOMOU, C., FRANCKEN, M., FRIEDERICH, S., PENA, R. G., HALLGREN, F., KHARTANOVICH, V., KHOKHLOV, A., KUNST, M., KUZNETSOV, P., MELLER, H., MOCHALOV, O., MOISEYEV, V., NICKLISCH, N., PICHLER, S. L., RISCH, R., ROJO GUERRA, M. A., ROTH, C., SZÉCSÉNYI-NAGY, A., WAHL, J., MEYER, M., KRAUSE, J., BROWN, D., ANTHONY, D., COOPER, A., ALT, K. W. & REICH, D. 2015. Massive migration from the steppe was a source for Indo-European languages in Europe. *Nature,* 522, 207.
HABIBA, ATHENSTÄDT, J. C., MILLS, B. J. & BRANDES, U. 2018. Social Networks and Similarity of Site Assemblages. *Journal of Archaeological Science,* 92, 63-72.
HAHN, F. 1939. Jungsteinzeit Kr. Bitburg. *Trierer Zeitschrift Jahresbericht,* 1938, 197-200.
HÁJEK, L. 1932. Příspěvek k Chronologickému zařazeni a vývoji šńurové keramiky. *Památky archeologické,* 38, 40-42.
HÁJEK, L. 1939. Kulturní jámy s keramikou zvoncovitých pohárů. *Památky archeologické,* 19, 119-122.
HÁJEK, L. 1942. Bernsteinfunde in der mitteleuropäischen Glockenbecherkultur. *Sudeta N.F.,* 2, 21-32.
HÁJEK, L. 1959. Kostená industrié otomanske kultury z Barce. *Slovenská Archeológia,* 7, 285-300.
HÁJEK, L. 1968. *Die Glockenbecherkultur in Böhmen* (Archeologické studijní materiály 5), Praha: Archeologicky ústav CSAV.

HAMBURG, T. 2005. *Neolithische bewoningsresten te Leidschendam. Begeleiding, Inventariserend Veldonderzoek (IVO) en Opgraving (DO) Leidschendam-Prinsenhof* (Archol Rapport 59), Leiden: Archol.

HAMBURG, T., LOHOF, E. & QUADFLIEG, B. 2012. *Bronstijd opgespoord. Archeologisch onderzoek van prehistorische vindplaatsen op Bedrijvenpark H2O – plandeel Oldebroek (Provincie Gelderland)* (Archol Rapport 142), Leiden: Archol.

HAMMER, Ø., HARPER, D. A. T. & RYAN, P. D. 2001. PAST: Paleontological statistics software package for education and data analysis. *Palaeontologia Electronica,* 4, 9.

HAMMERSMITH, H. 2010. Experimentation and Interpretation. The Use of Experimental Archaeology in the Study of the Past. *In:* MILLSON, D. C. E. (ed.) *The origins and spread of domestic plants in south-west Asia*, Oxford: Oxbow Books, 109-127.

HANSEN, M. 1986. Enkeltgravskultuens bopladsfund fra Vesthimmerland of Ribe-området. *In:* ADAMSEN, C. & EBBESEN, K. (eds.) *Stridsøksetid i Sydskandinavien: beretning fra et symposium 28.-30.X. 1985 i Vejle* (Arkæologiske skrifter 1), København: Forhistorisk Arkæologisk Institut, København Universitet, 286-291.

HANSEN, S., RENN, J., KLIMSCHA, F., BÜTTNER, J., HELWING, B. & KRUSE, S. 2016. The Digital Atlas of Innovations: A Research program on Innovations in Prehistory and Antiquity. *eTOPOI Journal for Ancient Studies Special Volume,* 6, 777-818.

HAOUR, A., MANNING, K., ARAZI, N., GOSSELAIN, O. P., GUÈYE, N. S., KEITA, D., LIVINGSTONE SMITH, A., MACDONALD, K. C., MAYOR, A., MCINTOSH, S. K. & VERNET, R. (eds.) 2010. *African Pottery Roulettes Past and Present: Techniques, Identification, and Distribution*, Oxford: Oxbow books.

HARCK, O. 1972. Der Riesenbecher von Hitzacker. *"Hannoversches Wendland" 3. Jahresheft der Heimatkundlichen Arbeitskreises Lüchow-Dannenberg*, Lüchow: Selbstverlag des Heimatkundlichen Arbeitskreises, 21-30.

HARRISON, R. J. 1974. A Closed Find from Cañada Rosal, near Écija (Sevilla). *Madrider Mitteilungen,* 15, 77-94.

HARRISON, R. J. 1974. Ireland and Spain in the Early Bronze Age: Fresh Evidence for Irish and British Contacts with the Proto-Atlantic Bronze Age in Spain in the Second Millennium B.C. *Journal of the Royal Society of Antiquaries of Ireland,* 104, 52-73.

HARRISON, R. J. 1974. A reconsideration of the Iberian background to Beaker metallurgy. *Palaeohistoria,* 16, 63-105.

HARRISON, R. J. 1977. *The Bell Beaker cultures of Spain and Portugal* (American School of Prehistoric Research Bulletin 35), Boston (MA): Harvard University.

HARRISON, R. J. 1980. *The beaker folk : copper age archaeology in Western Europe*, London: Thames & Hudson.

HARRISON, R. J., BUBNER, T. & HIBBS, V. 1976. The Beaker pottery from El Acebuchal, Carmona (Prov. Sevilla). *Madrider Mitteilungen,* 17, 79-141.

HARRISON, R. J. & GILMAN, A. 1977. Trade in the Second and Third millennia B.C. betwee the Maghreb and Iberia. *In:* MARKOTIC, V. (ed.) *Ancient Europe and the Mediterranean*, Warminster: Aris and Phillips, 89-104.

HARRISON, R. J. & HEYD, V. 2007. The Transformation of Europe in the Third Millennium BC: the example of 'Le Petit-Chasseur I + III' (Sion, Valais, Switzerland). *Prähistorische Zeitschrift,* 82, 129-214.

HARTZ, S., LÜBKE, H. & TERBERGER, T. 2007. From fish and seal to sheep and cattle: new research into the process of neolithisation in northern Germany. *In:* WHITTLE, A. W. R. & CUMMINGS, V. (eds.) *Going Over: The Mesolithic-Neolithic Transition in North-West Europe* (Proceedings of the British Academy 144), London: The British Academy, 567-594.

HARTZ, S. & MÜLLER, J. 2017. Riesenbecher reloaded. Der mediale Bedeutung einer Fundkategorie und ein einzigartiger Keramikbefund von Göhl LA 142. *In:* ERIKSEN, B. V., ABEGG-WIGG, A., BLEILE, R. & ICKERODT, U. (eds.) *Interaktion* *ohne Grenzen. Beispiele archäologischer Forschungen am Beginn dec 21. Jahrhunderts*, Schleswig: Archäologisches Landesmuseum Schleswig-Holstein, 35-48.

HÄUSLER, A. 1955. Die kulturellen und wirtschaftlichen Beziehungen der Bevölkerungsgruppen Mittelrusslands am Ende der jüngeren Steinzeit. *Wissenschaftliche Zeitschrift der Martin-Luther-Universität Halle-Wittenberg,* V, 69-146.

HAZZLEDINE WARREN, S., PIGGOTT, S. E., CLARK, J. G. D., BURKITT, M. C., GODWIN, H. & GODWIN, M. E. 1936. Archaeology of the Submerged Land-Surface of the Essex Coast. *Proceedings of the Prehistoric Society,* 2, 178-210.

HEALY, F. 2012. Chronology, Corpses, Ceramics, Copper and Lithics. *In:* ALLEN, M. J., GARDINER, J. P., SHERIDAN, J. A. & MCOMISH, D. (eds.) *Is there a British Chalcolithic? People, Place and Polity in the late 3rd millennium* (Prehistoric Society Research Papers 4), Oxford: Oxbow books, 144-163.

HECHT, D. 2007. *Das schnurkeramische Siedlungswesen im südlichen Mitteleuropa: Eine Studie zu einer vernachlässigten Fundgattung im Übergang vom Neolithikum zur Bronzezeit* PhD Thesis, Universität Heidelberg.

HEIJNIS, A. 2013. *Oldeboorn. A Bell Beaker settlement on a drowned sand dune in Fryslân.* MA Thesis, Leiden University.

HEIN, M. 1987. *Untersuchungen zur Kultur der Schnurkeramik in Mitteldeutschland* (Saarbrücker Beiträge zur Altertumskunde 50), Bonn: Verlag Dr. Rudolf Habelt GmbH.

HEIRBAUT, E. N. A. 2007. *Cuijk-Groot Heiligenberg. Onderzoek en opgraving van bronstijderven en een middeleeuwse nederzetting* (Archol Rapport 47), Leiden: Archol.

HEIRBAUT, E. N. A. 2011. *Sieraden op de brandstapel. Onderzoek naar een crematiegrafveld uit de Midden-IJzertijd en Middeleeuwse bewoning op het sportpark te Woezik-Noord, gemeente Wijchen* (Archeologische Berichten Wijchen – Rapport 12), Nijmegen: Gemeente Nijmegen.

HELBÆK, H. 1952. Spelt (Triticum Spelta L.) in Bronze Age Denmark. *Acta Archaeologica,* 23, 97-107.

HELENO, M. 1933. Grutas artificiais de Tojal de Vila Chã (Carenque). *Actas do Congresso Luso-Espanhola para o progresso das Ciências*, Lisboa, 5-25.

HELLMUNDT, A. 1964. *Die vor- und frühgeschichtlichen Denkmäler und Funde des Kreises Ueckermünde* (Die vor- und frühgeschichtlichen Denkmäler und Funde im Gebiet der Deutschen Demokratischen Republik 3), Schwerin: Landesamt für Denkmalpflege Mecklenburg-Vorpommern.

HELMS, M. W. 1988. *Ulysses' Sail: An Ethnographic Odyssey of Power, Knowledge, and Geographical Distance*, Princeton: Princeton University Press.

HENSHALL, A. S. 1963. A dagger-grave and other cist burials at Ashgrove, Methilhill, Fife. *Proceedings of the Society of Antiquaries of Scotland,* 97, 166-179.

HERMSEN, I. C. G. 2007. *Een afdaling in het verleden, archeologisch onderzoek van bewoningsresten uit de prehistorie en de Romeinse tijd op het terrein Colmschate-Skibaan (gemeente Deventer).* (Rapportages Archeologie Gemeente Deventer 19), Deventer: Gemeente Deventer.

HERMSEN, I. C. G. 2009. *Vissen in het verleden van Bergharen. Archeologisch onderzoek van prehistorische en middeleeuwse bewoningsresten aan Dorpsstraat 35 te Bergharen – Gemeente Wijchen* (Archeologische Berichten Wijchen – Rapport 7), Nijmegen: Gemeente Nijmegen.

HERMSEN, I. C. G. & HEIJTING, F. J. 2013. *Proefsleuvenonderzoek in het plangebied Nudepark fase 2 te Wageningen* (Archeodienst Rapport 207), Zevenaar: Archeodienst.

HERNÁNDEZ CARRIÓN, E. & GIL GONZÁLEZ, F. 1994. Memoria de las excavationes de urgencia en la Rambla de la Alquería (Jumilla – Murcia). *Memorias de Arqueológia,* 9, 108-124.

HERON, C., SHODA, S., BREU BARCONS, A., CZEBRESZUK, J., ELEY, Y., GORTON, M., KIRLEIS, W., KNEISEL, J., LUCQUIN, A., MULLER, J., NISHIDA, Y., SON, J. H. &

CRAIG, O. E. 2016. First molecular and isotopic evidence of millet processing in prehistoric pottery vessels. *Nature Scientific Reports,* 6, 38767.

HEYD, V. 1998. Die Glockenbecherkultur in Süddeutschland – Zum Stand der Forschung einer Regionalprovinzentlang der Donau. *In:* BENZ, M. & VAN WILLIGEN, S. (eds.) *Some New approaches to The Bell Beaker 'Phenomenon'. Lost Paradise…?, Proceedings of the 2nd Meeting of the « Association Archéologie et Gobelets », Feldberg (Germany), 18th-20th avril 1997* (British Archaeological Reports: International Series 690), Oxford: Archaeopress, 87-106.

HEYD, V. 2000. *Die Spätkupferzeit in Süddeutschland* (Saarbrücker Beiträge zur Altertumskunde 73), Bonn: Verlag Dr. Rudolf Habelt GmbH.

HEYD, V. 2004. Überregionale Verbindungen der süddeutschen Glockenbecherkultur anhand der Siedlungen. *In:* HEYD, V., HUSTY, L. & KREINER, L. (eds.) *Siedlungen der Glockenbecherkultur in Süddeutschland und Mitteleuropa* (Arbeiten zur Archäolgoei Süddeutschlands 17), Büchenbach: Dr. Faustus, 181-202.

HEYD, V. 2007. Families, Prestige Goods, Warriors & Complex Societies: Beaker Groups of the 3rd Millennium cal BC Along the Upper and Middle Danube. *Proceedings of the Prehistoric Society,* 73, 327-379.

HEYDECK, J. 1893. Zwei Steinzeitskelette (liegende Hocker) in dem Prussia-Museums. *Sitzungsberichte der Altertumsgesellschaft Prussia,* 18, 46-60.

HEYMANS, H. 1982. Aardewerk uit de overgangsperiode van het laat-neolithicum naar de vroege-bronstijd uit Geistingen. *Limburg,* 61, 268-271.

HEYMANS, H., DRENTH, E., KIJERS, D. & SCHREURS, J. (eds.) 2007. *Archeologisch onderzoek te Ittervoort. Oude bedrijvigheid op het industrieterrein Santfort ontsloten*, Ittervoort: Stichting Streekarcheologie Peel, Maas en Kempen.

HEYMANS, H. & VERMEERSCH, P. M. 1983. Siedlungsspuren aus Mittel- und Spätneoithikum, Bronzezeit und Eisenzeit in Geistingen, Huizerhof (Provinz Limburg). *Archaeologia Belgica,* 255, 15-64.

HIDDINK, H. 2006. *Opgravingen op het Rosveld bij Nederweert 2. Graven en grafvelden uit de ijzertijd en Romeinse tijd* (Zuidnederlandse Archeologische Rapporten 28), Amsterdam: ACVU-HBS.

HIELKEMA, J. 2004. *Aanvullend Archeologisch Onderzoek op vindplaats 5, Tiel-Medel-Oude Weiden, gemeente Tiel (Gld.)* (ARC Rapport 82), Groningen: ARC.

HIELKEMA, J. 2006. *Jagers-verzamelaars langs de Wâldwei. Een archeologisch onderzoek van een vindplaats uit het Mesolithicum, het Midden-Neolithicum en de Late IJzertijd/Romeinse Tijd bij Hempens, gemeente Leeuwarden (Fr.)* (ARC Rapport 131), Groningen: ARC.

HIGHAM, T. F. G., CHAPMAN, J., SLAVCHEV, V., GAYDARSKA, B., HONCH, N., YORDANOV, Y. & DIMITROVA, B. 2007. New perspectives on the Varna cemetery (Bulgaria) – AMS dates and social implications. *Antiquity,* 81, 640-645.

HILDEBRAND, E. B. 1863. Berättelse om antiqvariska undersökningar I Vestergötland år 1863. *Antikvarisk Tidskrift för Sverige,* I, 255-283.

HILLEBRAND, J. 1929. *A Pusztaistvánházi Korarézkori Temetö* (Archaeologia Hungarica 4), Budapest.

HISSEL, M. 2012. *Een inheems-Romeinse nederzetting in Oerle-Zuid (gemeente Veldhoven) Definitief archeologisch onderzoek in plangebied 'Zilverackers', gemeente Veldhoven, deelgebied Oerle-Zuid* (Diachron rapport 50), Amsterdam: Diachron.

HJELMQVIST, H. 1993. Some economic plants from the Prehistoric and Mediaeval Periods in southern Scania. *In:* LARSSON, L., CALLMER, J. & STJERNQUIST, B. (eds.) *The Archaeology of the Cultural Landscape* (Acta Archaeologica Lundensia 4 19), Lund: University of Lund, 359-367.

HÖGBERG, A. & OLAUSSON, D. 2007. *Scandinavian Flint – an Archaeological Perspective*, Aarhus: Aarhus University Press.

HOGESTIJN, J. W. H. & DRENTH, E. 2000. The TRB culture 'house-plan' of Slootdorp-Bouwlust and other known 'house plans' from the Dutch Middle and Late Neolithic: A Review. *In:* KELM, R. (ed.) *Vom Pfostenloch zum Steinzeithaus. Archäologische Forschung und Rekonstruktion jungsteinzeitlicher Haus- und Siedlungsbefunde im nortwestlichen Mitteleuropa*, Heide: AÖZA, 126-154.

HOGESTIJN, J. W. H. & WOLTERING, P. J. 1990. 'Het woiffie van Soibekarspel'. Een Laat-Neolithisch vrouwengraf te Sijbekarspel. *Westfrieslands Oud en Nieuw,* 57, 152-164.

HOLLNAGEL, A. 1958. *Die vor- und frühgeschichtlichen Denkmäler und Funde des Kreises Neustrelitz* (Die vor- und frühgeschichtlichen Denkmäler und Funde im Gebiet der Deutschen Demokratischen Republik 1), Schwerin: Landesamt für Denkmalpflege Mecklenburg-Vorpommern.

HOLLNAGEL, A. 1961. Kurze Fundberichte. *Bodendenkmalpflege in Mecklenburg Jahrbuch,* 1961, 241.

HOLLNAGEL, A. 1964. Gestörte jungsteinzeitliche Gräber und Siedlungsreste der älteren Eisenzeit auf dem "Langen Feld" bei Göhren, Kreis Rügen. *Bodendenkmalpflege in Mecklenburg Jahrbuch,* 1963, 7-30.

HOLLNAGEL, A. 1967. Kurze Fundberichte. *Bodendenkmalpflege in Mecklenburg Jahrbuch,* 1966, 289.

HOLLNAGEL, A. 1967. Kurze Fundberichte. *Bodendenkmalpflege in Mecklenburg Jahrbuch,* 1966, 294.

HOLWERDA, J. H. 1907. *Nederland's vroegste beschaving : proeve van een archaeologisch systeem*, Leiden: Brill.

HOORNE, J., SERGEANT, J., BOUDIN, M., TAELMAN, E., VANHEE, D. & VAN STRYDONCK, M. 2009. Een finaalneolithische potbeker op het Aquafintracé te Hansbeke – *Voordestraat* (gemeente Nevele, provincie Oost-Vlaanderen). *Notae Praehistoricae,* 29, 81-85.

HOUOT, A. 1995. *Le Soleil des Morts*, Toulon: Soleil Productions.

HÜBNER, E. 2005. *Jungneolithische Gräber auf der Jütischen Halbinsel. Typologische und chronologische Studien zur Einzelgrabkultur* (Nordiske fortidsminder 24), København: Der Kongelige Nordiske oldskirftselskab.

HUGHES, G. (ed.) 2000. *The Lockington Gold Hoard. An Early Bronze Age Barrow Cemetery at Lockington, Leicestershire*, Oxford: Oxbow Books.

HUIS IN 'T VELD, J. Y. 2004. *Sporen uit de Vroege Bronstijd en Romeinse Tijd te Culemborg. Een archeologische opgraving van 'vindplaats B' te Lanxmeer, Culemborg, gemeente Culemborg (Gld.)* (ARC Publicaties 97), Groningen: ARC.

HULST, R. S. 1966. A Pot Beaker from Velp, Prov. of Gelderland. *Berichten van de Rijksdienst voor het Oudheidkundig Bodemonderzoek,* 15/16, 231-232.

HULST, R. S. 1970. Rheden. Velp. *Archeologische Kroniek van Gelderland,* 1966-1967, 29.

HULST, R. S. & VAN SPRANG, A. 1970. Ermelo. Drie. *Archeologische Kroniek van Gelderland,* 1966-1967, 28.

HUNTINGTON, R. & METCALF, P. 1979. Introduction: The anthropology of Death Ritual. *Celebrations of death, the anthropology of mortuary ritual*, Cambridge: Cambridge University Press, 1-20.

HURCOMBE, L. 2008. Organics from inorganics: using experimental archaeology as a research tool for studying perishable material culture. *World Archaeology,* 40, 83-115.

HURTADO, V. & GARCÍA SANJUÁN, L. 1994. La necrópolis de Guadaira y la transición a la edad del bronce en la cuenca media del Guadiana. *Spal,* 3, 95-144.

HVASS, S. 1977. A house of the Single-Grave Culture excavated at Vorbasse in Central Jutland. *Acta Archaeologica,* 48, 219-232.

HVASS, S. 1986. En boplads fra enkeltgravskulturen i Vorbasse. *In:* ADAMSEN, C. & EBBESEN, K. (eds.) *Stridsøksetid i Sydskandinavien: beretning fra et symposium*

28.-30.X. 1985 i Vejle (Arkæologiske skrifter 1), København: Forhistorisk Arkæologisk Institut, København Universitet, 325-335.

ILON, G. 2005. Bucsu-Hosszú Aszú-dűlő. *Régészeti kutatások Magyarországon,* 2004, 179.

IRWIN-WILLIAMS, C. 1977. A network model for the analysis of prehistoric trade. *In:* EARLE, T. K. & ERICSON, J. E. (eds.) *Exchange systems in Prehistory*, New York: Academic Press, 141-151.

ISABEL DIAS, M., ISABEL PRUDÊNCIO, M. & VALERA, A. C. 2017. Provenance and circulation of Bell Beakers from Western European societies of the 3rd millennium BC: The contribution of clays and pottery analyses. *Applied Clay Science,* 146, 334-342.

ISBELL, W. H. 2000. What we should be studying: The "imagined community" and the "natural community". *In:* CANUTO, M. A. & YAEGER, J. (eds.) *An Archaeology of Communities: A New World Perspective*, London/New York: Routledge, 243-266.

IVERSEN, R. 2014. *Transformation of Neolithic Societies: An East Danish perspective on the 3rd millennium BC*, København: Københavns Universitet.

JACOB-FRIESEN, K. H. 1925. *Die "Sieben Steinhäuser" im Kreise Fallingbostel*, Hannover: Schulze.

JACOB-FRIESEN, K. H. 1930. Schmuckketten aus dem Kreise der Kugelflaschen. *In:* MIELKE, R. (ed.) *Albert Kiekebusch zum 60. Geburtstag* (Brandenburgia 39 39), Berlin, 30-32.

JACOB-FRIESEN, K. H. 1939. *Einführung in Niedersachsens Urgeschichte*, Hildesheim: Lax.

JACOBS, J. 1991. *Die Einzelgrabkultur in Mecklenburg-Vorpommern* (Beiträge zur Ur- und Frühgeschichte Mecklenburg-Vorpommerns 24), Schwerin: Archäologisches Landesmuseum Mecklenburg-Vorpommern.

JACOMET, S. 2008. Subsistenz und Landnutzung während des 3. Jahrtausends v. Chr. aufgrund von archäobotanischen Daten aus dem südwestlichen Mitteleuropa. *In:* DÖRFLER, W. & MÜLLER, J. (eds.) *Umwelt – Wirtschaft – Siedlungen im dritten vorchristlichen Jahrtausend Mitteleuropas und Südskandinaviens* (Offa 84), Neumünster, 355-377.

JAGOR, A. F., VOSS, J. A., VIRCHOW, R. & OLSHAUSEN, J. 1895. Prähistorischen Fund von Ciempozuelos. *Zeitschrift für Ethnologie,* 27, 119-125.

JANSEN, R. & ARNOLDUSSEN, S. 2007. Early and Middle Bronze Age settlement features of the multi-period site Oss-Horzak (province Noord-Brabant, Nl.) *Lunula,* 15, 23-34.

JANSSENS, M. 2008. *Plangebied Rolduckerstraat/J. Eckstraat te Kerkrade, gemeente Kerkrade; archeologisch vooronderzoek: een inventariserend veldonderzoek (IVO-P)* (RAAP Rapport 1810), Weesp: RAAP Archeologisch Adviesbureau.

JANSSENS, M. 2010. *Plangebied Groot Heiligenberg, cluster C te Cuijk Gemeente Cuijk Archeologisch onderzoek: proefsleuvenonderzoek en opgraving* (RAAP Rapport 2149), Weesp: RAAP Archeologisch Adviesbureau.

JAY, M. & RICHARDS, M. P. 2007. British Iron Age Diet: Stable Isotopes and Other Evidence. *Proceedings of the Prehistoric Society,* 73, 169-190.

JELGERSMA, S., DE JONG, J. D., ZAGWIJN, W. H. & VAN REGTEREN ALTENA, J. F. 1970. The coastal dunes in the western Netherlands; geology, vegetational history and archaeology. *Mededelingen Rijks Geologische Dienst,* 21, 94-154.

JENSEN, J. A. 1973. Bopladsen Myrhøj. 3 hustomter med klokkebægerkeramik. *Kuml,* 1972, 61-122.

JENSEN, J. A. 1984. Boplads under højen. En bronzealderhøj og en ny hustomt med klokkebægerkeramik. *FRAM,* 1984, 51-68.

JENSEN, J. A. 1989. Langagergård II – udgravningsresultat. Fund af en amfora fra jysk enkeltgravskultur. *In:* LARSSON, L. (ed.) *Stridsyxekultur i Sydskandinavien :*

rapport från det andra nordiska symposiet om stridsyxetid i Sydskandinavien, 31. X – 2. XI 1988, Lund: Lund University, 13-17.

JEUNESSE, C. & DENAIRE, A. 2010. *Du Néolithique final au Bronze ancien dans le Nord-Est de la France. Actualité de la recherche. Actes de la table ronde internationale de Strasbourg organisée par l'UMR 7044 du CNRS Maison Interuniversitaire des Sciences de l'Homme – Alsace (MISHA), 9 juin 2009*, Zimmersheim: Association pour la Promotion de la Recherche Archéologique en Alsace.

JOHANSEN, E. 1985. A Burial Mound with Culture Layers from the Early Bronze Age near Torslev, Northern Jutland. *Journal of Danish Archaeology,* 4**,** 115-120.

JONGSTE, P. F. B. 1997. *Aanvullend Archeologisch Onderzoek in het tracé van de Betuweroute, vindplaats 20 Dodewaard/Valburg Hiensche Veld* (Rapportage Archeologische Monumentenzorg 16), Amersfoort: ROB.

JONGSTE, P. F. B. 1998. *Aanvullend Archeologisch Onderzoek in het tracé van de Betuweroute, vindplaats 23 Valburg/Zettensche Veld-Oost* (Rapportage Archeologische Monumentenzorg 20), Amersfoort: ROB.

JONGSTE, P. F. B. & TEN ANSCHER, T. J. 1998. *Aanvullend Archeologisch Onderzoek in het tracé van de Betuweroute, vindplaats 22 Valburg/Zettensche Plas* (Rapportage Archeologische Monumentenzorg 19), Amersfoort: ROB.

JONGSTE, P. F. B. & VAN WIJNGAARDEN, G. J. 2002. *Archeologie in de Betuweroute: Het erfgoed van Eigenblok. Nederzettingssterreinen uit de Bronstijd te Rumpt (gemeente Geldermalsen)* (Rapportage Archeologische Monumentenzorg 86), Amersfoort: ROB.

JÖNS, H., GROENENDIJK, H. A., RAEMAEKERS, D. C. M., KEGLER, J. F., MENNENGA, M. & NÖSLER, D. 2013. Auf der Suche nach der Trichterbecherkultur – Op zoek naar de trechterbekercultuur. *Land der Entdeckungen. Die Archäologie des friesischen Küstenraums – Land van ontdekkingen. De archeologie van het Friese kustgebied*, Aurich: Ostfriesische Landschaft, 123-135.

JORDAN, W. 1954. Das Steinkammergrab von Altendorf, Krs. Wolfhagen. *In:* UENZE, S. V. O. (ed.) *Kurhessische Bodenaltertümer III* Marburg: Elwert Verlag, 5-26.

JØRGENSEN, G. 1979. A new contribution concerning the cultivation of spelt, Triticum spelta L., in prehistoric Denmark. *Arkœo-Physika,* 8**,** 135-145.

JORNS, W. 1961. *Aus der Welt der ältesten Darmstädter von der Steinzeit bis zum frühen Mittelalter*, Darmstadt.

JOSEPH, F. 2008. Le site d'habitat du IIIe Millénaire av. J-C. de la "ZAC Jules Vernes" à Gisly (Somme); présentation préliminaire. *Internéo,* 7**,** 163-171.

JOUSSAUME, R. 1970. Nouveau site campaniforme en Vendée. Le Marais-Girard, commune de Brétignolles. *Bulletin de la Société Préhistorique Française,* 67**,** 243-245.

JOUSSAUME, R. 1972. Céramique à décor plastique aux Sables-Vigniers, île d'Oléron (Charente-Maritime). *Bulletin de la Société Préhistorique Française,* 69**,** 85-87.

JOUSSAUME, R. 1976. Les civilisations néolithiques dans le Centre-Ouest. *In:* GUILAINE, J. (ed.) *La Préhistoire française : les civilisations néolithiques et protohistoriques de la France*, Paris: CNRS, 351-364.

JOUSSAUME, R. 1977. Pointe de Palmela à l'Angle-Guignard (Vendée). *Bulletin de la Société d'émulation de la Vendée, Chronique archéologique***,** 126.

JOUSSAUME, R. 1986. Campaniforme de la République 2 à Talmont-Saint-Hilaire (Vendée). *In:* JOUSSAUME, R. (ed.) *Cultures campaniformes dans le centre ouest de la France*, La Roche sur Yon: Groupe Vendéen d'Études Préhistoriques, 55-66.

JOUSSAUME, R. (ed.) 1986. *Cultures Campaniformes Dans le Centre-Ouest de la France*, La-Roche-sur-Yon: Groupe Vendéen d'Etudes Préhistoriques.

JOUSSAUME, R. 1986. Les sites campaniformes du littoral atlantique entre Loire et Gironde. *In:* JOUSSAUME, R. (ed.) *Cultures campaniformes dans le centre ouest de la France*, La Roche sur Yon: Groupe Vendéen d'Études Préhistoriques, 135-156.

JOUSSAUME, R. 2009. Le Campaniforme, du nom d'un gobelet en forme de cloche renversée. *In:* JOUSSAUME, R. (ed.) *La préhistoire en Vendée de la Pierre au Bronze* (4500 ans d'histoire avant les Gaulois), La Roche sur Yon: Le Centre Vendéen de Recherches Historiques, 135-159.

JUAN-TRESSERRAS, J. 1999. *Procesado y preparación de alimentos vegetales para consumo humano. Aportaciones del estudio de fitolitos, almidones y lípidos en yacimientos arqueológicos prehistóricos y protohistóricos del cuadrante NE de la Península Ibérica.* PhD Thesis, Universitat Autònoma de Barcelona.

JULIEN, M. & LEROY, E. 2008. L'habitat du Néolithique final dans la région de Douai (Nord): résultats préliminaires. *Internéo,* 7**,** 143-171.

KAISER, J. M. 2003. Puntas de flecha de la Edad del Bronce en la Península Ibérica. Producci'n, circulación y cronología. *Complutum,* 14**,** 73-106.

KALICZ-SCHREIBER, R. 1984. Komplex der Nagyrev-Kultur. *In:* TASIĆ, N. (ed.) *Kulturen der Frühbronzezeit des Karpatenbeckens und Nordbalkans*, Belgrade: Baklanološki institut SANU, 133-190.

KALICZ-SCHREIBER, R. & KALICZ, N. 2001. Were the Bell Beakers as Social indicators of the Early Bronze Age in Budapest? *In:* NICOLIS, F. (ed.) *Bell beakers today. Pottery, people, culture, symbols in prehistoric Europe. Proceedings of the International Colloquium Riva del Garda (Trento, Italy), 11-16 May 1998*, Trento: Provincia autonoma di Trento, Servizio beniculturali, Ufficio beni archeologici, 439-458.

KALOUSEK, F. 1956. Ein Biritueles Gräberfeld und Siedlungsobjekte der Glockenbecherkultur in Těšetice bei Znojmo (Znaim). *Sborník prací Filozofické fakulty brněnské univerzity,* 1**,** 5-14.

KAMPFFMEYER, U. 1983. Der neolithische Siedlungsplatz Hüde I am Dümmer. *In:* WEGNER, G. (ed.) *Frühe Bauernkulturen in Niedersachsen*, Oldenburg: Staatliches Museum für Naturkunde und Vorgeschichte, 119-134.

KAMPFFMEYER, U. 1991. *Die Keramik der Siedlung Hüde I am Dümmer. Untersuchungen zur Neolithisierung des nordwestdeutschen Flachlands.* PhD Thesis, Georg-August-Universität Gottingen.

KARS, E. 2000. Natuursteen. *In:* OUDHOF, J. W. M., DIJKSTRA, J. & VERHOEVEN, A. A. A. (eds.) *Archeologie in de Betuweroute. "Huis Malburg" van spoor tot spoor. Een middeleeuwse nederzetting in Kerk-Avezaath* (Rapportage Archeologische Monumentenzorg 81), Amersfoort: ROB, 145-159.

KAUL, F. 2005. Bronze Age tripartite cosmologies. *Prähistorische Zeitschrift,* 80**,** 135-148.

KEILING, H. 1978. Neue Funde neolithischer Keramik aus dem Bezirk Schwerin. *Ausgrabungen und Funde,* 23**,** 111-127.

KERDIVEL, G. 2009. *Occupation de l'espace et gestion des ressources à l'interface entre massifs primaires et bassins secondaires et tertiaires: l'exemple du Massif armoricain et de ses marges au Néolithique.* PhD Thesis, Université de Rennes.

KERSTEN, W. 1938. Spuren der nordeurasische Wohnplatzkultur am Niederrhein. *Germania,* 22**,** 71-77.

KERSTEN, W. 1966. Ein spätneolithischer Riesenbecher aus Mannhagen, Kr. Herzogtum Lauenburg. *Offa,* 23**,** 77-78.

KEUNEKE, H. & SCHWIEGER, H. 1943. Spätkaiserzeitliche Langhäuser bei Klein-Bünstorf, Kreis Uelzen. *Die Kunde,* 4/5**,** 59-88.

KIELMAN, D. 1986. The postholes of Kolhorn (northern site): preliminary data analysis and pattern recognition. *In:* FOKKENS, H., BANGA, P. M. & BIERMA, M. (eds.) *Op zoek naar mens en materiële cultuur*, Groningen: Rijks Universiteit Groningen, 21-35.

KILIAN, L. 1955. *Haffküstenkultur und Ursprung der Balten*, Bonn: Verlag Dr. Rudolf Habelt GmbH.

KINNES, I. A. & LONGWORTH, I. H. 1985. *Catalogue of the excavated prehistoric and Romano-British material in the Greenwell Collection*, London: British Museum.

KIRLEIS, W. & FISCHER, E. 2014. Neolithic cultivation of tetraploid free threshing wheat in Denmark and Northern Germany: implications for crop diversity and societal dynamics of the Funnel Beaker Culture. *Vegetation History and Archaeobotany,* 23, S81-S96.

KIRLEIS, W., KLOOß, S., KROLL, H. & MÜLLER, J. 2012. Crop growing and gathering in the northern German Neolithic: a review supplemented by new results. *Vegetation History and Archaeobotany,* 21, 221-242.

KLASSEN, L. 2000. *Frühes Kupfer im Norden. Untersuchungen zu Chronologie, Herkunft und Bedeutung der Kupferfunde der Nordgruppe der Trichterbecherkultur* (Jutland Archaeological Society Publications 36), Højbjerg: Jutland Archaeological Society.

KLASSEN, L. 2004. *Jade und Kupfer. Untersuchungen zum Neolithisierungsprozess im westlichen Ostseeraum unter besonderer Berücksichtigung der Kulturentwicklung Europas 5500-3500 BC* (Jutland Archaeological Society Publications 47), Højbjerg: Jutland Archaeological Society.

KLASSEN, L. 2005. Refshøjgård. Et bemærkelsesværdigt gravfund fra enkeltgravskulturen. *Kuml,* 2005, 17-59.

KLEBS, R. 1882. *Der Bernsteinschmuck der Steinzeit von der Baggerei bei Schwarzort und anderen Lokalitäten Preussens* (Beiträge zur Naturkunde Preussens), Königsberg: W. Koch.

KLEIJNE, J. P. 2015. *Kennemerland in de Bronstijd* (Provinciale Archeologische Rapporten), Haarlem: Huis van Hilde.

KLEIJNE, J. P. 2016. Between belts and Beakers. Pendants in the third millennium BC in Western and Central Europe. *In:* MÜLLER, A. & JANSEN, R. (eds.) *Metaaltijden 3. Bijdragen in de studie van de metaaltijden*, Leiden: Sidestone Press, 45-63.

KLEIJNE, J. P. 2018. Book Review of H. Fokkens, B. Steffens and S. van As. Farmers, Fishers, Fowlers, Hunters: Knowledge Generated by Development-led Archaeology about the Late Neolithic, the Early Bronze Age and the Start of the Middle Bronze Age (2850-1500 cal BC) in the Netherlands. *European Journal of Archaeology,* 21, 491-495.

KLEIJNE, J. P., BECKERMAN, S. M., BRINKHUIZEN, D. C., BRINKKEMPER, O., GARCIA-DIAZ, V., KUBIAK-MARTENS, L., LAUWERIER, R. C. G. M., NOBLES, G. R., OUDEMANS, T. F. M., PEETERS, J. H. M., RAEMAEKERS, D. C. M., SMIT, B. I., THEUNISSEN, E. M., VAN GIJN, A. L. & ZEILER, J. T. 2016. Sifting through Single Grave Settlements: Keinsmerbrug and Mienakker in the Noord Holland tidal area (the Netherlands). *In:* FURHOLT, M., GROßMANN, R. & SZMYT, M. (eds.) *Transitional Landscapes? The 3rd Millennium BC in Europe. Proceedings of the International Workshop "Socio-Environmental Dynamics over the Last 12,000 Years: The Creation of Landscapes III (15th-18th April 2013)" in Kiel* (Universitätsforschungen zur Prähistorischen Archäologie 292), Bonn: Verlag Dr. Rudolf Habelt GmbH, 171-181.

KLEIJNE, J. P., BRINKKEMPER, O., LAUWERIER, R. C. G. M., SMIT, B. I. & THEUNISSEN, E. M. (eds.) 2013. *A Matter of Life and Death at Mienakker (the Netherlands). Late Neolithic Behavioural Variability in a Dynamic Landscape* (Nederlandse Archeologische Rapporten 45), Amersfoort: Rijksdienst voor het Cultureel Erfgoed.

KLEIJNE, J. P. & DRENTH, E. 2019. An overview of Bell Beaker house plans in the Netherlands. *In:* GIBSON, A. M. (ed.) *The Bell Beaker Settlements of Europe. The Bell Beaker phenomenon from a domestic perspective* (Prehistoric Society Research Paper 9), Oxford: Oxbow Books.

KLEIJNE, J. P., FURHOLT, M. & MÜLLER, J. (eds.) 2018. *Think global, act local. Bell Beakers in Europe. Proceedings of the Bell Beaker Workshop Kiel 2017* (Journal of Neolithic Archaeology), Kiel: Christian-Albrechts Universität zu Kiel.

KLOOß, R. 2008. Ein Fundplatz des Übergangs vom Mittelneolithikum A zum Mittelneolithikum B aus Wangels LA 505, Kreis Ostholstein. Ein Vorbericht. *In:*

DÖRFLER, W. & MÜLLER, J. (eds.) *Umwelt – Wirtschaft – Siedlungen im dritten vorchristlichen Jahrtausend Mitteleuropas und Südskandinaviens* (Offa 84), Neumünster, 127-134.

KOCH, A. 1937. Funde der Glockenbecherkultur in Starkenburg. Stand Juli 1936. *Mannus,* 28, 517-521.

KOCH, E. 1998. *Neolithic bog pots from Zealand, Møn, Lolland and Falster* (Nordiske Fortidsminder serie B 16), Kopenhagen: Der Kongelige Nordiske Oldskirftselskab.

KOHLER-SCHNEIDER, M. & CANEPPELE, A. 2009. Late Neolithic agriculture in eastern Austria: archaeobotanical results from sites of the Baden and Jevišovice cultures (3600-2800 B.C.). *Vegetation History and Archaeobotany,* 18, 61-74.

KOKOWSKI, A. 2010. "Nieznany"grób megalityczny z Kuźnicy Żelichowskiej, woj. wielkopolskie. *Fontes Archaeologici Posnanienses,* 46, 221-224.

KONCZAK, R. 1998. Einsatzstücke aus Silexabschlägen – ein Gerättyp des Spätneolithikums. *Archäologische Berichte aus Mecklenburg-Vorpommern,* 5, 30-40.

KOOT, C. W. & BERKVENS, R. (eds.) 2004. *Bredase akkers eeuwenoud. 4000 jaar bewoningsgeschiedenis op de rand van zand en klei* (Rapportage Archeologische Monumentenzorg 102), Breda: ROB.

KOOT, J. M. 2001. Schaapweg (De Schilp). *Archeologische kroniek van Rijswijk over 2000* (Historische Vereniging Rijswijk Jaarboek 2001), Rijswijk: Historische Vereniging Rijswijk, 142-144.

KÖRNER, G. 1959. Ein bronzezeitlicher Mehrperiodenhügel bei Deutsch-Evern im Landkreis Lüneburg. *Nachrichten aus Niedersachsens Urgeschichte,* 28, 3-9.

KOROŠEC, P. & KOROŠEC, J. 1969. *Fundgut der Pfahlbausiedlungen bei Ig am Laibacher Moor* (Katalogi in monografije 3), Ljubljana: Narodni Muzej.

KORTEKAAS, G. L. G. A. 1987. Een laat-neolithisch akkercomplex in de Oosterpoortwijk te Groningen. *Groninger Volksalmanak,* 1987, 109-124.

KORTEKAAS, G. L. G. A. 2002. Jaarverslag archeologie in 2001. *Jaarboek voor archeologie, bouwhistorie en restauratie in de gemeente Groningen* (Hervonden Stad 2002), Groningen: Stichting Monument & Materiaal en de Dienst RO/EZ van de Gemeente Groningen, 4-28.

KOŚKO, A. 1999. Pontic Traits in the Materials of the Kujawy Funnel Beaker Culture and Early Corded Ware Culture – A Radiocarbon Perspective. *Baltic-Pontic Studies,* 7, 203-210.

KOSSIAN, R. 2007. *Hunte 1. Ein mittel- bis spätneolithischer und frühbronzezeitlicher Siedlungsplatz am Dümmer, Ldkr. Diepholz (Niedersachsen). Die Ergebnisse der Ausgrabungen des Reichsamtes für Vorgeschichte in den Jahren 1938 bis 1940* (Veröffentlichungen der archäologischen Sammlungen des Landesmuseums Hannover 52), Hannover: Landesmuseum Hannover.

KOSSINNA, G. 1909. Der Ursprung der Urfinnen und der Urindogermanen und ihre Ausbreitung nach dem Osten. *Mannus,* 1, 17-52, 225-245.

KOSSINNA, G. 1910. Der Ursprung der Urfinnen und der Urindogermanen und ihre Ausbreitung nach dem Osten, teil II. *Mannus,* 2, 59-108.

KOZŁOWSKI, L. 1924. *Młodsza epoka kamienna w Polsce (Neolit)*, Kraków: Towarzystwo Naukowe.

KRAMER, C. 1985. Ceramic Ethnoarchaeology. *Annual Review of Anthropology,* 14, 77-102.

KRANENDONK, P., VAN DER KROFT, P., LANZING, J. J. & MEIJLINK, B. H. F. M. (eds.) 2006. *Witte vlekken ingekleurd. Archeologie in het tracé van de HSL-Zuid* (Rapportage Archeologische Monumentenzorg 113), Amersfoort: ROB.

KRAUTWURST, R. 2002. Zur Bedeutung der schnurkeramischen Wellenleistenkeramik. *In:* MÜLLER, J. (ed.) *Vom Endneolithikum zur Frühbronzezeit: Muster sozialen Wandels? Tagung Bamberg 14. – 16. Juni 2001* (Universitätsforschungen zur Prähistorischen Archäologie 90), Bonn: Verlag Dr. Rudolf Habelt GmbH, 89-96.

KRISTIANSEN, K. 2007. Eurasian Transformations: Mobility, Ecological Change, and the Transmission of Social Institutions in the Third Millennium and Early Second Millennium B.C.E. *In:* HORNBORG, A. & CRUMLEY, C. (eds.) *The World System and the Earth System*, Walnut Creek: Left Coast Press, 149-163.

KRISTIANSEN, K. & LARSSON, T. B. 2005. *The Rise of Bronze Age Society: Travels, Transmissions and Transformations*, Cambridge: Cambridge University Press.

KRÓL, D. (ed.) 1997. *The Built Environment of Coast Areas During the Stone Age* (The Baltic Sea-Coast Landscapes Seminar Session 1), Gdańsk: Regional Centre for Studies and Preservation of Built Environment.

KROLL, H. 1980. Einige vorgeschichtliche Vorratsfunde von Kulturpflanzen aus Norddeutschland. *Offa,* 37**,** 372-377.

KROUŽEK, J. 2012. *Kultura zvoncovitých pohárů ve východní části středních Čech.* BA Thesis, University of Western Bohemia.

KUBIAK-MARTENS, L., BRINKKEMPER, O. & OUDEMANS, T. F. M. 2015. What's for dinner? Processed food in the coastal area of the northern Netherlands in the Late Neolithic. *Vegetation History and Archaeobotany,* 24**,** 47-62.

KUHN, H.-J. 1979. *Das Spätneolithikum in Schleswig-Holstein* (Offa Bücher 40), Neumünster: Wachholtz.

KUIJPERS, M. H. G. 2008. *Bronze Age metalworking in the Netherlands (c.2000-800 BC). A research into the preservation of metallurgy related artefacts and the social position of the smith*, Leiden: Sidestone Press.

KUNST, M. 1987. *Zambujal. Teil 2: Glockenbecher und kerbblattverzierte Keramik aus den Grabungen 1964 bis 1973* (Madrider Beiträge 5.2), Berlin: Deutsches Archäologisches Institut.

KUNST, M. 1995. Zylindrische Gefässe, Kerbblattverzierung und Glockenbecher in Zambujal (Portugal). Ein beitrag zur kupferzeitlichen Keramikchronologie. *Madrider Mitteilungen,* 36**,** 136-149.

KUNST, M. 2007. Zambujal and the enclosures of the Iberian Peninsula. *In:* HARDING, A. F., SIEVERS, S. & VENCLOVÁ, N. (eds.) *Enclosing the Past. Inside and Outside in Prehistory* (Sheffield Archaeological Monographs), Sheffield: J.R. Collis, 76-96.

KUNST, M. & LUTZ, N. 2008. Zambujal (Torres Vedras, Portugal). Zur Präzision der absoluten Chronologie durch die Untersuchungen an der vierten Befestigungslinie. *Madrider Mitteilungen,* 49**,** 29-63.

KYSELÝ, R. & PEŠKE, L. 2016. Horse size and domestication: Early equid bones from the Czech Republic in the European context. *Anthropozoologica,* 51**,** 15-39.

LACK, J. & LACK, B. 1986. Un nouvel habitat de la culture à céramique cordée à Burnhaupt – Le Bas (Haut-Rhin). *Cahiers de L'Association pour la Promotion de la Recherche Archéologique en Alsace,* 2**,** 72-85.

LAMBOT, B. 1981. Le site chalcolithique du Gord à Compiègne (Oise) – Note préliminaire. *Cahiers Archéologiques de Picardie,* 8**,** 5-18.

LANDOLT, M., ALIX, G. & PUTELAT, O. 2010. Premiers éléments sur le puits funéraire de la fin du troisième millénaire avant J-C de Sainte-Croix-en-Plaine « Holzackerfeld» (Haut-Rhin). *In:* JEUNESSE, C. & DENAIRE, A. (eds.) *Du Néolithique final au Bronze ancien dans le Nord-Est de la France. Actualité de la recherche. Actes de la table ronde internationale de Strasbourg organisée par l'UMR 7044 du CNRS Maison Interuniversitaire des Sciences de l'Homme – Alsace (MISHA), 9 juin 2009*, Zimmersheim: Association pour la Promotion de la Recherche Archéologique en Alsace, 57-72.

LANGOVÁ, J. & RAKOVSKÝ, I. 1981. Objekty kultury zvoncovitých pohárů z Jezeřan-Maršovic. *Archeologické rozhledy,* 33**,** 19-36.

LANTING, J. N. 1973. Laat Neolithicum en Vroege Bronstijd in Nederland en N.W.-Duitsland: Continue ontwikkelingen. *Palaeohistoria,* 15**,** 215-312.

LANTING, J. N. 1986. Spoolde: Onderzoek en vondsten binnendijks. *In:* FOKKENS, H., BANGA, P. M. & BIERMA, M. (eds.) *Op zoek naar mens en materiële cultuur*, Groningen: Rijks Universiteit Groningen, 37-58.

LANTING, J. N. 2008. De NO-Nederlandse/NW-Duitse Klokbekergroep: Culturele achtergrond, typologie van het aardewerk, datering, verspreiding en grafritueel. *Palaeohistoria,* 49/50**,** 11-326.

LANTING, J. N. 2015. *Kritische Nabeschouwingen*, Groningen: Barkhuis.

LANTING, J. N. & VAN DER PLICHT, J. 1996. Wat hebben Floris V, skelet Swifterbant S2 en visotters gemeen? *Palaeohistoria,* 38**,** 491-519.

LANTING, J. N. & VAN DER PLICHT, J. 1998. Reservoir effects and apparent 14C-ages. *Journal of Irish Archaeology,* 9**,** 151-165.

LANTING, J. N. & VAN DER PLICHT, J. 2000. De ^{14}C Chronologie van de Nederlandse Pre- en Protohistorie III: Neolithicum. *Palaeohistoria,* 41/42**,** 1-110.

LANTING, J. N. & VAN DER WAALS, J. D. 1976. Beaker culture relations in the Lower Rhine Basin. *In:* LANTING, J. N. & VAN DER WAALS, J. D. (eds.) *Glockenbecher Symposion Oberried 1974*, Bussum/Haarlem: Fibula-Van Dishoeck, 1-80.

LANTING, J. N. & VAN DER WAALS, J. D. (eds.) 1976. *Glockenbecher Symposion Oberried 1974*, Bussum/Haarlem: Fibula-Van Dishoeck.

LAPORTE, L. (ed.) 2009. *Des Premiers Paysans aux Premiers Métallurgistes sur la Façade Atlantique de la France (3500-2000 av. J.-C.)* (Mémoire de la Société de recherches archéologiques de Chauvigny 33), Chauvigny: Association des Publications Chauvinoises.

LAPORTE, L. & GOMEZ DE SOTO, J. 2008. Du Néolithique final au tout premier Bronze Aancien dans le Centre-Ouest de la France et plus généralement sur la façade atlantique; des données encore très lacunaires pour la seconde moitié du III^{e} millénaire av. J.-C. *Bulletin de la Société Préhistorique Française,* 105**,** 555-576.

LAPORTE, L. & PICQ, C. 2002. Les occupations Néolithiques du Vallon des Ouchettes (Plassay, Charente-Maritime). *Gallia Préhistoire,* 44**,** 1-120.

LAUX, F. 2000. Späte Einzelgrabkultur und Aunjetitzer Kultur. Auf dem Wege zur Bronzezeit im nortöstlichen Niedersachsen. *Studia antiquaria. Festschrift für Niels Bantelmann zum 60. Geburtstag* (Universitätsforschungen zur Prähistorischen Archäologie 63), Bonn: Verlag Dr. Rudolf Habelt GmbH, 17-30.

LAZARICH GONZÁLEZ, M. 2016. *Las puntas de tipo "Palmela"*, Jerez: Museo Arqueológico Municipal de Jerez.

LAZARICH, M., BRICEÑO, E., RAMOS, A., CARRERAS, A., FERNÁNDEZ, J. V., JENKINS, V., FELIU, M. J., VERSACI, M., TORRES, F. R., M.J., PERALTA, P., MESA, M., NÚÑEZ, M., STRATTON, S., SÁNCHEZ, M. & GRILLÉ, J. M. 2009. *La necrópolis colectiva en cuevas artificiales de Paraje de Monte Bajo (Alcalá de los Gazules, Cádiz)* (IV Encuentro de Arqueología del Suroeste Peninsular), Huelva: Ayuntamiento de Aracena.

LE BRUN-RICALENS, F. & VALOTTEAU, F. 2011. Les sépultures campaniformes d'Altwies – "Op Dem Boesch" (Grand-Duché de Luxembourg). *In:* SALANOVA, L. & TCHÉRÉMISSINOFF, Y. (eds.) *Les sépultures individuelles campaniformes en France* (Gallia Préhistoire Supplément 41), Paris: CNRS, 115-124.

LE BRUN-RICALENS, F. & VALOTTEAU, F. 2012. Deux nouvelles lames retouchées en silex de type Grans-Pressigny découvertes à Bourglinster – "Aechholz" (G.-D. de Luxembourg). *Bulletin de la Société Préhistorique Luxembourgeoise,* 34**,** 101-115.

LECHTERBECK, J., KERIG, T., KLEINMANN, A., SILLMANN, M., WICK, L. & RÖSCH, M. 2013. How was Bell Beaker economy related to Corded Ware and Early Bronze Age lifestyles? Archaeological, botanical and palynological evidence from the Hegau, Western Lake Constance region. *Environmental Archaeology,* 19**,** 95-113.

LEE, E. J., RENNEBERG, R., HARDER, M., KRAUSE-KYORA, B., RINNE, C., MÜLLER, J., NEBEL, A. & VON WURMB-SCHWARK, N. 2014. Collective burials among agro-pastoral societies in later Neolithic Germany: perspectives from ancient DNA. *Journal of Archaeological Science,* 51, 174-180.

LEEDS, E. T. 1922. Further Discoveries of the Neolithic and Bronze Ages at Peterborough. *The Antiquaries Journal,* 2, 220-237.

LEHMANN, L. T. 1965. Placing the pot beaker. *Helinium,* 5, 3-31.

LEHMANN, L. T. 1967. New pot beakers from the Veluwe. *Berichten van de Rijksdienst voor het Oudheidkundig Bodemonderzoek,* 17, 162-166.

LEHMANN, L. T. 1967. Pot Beaker News. *Helinium,* 7, 65-69.

LEHMANN, L. T. 1967. Unusual beaker pottery from the Veluwe. *Berichten van de Rijksdienst voor het Oudheidkundig Bodemonderzoek,* 17, 159-161.

LEHMANN, L. T. 1969. Urn or Food Vessel. *Berichten van de Rijksdienst voor het Oudheidkundig Bodemonderzoek,* 19, 273-274.

LEHMPHUL, R. 2012. Final Neolithic to Early Iron Age Settlement Stratigraphy at Altgaul, Brandenburg. A Preliminary Report. *In:* KNEISEL, J., KIRLEIS, W., DAL CORSO, M., TAYLOR, N. & TIEDTKE, V. (eds.) *Collapse or Continuity? Environment and Development of Bronze Age Human Landscapes (Proceedings of the International Workshop "Socio-Environmental Dynamics over the last 12,000 years: the Creation of Landscapes II (14th -18th March 2011)" in Kiel)*, Bonn: Verlag Dr. Rudolf Habelt GmbH, 171-184.

LEHMPHUL, R. & WEIß, U. 2014. "Riesenbecher" und Flintpfeilspitzen – Eindneolithische Funde aus Sukow-Marienhof, Lkr. Rostock. *In:* JANTZEN, D., SAALOW, L. & SCHMIDT, J.-P. (eds.) *Pipeline: Archäologie. Ausgrabungen auf den großen Ferngastrassen in Mecklenburg-Vorpommern*, Schwerin: Landesamt für Kultur und Denkmalpflege Mecklenburg-Vorpommern, 75-76.

LEISNER, V. 1961. Vasos eneolíticos decorados no interior. *Revista de Guimarães,* 71, 409-428.

LEISNER, V. 1965. *Die Megalithgräber der Iberischen Halbinsel: der Westen* (Madrider Forschungen I,3), Berlin: Deutsches Archäologisches Institut.

LEISNER, V. & SCHUBART, H. 1966. Die Kupferzeitliche Befestigung von Pedra do Ouro/Portugal. *Madrider Mitteilungen,* 7, 9-59.

LEISNER, V., ZBYSZEWSKI, G. & DA VEIGA FERREIRA, O. 1961. *Les grottes artificielles de Casal do Pardo (Palmela) et la culture du vase campaniforme* (Serviços Geológicos de Portugal Mémoria 8), Lisboa: Direcção-General de Minas e Serviços Geológicos.

LEITÃO, M., NORTH, C. T. & DA VEIGA FERREIRA, O. 1972. O povoado pré-histórico da Serra da Espargueira (Belas). *Actas das II Jornadas Arqueológicas Vol I*, Lisboa: Associação dos Arqueólogos Portugueses, 143-157.

LEITÃO, M., NORTH, C. T. & NORTON, J. 1984. *The prehistoric burial cave at Verdelha dos Ruivos (Vialonga), Portugal* (L'âge du cuivre européen), Paris: CNRS.

LEMERCIER, O. 2004. *Les Campaniformes dans le Sud-est de la France* (Monographies d'Archéologie Méditerranéenne 18), Lattes: CNRS.

LEMONNIER, P. (ed.) 1993. *Technological Choices. Transformation in material cultures since the Neolithic*, London/New York: Routledge.

LETTERLÉ, F. & MARTINEZ, R. 1985. Un site d'habitat chasséen et S.O.M. à Sagy (Val d'Oise). *Revue Archéologique de Picardie,* 3-4, 39-52.

L'HELGOUACH, J. 1965. *Les Sépultures Mégalithiques en Armorique*, Rennes: Université de Rennes.

LIBRADO, P., FAGES, A., GAUNITZ, C., LEONARDI, M., WAGNER, S., KHAN, N., HANGHOJ, K., ALQURAISHI, S. A., ALFARHAN, A. H., AL-RASHEID, K. A., DER SARKISSIAN, C., SCHUBERT, M. & ORLANDO, L. 2016. The Evolutionary Origin and Genetic Makeup of Domestic Horses. *Genetics,* 204, 423-434.

LIBRADO, P., GAMBA, C., GAUNITZ, C., DER SARKISSIAN, C., PRUVOST, M., ALBRECHTSEN, A., FAGES, A., KHAN, N., SCHUBERT, M., JAGANNATHAN, Y., SERRES-ARMERO, A., KUDERNA, L. F. K., POVOLOTSKAYA, I. S., SEGUIN-ORLAN-

DO, A., LEPETZ, S., NEUDITSCHKO, M., THÈVES, C., ALQURAISHI, S. A., LFARHAN, A. H., AL-RASHEID, K. A., RIEDER, S., SAMASHEV, Z., FRANCFORT, H.-P., BENECKE, N., HOFREITER, M., LUDWIG, A., KEYSER, C., MARQUES-BONET, T., LUDES, B., CRUBÉZY, E., LEEB, T., WILLERSLEV, E. & ORLANDO, L. 2017. Ancient genomic changes associated with domestication of the horse. *Science,* 358**,** 442-445.

LIMBURSKÝ, P. 2013. Sídliště nálezy kultury se zvoncovitými poháry ve Vlíněvsi ok. Melník. *Archeologické rozhledy,* 65**,** 175-192.

LINKE, B. 1939. Zuwachs- und Forschungsbericht des Morgenstern-Museums in Wesermünde. *Nachrichtenblatt für Deutsche Vorzeit,* 15**,** 224-228.

LIU, W. T. & DUFF, R. W. 1972. The Strength in Weak Ties. *The Public Opinion Quarterly,* 36**,** 361-366.

LIVERSAGE, D. 1987. Mortens Sande 2 – A Single Grave Camp Site in Northwest Jutland. *Journal of Danish Archaeology,* 6**,** 101-124.

LIVERSAGE, D. 1989. Radiometrisk datering og beaker bosættelse i en nordvest jysk biotop. *In:* LARSSON, L. (ed.) *Stridsyxekultur i Sydskandinavien : rapport från det andra nordiska symposiet om stridsyxetid i Sydskandinavien, 31. X – 2. XI 1988* (Institute of Archaeology, Report Series 36), Lund: University of Lund, 219-225.

LIVERSAGE, D. 2003. Bell Beaker Pottery in Denmark – Its Typology and Internal Chronology. *In:* CZEBRESZUK, J. & SZMYT, M. (eds.) *The Northeast Frontier of Bell Beakers. Proceedings of the symposium held at the Adam Mickiewicz University, Poznań (Poland), May 26-29 2002* (British Archaeological Reports: International Series 1155), Oxford: Archaeopress, 39-49.

LIVERSAGE, D. & ROBINSON, D. 1995. Prehistoric Settlement and Landscape Development in the Sandhill Belt of Southern Thy. *Journal of Danish Archaeology,* 11**,** 39-56.

LOHOF, E. 1991. *Grafritueel en sociale verandering in de bronstijd van Noordoost-Nederland.* PhD Thesis, University of Amsterdam.

LOHOF, E., HAMBURG, T. & FLAMMAN, J. P. (eds.) 2012. *Steentijd opgespoord. Archeologisch onderzoek in het tracé van de Hanzelijn-Oude Land* (ADC Rapport 2576), Amersfoort: ADC Archeoprojecten.

LOMBORG, E. 1973. *Die Flintdolche Dänemarks. Studien über Chronologie und Kulturbeziehungen des südskandinavischen Spätneolithikums* (Nordiske Fortidsminder Serie B – in quatro Bind 1), København: Det kgl. nordiske Oldskriftselskab.

LÓPEZ JIMÉNEZ, O. & RESINO TORIBIO, J. 1999. Nuevas aportaciones sobre el pblamiento calcolítico de la Meseta Norte: el poblado calcolítico de Carratiermes (Montejo de Tiermes, Soria). *XXIV Congreso Nacional de Arqueología, Cartagena, 28.-31.10.1997*, Cartagena, 113-121.

LORIN, Y. & TRAWKA, H. 2006. Le Néolithique Final sur le site de la Z.A.C. Saint-Martin à Aire-sur-la-Lyes (Pas-de-Calais): nouvelles données sur l'architecture domestique dans le Nord de la France. *Internéo,* 6**,** 95-102.

LOUBOUTIN, C., BURNEZ, C., CONSTANTIN, C. & SIDÉRA, I. 1997. Beaumont-La Tricherie (Vienne) et Challignac (Charente): deux sites d'habitat de la fin du Néolithique. *Antiquités Nationales,* 29**,** 49-64.

LOUWE KOOIJMANS, L. P. 1973. Een grafheuvelgroep uit het laat-neolithicum en de bronstijd in het terrein van de Romeinse castra te Nijmegen. *In:* VAN ES, W. A., HUBRECHT, A. V. M. & STUART, P. (eds.) *Archeologie en historie, opgedragen aan H. Brunsting bij zijn zeventigste verjaardag*, Bussum: Fibula-Van Dishoeck, 87-125.

LOUWE KOOIJMANS, L. P. 1974. *The Rhine/Meuse Delta, four studies on its prehistoric occupation and Holocene geology* (Analecta Praehistorica Leidensia 7), Leiden: Leiden University.

LOUWE KOOIJMANS, L. P. 1976. Local developments in a borderland; a survey of the Neolithic at the Lower Rhine. *Oudheidkundige Mededelingen van het Rijksmuseum van Oudheden te Leiden,* 57**,** 227-297.

LOUWE KOOIJMANS, L. P. 1980. De midden-neolithische vondstgroep van het Vormer bij Wijchen en het cultuurpatroon rond de zuidelijke Noordzee circa 3000 v. Chr. *Oudheidkundige Mededelingen van het Rijksmuseum van Oudheden te Leiden,* 61, 113-208.

LOUWE KOOIJMANS, L. P. 1985. *Sporen in het land. De Nederlandse delta in de prehistorie*, Amsterdam: Meulenhoff.

LOUWE KOOIJMANS, L. P. 2006. Nogmaals 'Hazendonk'. *In:* BLOEMERS, J. H. F. (ed.) *Tussen D26 en P14. Jan Albert Bakker 65 jaar*, Amsterdam: Amsterdam Archeologisch Centrum, 147-180.

LOUWE KOOIJMANS, L. P. 2010. De VL-pot van Kootwijk en enkele andere potdeposities uit de tweede helft van het vierde millennium v. Chr. *In:* VERHART, L. B. M. & DE RIDDER, T. (eds.) *Vlaardingen-cultuur* (Westerheem Special 2), Eindhoven: AWN, 194-207.

LOUWE KOOIJMANS, L. P. 2011. Schipluiden and the final stage of neolithisation in the Lower Rhine Basin. *Revue Archéologique de Picardie,* 28, 1-18.

LOUWE KOOIJMANS, L. P. & VAN DE VELDE, P. 1980. *De opgraving Hekelingen III, gemeente Spijkenisse, voorjaar en zomer 1980. Interim-rapport over de verkenningen en opgravingen van de steentijd-nederzettingen in de deelplannen Akkers-13 en -14 en Vriesland-1 en -2.*, Leiden: Rijksmuseum van Oudheden.

LOUWE KOOIJMANS, L. P., VAN DEN BROEKE, P. W., FOKKENS, H. & VAN GIJN, A. L. (eds.) 2005. *Nederland in de Prehistorie*, Amsterdam: Bert Bakker.

LOUWE KOOIJMANS, L. P. & VERHART, L. B. M. 1991. Een middenneolithisch nederzettingsterrein en een kuil van de Stein-groep op de voormalige Kraaienberg bij Linden, gemeente Beers (N-Br.). *Oudheidkundige Mededelingen van het Rijksmuseum van Oudheden te Leiden,* 72, 49-108.

LOZE, I. B. 2003. The Lubāns, North Belarusian and Šagara Cultures as an Eastern Phenomenon of an Eneolithic Cultural Unit. *In:* CZEBRESZUK, J. & SZMYT, M. (eds.) *The Northeast Frontier of Bell Beakers. Proceedings of the symposium held at the Adam Mickiewicz University, Poznań (Poland), May 26-29 2002* (British Archaeological Reports: International Series 1155), Oxford: Archaeopress, 123-136.

LOZE, I. B. 2006. Crouched burials of the Corded Ware Culture in the East Baltic. *In:* LARSSON, L. & ZAGORSKA, I. (eds.) *Back to the Origin. New Research in the Mesolithic-Neolithic Zvejnieki cemetery and environment, northern Latvia* (Acta Archaeologica Lundensia 52), Lund: Almqvist & Wiksell International, 311-326.

LÜBKE, H. 1992. Neue Ausgrabungen in Boberg. *Archäologie in Deutschland,* 1, 48-49.

LUDWIG, A., PRUVOST, M., REISSMANN, M., BENECKE, N., BROCKMANN, G. A., CASTAÑOS, P., CIESLAK, M., LIPPOLD, S., LLORENTE, L., MALASPINAS, A.-S., SLATKIN, M. & HOFREITER, M. 2009. Coat Color Variation at the Beginning of Horse Domestication. *Science,* 324, 485.

MACHNIK, J. 1997. Die neuesten ^{14}C-datierten Fundstellen der Schnurkeramikkultur in den Karpaten. *In:* FRITSCH, B., MAUTE, M., MATUSCHIK, I., MÜLLER, J. & WOLF, C. (eds.) *Tradition und Innovation: Prähistorische Archäologie als historische Wissenschaft: Festschrift für Christian Strahm* (Internationale Archäologie – Studia honoraria 3), Rahden: Verlag Marie Leidorf GmbH, 257-273.

MACHNIK, J., SOSNOWSKA, E. & CYHYŁYK, W. 1997. Osada ludności kultury ceramiki sznurowej z początków III tysiąclecia przed Chr. w Side koło Sambora. *Rocznik Przemyski,* 33, 3-26.

MACIÑEIRA PARDO DE LAMA, F. 1941. El vaso campaniforme y condiciones de sus intactos yacimientos túmulares en la estación de Puentes, del Cabo Ortegal. *Sociedad Española de Arqueología, Etnografía y Prehistoria, Actas y Memórias,* 16, 356-369.

MAKAROWICZ, P. 2003. The Construction of Social Structure: Bell Beakers and Trzciniec Complex in North-Eastern Part of Central Europe. *Przegląd Archeologiczny,* 51, 123-158.

MALUQUER DE MOTES, J. 1964. Notas sobre la cultura megalítica Navarra. *Principe de Viana,* 24, 93-148.

MANEM, S. 2008. *Les Fondements Technologiques de la Culture des Duffaits (Âge du Bronze Moyen).* PhD Thesis, Université de Paris X / Université de Nanterrre.

MARIËN, M. E. 1948. La Civilisation des "Gobelets"en Belgique. *Bulletin des Musées Royaux d'Art et d'Histoire,* 25, 16-48.

MARIËN, M. E. 1952. Tessons de poterie énéolithique de l'Abri des Aulnes, à Dave. *Publication extraordinaire de la Société Archéologique de Namur,* 8, 63-69.

MAROLLE, C. 1985. Seine-Oise-Marne, Chalcolithique et Bronze ancien à Remilly-Aillicourt (Ardennes), lieu-dit La Bonne Fache. *Préhistoire et Protohistoire en Champagne-Ardenne,* 9, 37-53.

MAROLLE, C. 1991. Habitats préhistoriques à Remilly-Aillicourt (Ardennes). *Revue historique ardennaise,* 4, 61-70.

MARQUES, G. 1967. Castro Eneolítico de Sesimbra – notícia do seu achado. *Boletím do Centro de Estudos do Museu Arqueológico de Sesimbra,* 1, 10-15.

MARQUES, G. 1987. Aspectos da proto-história do território Português III – Castelo da Amoreira (Odivelas, Loures). *Boletím Cultural,* 1, 51-58.

MARSEEN, O. 1953. Fangstfolk på Selbjerg. *Kuml,* 3, 102-120.

MARTIAL, E. & PRAUD, I. 2007. Un site pallisadé du Néolithique Final à Houplin-Ancoisne (Nord, France). *Archaeologia Mosellana,* 7, 403-443.

MARTIAL, E., PRAUD, I. & BOSTYN, F. 2004. Recherches récentes sur le Néolithique final dans le nord de la France. *In:* VANDER LINDEN, M. & SALANOVA, L. (eds.) *Le troisième millénaire dans le nord de la France et en Belgique. Actes de la journée d'études SRBAP-SPF, 8 mars 2003, Lille* (Anthropologica et Praehistorica 115), Brussel: SRBAP, 49-71.

MARTIN, J.-M., MARTINEZ, R. & PROST, D. 1996. Le site chalcolithique de Bettencourt-Saint-Ouen (Somme). *Internéo,* 1, 141-168.

MARTIN VALLS, R. & DELIBES DE CASTRO, G. 1974. *La cultura del vaso campaniforme en las campiñas meridionales del Duero: el enterramiento de Fuente Olmedo (Valladolid)* (Monografia 1), Valladolid: Museo Arqueológico de Valladolid.

MARTIN VALLS, R. & DELIBES DE CASTRO, G. 1976. Hallazgos arqueológicos de la provincia de Zamora (III). *Boletín del Seminario de Estudios de Arte y Arqueologia,* 42, 411-440.

MARTIN VALLS, R. & DELIBES DE CASTRO, G. 1989. *La cultura del vaso campaniforme en las campiñas meridionales del Duero: el enterramiento de Fuente-Olmedo (Valladolid)* (Monografias del Museo Arqueológico de Valladolid 1), Valladolid: Museo Arqueológico de Valladolid.

MARTON, R. 1927. *Az ösrégészet kézikönyve II, Az újalb kökor*, Cluj-Kolozsvár: Roska M.

MAŠEK, N. 1976. Sídlištní objekt kultury zvoncovitých pohárů v Hostivaři – Praha 10. *Archeologické rozhledy,* 28, 18-31.

MATĚJÍČKOVÁ, A. (ed.) 1999. *Sídliště kultury zvoncovitých pohárů v Zádovicích (okr. Hodonín) – Siedlung der Glockenbecherkultur in Zadovice (Bez. Hodonin)* (Pravěk supplementum 5), Brno: Ústav Archeologické Památkové Péče Brno.

MATTHIAS, W. 1968. *Kataloge zur mitteldeutschen Schnurkeramik. Teil III: Nordharzgebiet* (Veroffentlichungen des Landesmuseums für Vorgeschichte in Halle 23), Berlin: Landesmuseums für Vorgeschichte Halle.

MATTHIAS, W. 1987. *Kataloge zur mitteldeutschen Schnurkeramik. Teil VI: Restgebiete und Nachträge* (Veroffentlichungen des Landesmuseums für Vorgeschichte in Halle 40), Berlin: Landesmuseums für Vorgeschichte Halle.

MAYNARD, G. 1950. Recent Archaeological Field Work in Suffolk. *Proceedings of the Suffolk Institute for Archaeology & History,* 25, 205-219.

MEIJLINK, B. H. F. M. & KRANENDONK, P. 2002. *Archeologie in de Betuweroute: Boeren, erven, graven. De boerengemeenschap van De Bogen bij Meteren (2450-1250 v. Chr.)* (Rapportage Archeologische Monumentenzorg 87), Amersfoort: ROB.

MEIRSMAN, E. & MOREE, J. M. 2006. *Albrandswaard Portland vindplaats 20-136. Opgraving van drie houtskoolplekken uit het Laat Neolithicum* (BOORrapport 146), Rotterdam: BOOR.

MEIRSMAN, E. & VAN DER ROEST, J. 2010. *Archeologisch onderzoek BN – Valkensteinsche Blok Gemeente Albrandswaard – definitief onderzoek – fase 1* (Grontmij Archeologische Rapporten 741), Houten: Grontmij.

MEISTRUP-LARSEN, L. & KRAMER, F. E. 1997. Gadegaard – en skaldynge med rige fund fra den tidlige bondestenalder ved Skævinge. *NoMus,* 4/97, 3-5.

MELCHIOR, L., LYNNERUP, N., SIEGISMUND, H. R., KIVISILD, T. & DISSING, J. 2010. Genetic Diversity among Ancient Nordic Populations. *PLoS One,* 5, e11898.

MELLER, H. 2017. Armies in the Early Bronze Age? An alternative interpretation of Únětice Culture axe hoards. *Antiquity,* 91, 1529-1545.

MERTENS, K. 1998. Die nordostniedersächsischen Riesenbecher. Ein lokales Phänomen mit überregionaler Bedeutung? *In:* KOSKO, A. & CZEBRESZUK, J. (eds.) *"Trziniec" – system kulturiowy czy interkulturowy proces?* , Poznań: Wydawnictwo Poznanskie, 193-202.

MERTENS, K. 1999. Ein niederländischer Potbeker aus Godenstedt, Stadt Zeven, Kreis Rotenburg/Wümme. *Offa,* 56, 247-257.

MERTENS, K. 2003. Einflüsse der Glockenbecherkultur in Norddeutschland. *In:* CZEBRESZUK, J. & SZMYT, M. (eds.) *The Northeast Frontier of Bell Beakers. Proceedings of the symposium held at the Adam Mickiewicz University, Poznań (Poland), May 26-29 2002* (British Archaeological Reports: International Series 1155), Oxford: Archaeopress, 51-72.

MEULENGRACHT OLSEN, A. 2013. *Different Similarities – Similar Differences. Regional Variation in Bell Beaker Influenced Early Late Neolithic Ceramics in Denmark.* MA Thesis, University of Aarhus.

MEURKENS, L. (ed.) 2015. *Nederzettingen uit het mesolithicum, neolithicum en de bronstijd in Loven-Noord gemeente Tilburg* (Archol Rapport 163), Leiden: Archol.

MEURKENS, L., VAN BEEK, R., DOORENBOSCH, M., FOKKENS, H., HEUNKS, E., DEBONO SPITERI, C., KNIPPENBERG, S., MEIRSMAN, E., VAN HEES, E. & VERBAAS, A. 2015. A Late Neolithic Single Grave Culture burial from Twello (central Netherlands): environmental setting, burial ritual and contextualisation. *Analecta Praehistorica Leidensia,* 45, 29-53.

MEYER, M. 1991. Eine Aunjetitzer Tasse von Restorf, Kr. Lüchow-Dannenberg – Gedanken zur Nordwest-Peripherie der Aunjetitzer Kultur. *Archäologisches Korrespondenzblatt,* 21, 491-499.

MEYER, M. 1993. *Pevestorf 19. Ein mehrperiodiger Fundplatz im Landkreis Lüchow-Dannenberg* (Veröffentlichungen der archäologischen Sammlungen des Landesmuseums Hannover 40), Oldenburg: Landesmuseum Hannover.

MEYLEMANS, E., JACOPS, J., BOGEMANS, F., DEFORCE, K., ERVYNCK, A., LENTACKER, A., PERDAEN, Y., STORME, A., VAN NEER, W. & VANMONTFORT, B. L. L. 2014. *Archeologisch evaluatieonderzoek van een prehistorische vindplaats (mesolithicum tot vroege bronstijd) in het Sigma- gebied 'Zennegat' (Mechelen, prov. Antwerpen),* Brussel: Onroerend Erfgoed.

MIDGLEY, M. S. 1992. *TRB culture. The First Farmers of the North European Plain*, Edinburgh: Edinburgh University Press.

MILLARD, A. R. 2016. Conventions for Reporting Radiocarbon Determinations. *Radiocarbon,* 56, 555-559.

MISCHKA, D., DÖRFLER, W., GROOTES, P. M., HEINRICH, D., MÜLLER, J. & NELLE, O. 2007. Die neolithische Feuchtbodensiedlung Bad Oldesloe Wolkenwehe LA 154 Vorbericht zu den Untersuchungen 2006. *Offa,* 61/62, 25-63.

MITHEN, S. (ed.) 1998. *Creativity in Human Evolution and Prehistory* (Theoretical Archaeology Group), London/New York: Routledge.

MØBJERG, T., JENSEN, P. M. & MIKKELSEN, P. H. 2007. Enkehøj. En boplads med klokkebægerkeramik og korn. *Kuml,* 2007, 9-45.

MODDERMAN, P. J. R. 1955. Laat bekeraardewerk versierd met indrukken van een wikkeldraadstempel. *Berichten van de Rijksdienst voor het Oudheidkundig Bodemonderzoek,* 6, 32-43.

MODDERMAN, P. J. R. 1957. Een dodenhuis op de Gelpenberg bij Aalden. *Nieuwe Drentse Volksalmanak,* 75, 19-22.

MODDERMAN, P. J. R. 1971. Beaker pottery from Hunebed D19 near Drouwen, Prov. Drenthe. *Analecta Praehistorica Leidensia,* 4, 47-51.

MODDERMAN, P. J. R., BAKKER, J. A. & HEIDINGA, H. A. 1976. Nederzettingssporen uit Midden-Neolithicum (TRB), Late Bronstijd en Middeleeuwen in het Beekhuizerzand onder Harderwijk, Prov. Gelderland. *Analecta Praehistorica Leidensia,* 9, 39-73.

MOLTHOF, H. 2013. *Plangebied Donklaan 78, Gemeente Voorschoten. Archeologisch vooronderzoek: een waarderend proefsleuvenonderzoek* (RAAP Rapport 2671), Weesp: RAAP Archeologisch Adviesbureau.

MONTELIUS, O. 1872. *Svenska fornsaker I. Stenåldern och bronsåldern*, Stockholm: Norstedt.

MONTELIUS, O. 1917. *Minnen från vår forntid*, Stockholm: Norstedt & Söner.

MONTERO RUÍZ, I., BOKBOT, Y., MURILLO-BARROSO, M. & GENER MORET, M. 2012. Metalurgia pre-islámica en Marruecos: Nuevos análisis y valoración comparativa con la metalurgia de la Península Ibérica. *Estudos Arqueológicos de Oeiras,* 19, 113-118.

MOREE, J. M., BAKELS, C. C., BLOO, S. B. C., BRINKHUIZEN, D. C., HOUKES, R. A., JONGSTE, P. F. B., VAN TRIERUM, M. C., VERBAAS, A. & ZEILER, J. T. 2010. Barendrecht-Carnisselande: bewoning van een oeverwal vanaf het Laat Neolithicum tot in de Midden-Bronstijd. *In:* CARMIGGELT, A., VAN TRIERUM, M. C. & WESSELINGH, D. A. (eds.) *Archeologisch onderzoek in de gemeente Barendrecht. Prehistorische bewoning op een oeverwal en middeleeuwse bedijking en bewoning* (Boorbalans 7), Rotterdam: BOOR, 15-154.

MOREE, J. M., CARMIGGELT, A., GOOSSENS, T. A., GUIRAN, A. J., PETERS, F. J. C. & VAN TRIERUM, M. C. 2002. Archeologisch onderzoek in het Maasmondgebied: archeologische kroniek 1991-2000. *Boorbalans,* 5, 87-209.

MOREE, J. M., SCHOONHOVEN, A. V. & VAN TRIERUM, M. C. 2010. Archeologisch onderzoek in het Maasmondgebied: archeologische kroniek 2001-2006. *Boorbalans,* 6, 77-235.

MOSER, A. 1994. Zur zeitliche Stellung der "Riesenbecher" des Hannoverschen Wendlandes. *Nachrichten aus Niedersachsens Urgeschichte,* 63, 3-38.

MÜLLER, A., VAN BERGEIJK, G., DRENTH, E., VOS, P. C. & VAN HEERINGEN, R. M. 2008. *Akersloot-Klein Dorregeest. Een vindplaats van de Klokbekercultuur in de gemeente Castricum, provincie Noord-Holland* (Rapportage Archeologische Monumentenzorg 159), Amersfoort: RACM.

MÜLLER, J. 2013. Demographic traces of technological innovation, social change and mobility: from 1 to 8 million Europeans (6000-2000 BCE). *In:* KADROW, S. & WŁODARCZAK, P. (eds.) *Environment and subsistence – forty years after Janusz Kruk's 'Settlement studies'*, Bonn: Verlag Dr. Rudolf Habelt GmbH, 493-506.

MÜLLER, J., HINZ, M. & ULLRICH, M. 2015. Bell Beakers – Chronology, Innovation and Memory: a multivariate approach. *In:* PRIETO MARTINEZ, M. P. & SALANOVA, L. (eds.) *The Bell Beaker Transition in Europe. Mobility and local evolution during the 3rd millennium BC,* Oxford: Oxbow Books, 57-68.

MÜLLER, J., SEREGÉLY, T., BECKER, C., CHRISTENSEN, A.-M., FUCHS, M., KROLL, H., MISCHKA, D. & SCHÜSSLER, U. 2009. A Revision of Corded Ware Settlement

Pattern – New Results from the Central European Low Mountain Range. *Proceedings of the Prehistoric Society,* 75, 125-142.

MÜLLER, J. & VAN WILLIGEN, S. 2001. New radiocarbon evidence for european Bell Beakers and the consequences for the diffusion of the Bell Beaker Phenomenon. *In:* NICOLIS, F. (ed.) *Bell beakers today. Pottery, people, culture, symbols in prehistoric Europe. Proceedings of the International Colloquium Riva del Garda (Trento, Italy), 11-16 May 1998*, Trento: Provincia autonoma di Trento, Servizio beniculturali, Ufficio beni archeologici, 59-80.

MÜLLER, S. 1918. *Stenalderens Kunst i Danmark* (Oldtidens Kunst i Danmark 1), København: Reitzel.

MUSCHA, V. 1958. Příspěvek k časovému zařazení eneolitických pasových zápon. *Archeologické rozhledy,* 10, 62-79.

MUŠKA, J. 1981. The Settlement and Cemetery Sites of the Bell Beaker Culture at Radovesice by Bílina. *Archaeological News in the Czech Socialist Republic. X Congrés international des sciences prehistoriques et protohistoriques*, Praha/Brno, 51.

MYRES, N. M., ROOTSI, S., LIN, A. A., JARVE, M., KING, R. J., KUTUEV, I., CABRERA, V. M., KHUSNUTDINOVA, E. K., PSHENICHNOV, A., YUNUSBAYEV, B., BALANOVSKY, O., BALANOVSKA, E., RUDAN, P., BALDOVIC, M., HERRERA, R. J., CHIARONI, J., DI CRISTOFARO, J., VILLEMS, R., KIVISILD, T. & UNDERHILL, P. A. 2011. A major Y-chromosome haplogroup R1b Holocene era founder effect in Central and Western Europe. *European Journal of Human Genetics,* 19, 95-101.

N.N. 1935. Zuffenhausen. *Fundberichte aus Schwaben,* VIII, 50.

NADLER, M. 1999. Steinbruch gibt Glockenbecher-Siedlung frei. *Archäologie in Deutschland,* 1998, 35-36.

NAUE, J. 1899. Die Bronzezeit in Bayern. *Korrespondenz-Blatt der Deutschen Gesellschaft für Anthropologie, Ethnologie und Urgeschichte,* 33, 127-134.

NEEDHAM, S. P. 2000. Power Pulses Across a Cultural Divide: Cosmologically Driven Acquisition Between Armorica and Wessex. *Proceedings of the Prehistoric Society,* 66, 151-207.

NEEDHAM, S. P. 2007. Isotopic aliens: Beaker movement and cultural transmissions. *In:* LARSSON, M. & PARKER PEARSON, M. (eds.) *From Stonehenge to the Baltic* (British Archaeological Reports: International Series 1692), Oxford: Archaeopress, 41-46.

NELSON, H. 2001. Spätneolithische Keramikfunde aus dem Landkreis Celle. *Nachrichten aus Niedersachsens Urgeschichte,* 70, 189-210.

NETO, N. 2003. A cêramica decorada Neolítica e Calcolítica do povoado das Baútas (Amadora). *ARQA – patromónio em revista,* 1, 36-51.

NEUMANN, G. 1969. Die Glockenbecherkultur im Spiegel einiger thüringischer Siedlungsplätze. *In:* BEHRENS, H. & SCHLETTE, F. (eds.) *Die neolithischen Becherkulturen im Gebiet der DDR und ihre europäischen Beziehungen* (Veröffentlichungen des Landesmuseums für Vorgeschichte in Halle 24), Berlin: Landesmuseum für Vorgeschichte Halle, 131-142.

NEUSTUPNÝ, E. (ed.) 2013. *The Eneolithic* (The Prehistory of Bohemia 3), Prague: Archeologický ústav AV ČR.

NEWMAN, M. E. J. 2010. *Networks An Introduction*, Oxford: Oxford University Press.

NEWMAN, M. E. J. & GIRVAN, M. 2004. Finding and evaluating community structure in networks. *Physical Review E,* 69, 026113.

NICOLAS, C. 2016. *Flèches de pouvoir à l'aube de la métallurgie de la Bretagne au Danemark (2500-1700 av. n. è.),* Leiden: Sidestone Press.

NICOLIS, F. (ed.) 2001. *Bell Beakers today. Pottery, people, culture, symbols in prehistoric Europe. Proceedings of the International Colloquium Riva del Garda (Trento, Italy) 11-16 May 1998*, Trento: Provincia autonoma di Trento, Servizio beniculturali, Ufficio beni archeologici.

NIEKUS, M. J. L. T. & HUISMAN, H. 2001. Natuursteen. *In:* SCHONEVELD, J. & GEHASSE, E. F. (eds.) *Archeologie in de Betuweroute. Boog C-Noord, een vindplaats bij Meteren op de overgang van Neolithicum naar Bronstijd* (Rapportage Archeologische Monumentenzorg 84), Amersfoort: ROB, 103-134.

NILIUS, I. 1981. Beitrag zur Stellung der Einzelgrabkultur in Mecklenburg. *Jahresschrift für Mitteldeutsche Vorgeschichte,* 64, 63-87.

NOBLES, G. R. 2016. *Dwelling on the edge of the Neolithic. Investigating human behaviour through the spatial analysis of Corded Ware settlement material in the Dutch coastal wetlands (2900-2300 cal BC)* (Groningen Archaeological Studies 32), Groningen: Barkhuis.

NOEL, J.-Y. 2008. *In terra incognita*: le Campaniforme normand, synthèse préliminaire du mobilier céramique. *Bulletin de la Société Préhistorique Française,* 105, 577-593.

NOENS, G. 2011. *Een afgedekt mesolithisch nederzettingsterrein te Hempens/N31 (gemeente Leeuwarden, provincie Friesland, Nl.). Algemeen kader voor de studie van een lithische vindplaats* (Archaeological Reports Ghent University 7), Gent: Academia Press.

NOENS, G. & CROMBÉ, P. 2007. *De steentijdvindplaats Leeuwarden-Hempens/ N31. Basisrapport van de Definitieve Archeologische Opgraving: fase 2* (UGent Archeologische Rapporten 2007-5), Gent: Academia Press.

NORDMAN, C. A. 1918. *Studier öfver Gånggriftkulturen i Danmark*, Helsinki: University of Helsinki.

NOWOTHNIG, W. 1937. *Die Schönfelder Gruppe*, Halle: Gebauer-Schwetschke.

ODRIOZOLA, C. P., SOUSA, A. C., MATALOTO, R., BOAVENTURA, R., ANDRADE, M., VILLALOBOS GARCÍA, R., GARRIDO-CORDERO, J. A., RODRIGUEZ, E., MARTÍNEZ-BLANES, J. M., AVILÉS, M. A., DAURA, J., SANZ, M. & RIQUELME, J. A. 2017. Amber, beads and social interaction in the Late Prehistory of the Iberian Peninsula: an update. *Archaeological and Anthropological Sciences*.

OLALDE, I., BRACE, S., ALLENTOFT, M. E., ARMIT, I., KRISTIANSEN, K., ROHLAND, N., MALLICK, S., BOOTH, T., SZÉCSÉNYI-NAGY, A., MITTNIK, A., ALTENA, E., LIPSON, M., LAZARIDIS, I., PATTERSON, N. J., BROOMANDKHOSHBACHT, N., DIEKMANN, Y., FALTYSKOVA, Z., FERNANDES, D. M., FERRY, M., HARNEY, E., DE KNIJFF, P., MICHEL, M., OPPENHEIMER, J., STEWARDSON, K., BARCLAY, A., ALT, K. W., AVILÉS FERNÁNDEZ, A., BÁNFFY, E., BERNABÒ-BREA, M., BILLOIN, D., BLASCO, C., BONSALL, C., BONSALL, L., ALLEN, T., BÜSTER, L., CARVER, S., CASTELLS NAVARRO, L., CRAIG, O. E., COOK, G. T., CUNLIFFE, B., DENAIRE, A., DINWIDDY, K. E., DODWELL, N., ERNÉE, M., EVANS, C., KUCHAŘÍK, M., FRANCÈS FARRÉ, J., FOKKENS, H., FOWLER, C., GAZENBEEK, M., GARRIDO PENA, R., HABER-URIARTE, M., HADUCH, E., HEY, G., JOWETT, N., KNOWLES, T., MASSY, K., PFRENGLE, S., LEFRANC, P., LEMERCIER, O., LEFEBVRE, A., LOMBA MAURANDI, J., MAJÓ, T., MCKINLEY, J. I., MCSWEENEY, K., BALÁZS GUSZTÁV, M., MODI, A., KULCSÁR, G., KISS, V., CZENE, A., PATAY, R., ENDRÓDI, A., KÖHLER, K., HAJDU, T., CARDOSO, J. L., LIESAU, C., PARKER PEARSON, M., WŁODARCZAK, P., PRICE, T. D., PRIETO, P., REY, P.-J., RÍOS, P., RISCH, R., ROJO GUERRA, M. A., SCHMITT, A., SERRALONGUE, J., SILVA, A. M., SMRČKA, V., VERGNAUD, L., ZILHÃO, J., CARAMELLI, D., HIGHAM, T., HEYD, V., SHERIDAN, A., SJÖGREN, K.-G., THOMAS, M. G., STOCKHAMMER, P. W., PINHASI, R., KRAUSE, J., HAAK, W., et al. 2018. The Beaker Phenomenon And The Genomic Transformation Of Northwest Europe. *Nature,* 555, 190-196.

OLSEN, J., HORNSTRUP, K. M., HEINEMEIER, J., BENNIKE, P. & THRANE, H. 2011. Chronology of the Danish Bronze Age based on ^{14}C dating of cremated bone remains. *Radiocarbon,* 53, 261-275.

ONDRÁČEK, J. 1978. Grabung eines Objektes der Glockenbecherkultur in Bořitov, (Bez. Blansko). *Přehled výzkumů AÚ ČSAV,* 1976, 26.

ONDRÁČEK, J., DVOŘÁK, P. & MATĚJÍČKOVÁ, A. 2005. *Siedlungen der Glockenbecherkultur in Mähren. Katalog der Funde* (Pravěk Supplementum 15), Brno: Ústav Archeologické Památkové Péče Brno.

OUTRAM, Z., STEAR, N. A., KASPAROV, A., USMANOVA, E. R., VARFOLOMEEV, V. & EVERSHED, R. P. 2011. Horses for the dead: funerary foodways in Bronze Age Kazakhstan. *Antiquity,* 85, 116-128.

PALLIARDI, J. 1914. Die relatieve Chronologie der jüngeren Steinzeit in Mähren. *Wiener Prähistorisches Zeitschrift,* 1, 256-277.

PALLIARDI, J. 1919. Beiträge zur Kenntnis der Glockenbecherkultur. *Wiener Prähistorisches Zeitschrift,* 6, 41-56.

PARENT, J.-P., VAN DER PLAETSEN, P. & VANMOERKERKE, J. 1987. *Prehistorische jagers en veetelers aan de Donk te Oudenaarde* (VOBOV-info 24/25), Belsele: De Belie.

PARENT, J.-P., VAN DER PLAETSEN, P. & VANMOERKERKE, J. 1989. Les fouilles de sauvetage d'Oudenaarde-Donk. *Cahiers de Préhistoire du Nord,* 6, 33-43.

PARENT, J.-P. & VANMOERKERKE, J. 1986. Een Midden-Paleolithisch en Neolithisch site te Huise. *VOBOV-info,* 22-23, 1-8.

PARKER PEARSON, M. 1999. *The Archaeology of Death and Burial*, Stroud: Sutton Publishing.

PATAY, P. 1958. Rezkori aranyletek. *Archaeologiai Értesitö,* 85, 37-45.

PÄTZOLD, J. 1954. Ein reichhaltiger Grabhügel der Einzelgrabkultur von der Katenbäker Heide bei Wildeshausen und weitere oldenburgische Keramikfunde der Becherkulturen. *Oldenburger Jahrbuch,* 54, 3-26.

PAUTREAU, J.-P. (ed.) 1974. *L'habitat Peu-Richardien de la Sauzaie, commune de Soubise (Charente-Maritime). Fouille de Sauvetage. Premiers résultats*, Poitiers: Circonscription des Antiquités Préhistoriques "Poitou-Charentes".

PAUTREAU, J.-P. 1975. Datations radio-carbone de l'Artenac du Camp Allaric à Aslonnes (Vienne). *Bulletin de la Société Préhistorique Française,* 72, 24-25.

PAUTREAU, J.-P. 1978. L'habitat protohistorique du coteau de Montigné à Coulon (Deux-Dèvres) Traveaux 1978. *Bulletin de la Société Historique et Scièntifique des Deux-Sèvres 2e série,* 11, 189-226.

PAUTREAU, J.-P. 1994. Le grand bâtiment d'Antran (Vienne) : une nouvelle attribution chronologique. *Bulletin de la Société Préhistorique Française,* 91, 418-419.

PAUTREAU, J.-P. & MAITAY, C. 2007. L'éperon barré du Camp Allaric, Aslonnes (Vienne). Trente années de recherches. *La Congrès Du Centenaire: Un siècle de construction du discours scientifique en Préhistoire. Volume 2: Des idées d'hier. Actes de XXVIe Congrès Préhistorique de France, Avignon, 21-25 septembre 2004,* Paris: Société Préhistorique Française, 359-369.

PAUTREAU, J.-P. & ROBERT, P.-P. 1980. Le gisement campaniforme des Deux-Moulins au Bois-en-Ré (Charente-Maritime). *Bulletin de la Société Préhistorique Française,* 77, 283-288.

PAVLŮ, I. 2000. První sídliště kultury zvoncovitých pohárů na Čáslavsku. *In:* ČECH, P. & DOBEŠ, M. (eds.) *Sborník Miroslavu Buchvaldkovi*, Most: Ústav archeologické památkové péče severozápadních Čech, 195-199.

PAYNE, G. 1885. Thursday, January 17th, 1884. *Proceedings of the Society of Antiquaries of London,* 10, 29-30.

PEARSALL, D. M. 2015. *Paleoethnobotany : a handbook of procedures*, Walnut Creek: Left Coast Press.

PEEPLES, M. A. 2011. R Script for Calculating the Brainerd-Robinson Coefficient of Similarity and Assessing Sampling Error. [Accessed September 11, 2017].

PEREIRA, F. 1915. Estação Arqueológica do Outeiro da Assenta (Obidos). *O Arqueólogo Português,* I, 135-146.

PERICOT Y GARCÍA, L. 1927. Los vasos campaniformes de la Colección "La Iglesia". *Boletín de la Real Academia Gallega,* 22, 283-291.

PERIDY, P. 1997. Saint-Mathurin. La Chevêtelière. *Bilan Scientifique des Pays de la Loire,* 1997, 84-85.

PERIDY, P. 1999. Saint-Mathurin. La Chevêtelière. *Bilan Scientifique des Pays de la Loire,* 1999, 102-104.

PERIDY, P. 2000. Saint-Mathurin. La Chevêtelière. *Bilan Scientifique des Pays de la Loire,* 2000, 89.

PERSCHMANN, T. 1873. Das Hünengrab bei Uthleben. *Zeitschrift des Harzvereins,* VI, 486-488.

PEŠKA, J. 2000. Otázka sídlišť kultury se šňůrovou keramikou na Moravě. *In Memoriam Jan Rulf* (Památky Archeologické Supplementum 13), Praha: Institute of Archaeology, Czech Academy of Sciences, 424-438.

PEŠKA, J. 2011. Neue absolute Datierungen aus dem späten Äneolithikum Mährens. *Offa,* 63/64, 7-44.

PEŠKA, J. 2013. Das Besiedlungsbild in der Blütezeit der Frühbronzezeit im Gebiet des mittleren Donauraumes. *In:* MELLER, H., BERTEMES, F., BORK, H.-R. & RISCH, R. (eds.) *1600 – Kultureller umbruch im Schatten des Thera-Ausbruchs? 4. Mitteldeutsscher Archäologentag vom 14.-16. Okt. 2011 Halle (Saale)* (Tagungen des Landesmuseums für Vorgeschichte Halle 9), Halle: Landesmuseum für Vorgeschichte Halle, 387-498.

PETERS, F. C. J. 1999. *Vinex-locatie Midden-IJsselmonde: Archeologisch vooronderzoek bij de deelplannen Gaatkensoog en Gaatkensplas van de nieuwbouwlocatie Carnisselande (gemeente Barendrecht)* (BOORrapport 40), Rotterdam: BOOR.

PETERS, F. C. J. 2001. *Vinex-locatie Midden-IJsselmonde: Aanvullende Archeologische Onderzoeken in de nieuwbouwlocatie Carnisselande (gemeente Barendrecht)* (BOORrapport 62), Rotterdam: BOOR.

PÉTREQUIN, P. 1993. North Wind, South Wind: Neolithic technological choices in the Jura Mountains, 3700-2400 BC. *In:* LEMONNIER, P. (ed.) *Technological choices: transformation in material cultures since the Neolithic*, London: Routledge, 36-76.

PETSCH, W. 1937. Ein Trichterbecher von Venz auf Rügen und die Gingster Keramik. *Greifswalder Mitteilungen,* 10, 5-14.

PICHLEROVA, M. 1968. Eneoliticky kosteny závesok z Jablonca. *Archeologické rozhledy,* 20, 351-352.

PININGRE, J.-F. 1985. Un aspect de la fin du Néolithique dans le Nord de la France. Les sites de Seclin, Houplin-Ancoisne et Saint-Saulve (Nord). *Revue Archéologique de Picardie,* 3-4, 53-69.

PLEINER, R. & RYBOVÁ, A. 1978. *Pravěké dějiny Čech*, Praha: Academia.

PLEYTE, W. 1902. *Nederlandsche oudheden van de vroegste tijden tot Karel de Groote – West Friesland*, Leiden: Brill.

POCKRANDT, W. 1976. Das Hünengrab von Selchowhammer. *Heimatbrief. Monatsschrift für die Landsleute aus dem Netzekreis in der Pommerschen Landsmannschaft,* 27.

POLLARD, A. M., PELLEGRINI, M. & LEE-THORP, J. A. 2011. Technical Note: Some Observations on the Conversion of Dental Enamel $ð^{18}O_p$ Values to $ð^{18}O_w$ to Determine Human Mobility. *American Journal of Physical Anthropology,* 145, 499-504.

POLO-DÍAZ, A. & FERNÁNDEZ-ERASO, J. 2010. Same anthropogenic activity, different taphonomic processes: a comparison of deposits from Los Husos I & II (Upper Ebro Basin, Spain). *Quaternary International,* 214, 82-97.

PRAUD, I., BERNARD, V., MARTIAL, E. & PALAU, R. 2007. Un bâtiment du Néolithique final à Houplin-Ancoisne (Nord, France). *In:* BESSE, M. (ed.) *Sociétés néolithiques. Des faits archéologiques aux fonctionnements socio-économiques. Actes du 27e colloque interrégional sur le Néolithique(Neuchâtel, 1 et 2 octobre 2005)* (Cahiers d'archéologie romande 108), Lausanne: Cahiers d'archéologie romande, 445-460.

PRAUD, I. & MARTIAL, E. 2000. Une nouvelle occupation du Néolithique final dans la vallée de la Deûle, à Annœullin (Nord). *Internéo,* 3, 131-142.

PRESCOTT, C. 2012. No longer north of the beakers. Modeling an interpretive platform for third millennium transformations in Norway. *In:* FOKKENS, H. & NICOLIS, F. (eds.) *Background to Beakers. Inquiries into regional cultural backgrounds of the Bell Beaker complex*, Leiden: Sidestone Press, 37-60.

PRESCOTT, C. & GLØRSTAD, H. 2015. Expanding 3rd millennium transformations: Norway. *In:* PRIETO MARTINEZ, M. P. & SALANOVA, L. (eds.) *The Bell Beaker Transition in Europe. Mobility and local evolution during the 3rd millennium BC*, Oxford: Oxbow Books, 77-87.

PRICE, T. D., GRUPE, G. & SCHRÖTER, P. 1994. Reconstruction of migration patterns in the Bell Beaker period by stable strontium isotope analysis. *Applied Geochemistry,* 9**,** 413-417.

PRICE, T. D., GRUPE, G. & SCHRÖTER, P. 1998. Migration in the Bell Beaker period of central Europe. *Antiquity,* 72**,** 405-411.

PRICE, T. D., KNIPPER, C., GRUPE, G. & SMRCKA, V. 2004. Strontium isotopes and prehistoric human migration: the Bell Beaker period in Central Europe. *European Journal of Archaeology,* 7**,** 9-40.

PŘICHYSTAL, A. & ŠEBELA, L. 2015. Silicite daggers from the territories of the Czech Republic and Slovakia. *In:* FRIEMAN, C. J. & ERIKSEN, B. V. (eds.) *Flint daggers in prehistoric Europe*, Oxford: Oxbow Books, 133-148.

PŘICHYSTAL, A. & VŠIANSKÝ, D. 2012. Petroarchaeological investigation of stone industry from Hoštice I. *In:* MATĚJÍČKOVÁ, A. & DVOŘÁK, P. (eds.) *Funerary areas of the Bell Beaker period on the D1 Vyškov – Mořice motorway* (Pravěk supplementum 24), Brno: Ústav Archeologické Památkové Péče Brno, 303-322.

PRIEBE, H. 1938. Die Westgruppe der Kugelamphoren. *Jahresschriften für Vorgeschichte der Sächsisch-Thüringer Länder,* 28**,** 1-144.

PRIEGO, C. & QUERO, S. 1992. *El Ventorro, un Poblado Prehistorico de los Albores de la Metalurgica*, Madrid: Museos Municipal.

PRIETO MARTINEZ, M. P. 2008. Bell Beaker Communities in Thy: The First Bronze Age Society in Denmark. *Norwegian Archaeological Review,* 41**,** 115-158.

PRIETO MARTÍNEZ, M. P. 2011. La Alfarería de las Comunidades Campaniformes en Galicia: contextos, cronologías y estilo. *In:* PRIETO MARTINEZ, M. P. & SALANOVA, L. (eds.) *Las Comunidades Campaniformes en Galicia. Cambios sociales en el III y II Milenios BC en el NW de la Península Ibérica*, Pontevedra: Deputación Pontevedra, 345-361.

PRIETO MARTINEZ, M. P. & SALANOVA, L. 2009. Coquilles et Campaniforme en Galice et en Bretagne: mécanismes de circulation et stratégies identitaires. *Bulletin de la Société Préhistorique Française,* 106**,** 73-93.

PRIETO MARTINEZ, M. P. & SALANOVA, L. (eds.) 2013. *Current researches on Bell Beakers. Proceedings of the 15th International Bell Beaker Conference: From Atlantic to Ural. 5th – 9th May 2011. Poio (Pontevedra, Galicia, Spain)*, Santiago de Compostela: Galician Archaeopots.

PRIETO MARTINEZ, M. P. & SALANOVA, L. (eds.) 2015. *The Bell Beaker Transition in Europe. Mobility and local evolution during the 3rd millennium BC*, Oxford: Oxbow Books.

RADIVOJEVIĆ, M. & GRUJIĆ, J. 2017. Community structure of copper supply networks in the prehistoric Balkans: An independent evaluation of the archaeological record from the 7th to the 4th millennium BC. *Journal of Complex Networks***,** 1-19.

RAEMAEKERS, D. C. M. 1999. *The Articulation of a New Neolithic. The meaning of the Swifterbant Culture for the process of neolithisation in the western part of the North European Plain (4900-3400 BC)* (Archaeological Studies Leiden University 3), Leiden: Leiden University Press.

RAEMAEKERS, D. C. M. 2005. An outline of Late Swifterbant pottery in the Noordoostpolder (province of Flevoland, the Netherlands) and the chronological development of the pottery of the Swifterbant culture. *Palaeohistoria,* 45/46**,** 11-36.

RAEMAEKERS, D. C. M., AALDERS, Y. I., BECKERMAN, S. M., BRINKHUIZEN, D. C., DEVRIENDT, I., HUISMAN, H., DE JONG, M., MOLTHOF, H. M., PRUMMEL, W., NIEKUS, M. J. L. T. & VAN DER WAL, M. 2012. The submerged pre-Drouwen TRB settlement site Wetsingermaar, c. 3500 cal. BC (province of Groningen, the Netherlands). *Palaeohistoria,* 53/54**,** 1-24.

RAETZEL-FABIAN, D. 2001. Anmerkungen zur Interpretation von 14C-Daten. *In:* CZEBRESZUK, J. & MÜLLER, J. (eds.) *Die absolute Chronologie in Mitteleuropa 3000-2000 v. Chr.*, Poznan/Bamberg/Rahden: Verlag Marie Leidorf GmbH, 11-23.

RAHBEK, U. & RASMUSSEN, K. L. 1993. Danske arkæologiske 14C-dateringer. *Arkæologiske udgravninger i Danmark,* 1992**,** 271-304.

RAHBEK, U. & RASMUSSEN, K. L. 1994. Danske arkæologiske 14C-dateringer. *Arkæologiske udgravninger i Danmark,* 1993**,** 276-288.

RAHMSTORF, L. 2008. The Bell Beaker Phenomenon and the interaction spheres of the Early Bronze Age East Medierranean: similarities and differences. *In:* LEHOËRFF, A. (ed.) *Construire le temps. Histoire et méthodes des chronologies et calendriers des derniers millénaires avant notre ère en Europe occidentale. Actes du XXXe colloque international de Halma-Ipel, UMR 8164 (CNRS, Lille, MCC), 7-9 décembre 2006, Lille, Glux-en-Glenne*, Bibracte: CNRS, 149-170.

RAICHLEN, D. A., WOOD, B. M., GORDON, A. D., MABULLA, A. Z. P., MARLOWE, F. W. & PONTZER, H. 2014. Evidence of Lévy walk foraging patterns in human hunter-gatherers. *Proceedings of the National Academy of Sciences,* 111**,** 728-733.

RAKOVSKÝ, I. 1985. Sídliště kultury zvoncovitých pohárů v Holubicích. *Archeologické rozhledy,* 37**,** 377-392.

RAMMINGER, B. 2012. Multiple Grenzen: Das Beispiel Boberger Dünen. *In:* DOPPLER, T., RAMMINGER, B. & SCHIMMELPFENNIG, D. (eds.) *Grenzen und Grenzräume? Beispiele aus Neolithikum und Bronzezeit. Beiträge der Sitzung der Arbeitsgemeinschaften Neolithikum und Bronzezeit in Greifswald* (Fokus Jungsteinzeit 2), Loogh, 297-320.

RAPOPORT, A. & HORVATH, W. J. 1961. A Study of a Large Sociogram. *Systems Research and Behavioural Science,* 6**,** 279-291.

RASMUSSEN, U. 2016. Gaasemosen: a contribution to the study of the economic strategy of the Single Grave Culture. *In:* FURHOLT, M., GROßMANN, R. & SZMYT, M. (eds.) *Transitional Landscapes? The 3rd Millennium BC in Europe. Proceedings of the International Workshop "Socio-Environmental Dynamics over the Last 12,000 Years: The Creation of Landscapes III (15th-18th April 2013)" in Kiel* (Universitätsforschungen zur Prähistorischen Archäologie 292), Bonn: Verlag Dr. Rudolf Habelt GmbH, 143-157.

RASSMANN, K. 1993. *Spätneolithikum und frühe Bronzezeit im Flachland zwischen Elbe und Oder* (Beiträge zur Ur- und Frühgeschichte Mecklenburg-Vorpommerns 28), Lübstorf: Archäologisches Landesmuseum für Mecklenburg-Vorpommern.

RASSMANN, K. 2001. Vortrag zur Jahressitzung 2000 der Römisch-Germanischen Kommission. Die Nutzung baltischen Feuersteins an der Schwelle zur Bronzezeit – Krise oder Konjunktur der Feuersteinverarbeitung? *Bericht der Römisch-Germanischen Kommission,* 81**,** 5-36.

REHMAN, F., ROBINSON, V. J., NEWTON, G. W. A. & SHENNAN, S. J. 1991. Neutron Activation Analysis and the Bell Beaker Folk. *In:* BUDD, P., CHAPMAN, R. J., JACKSON, C., JANAWAY, R. & OTTAWAY, B. S. (eds.) *Archaeological Sciences 1989: Proceedings of A Conference on the Application of Scientific Techniques to Archaeology, Bradford, september 1989* (Oxbow Monographs 9), Oxford: Oxbow books, 95-103.

REHMAN, F., ROBINSON, V. J. & SHENNAN, S. J. 1992. A neutron activation study of Bell Beakers and associated pottery from Czechoslovakia and Hungary. *Památky archeologické,* 83**,** 197-211.

REIMER, P. J., BARD, E., BAYLISS, A., BECK, J. W., BLACKWELL, P. G., BRONK RAMSEY, C., BUCK, C. E., CHENG, H., EDWARDS, R. L., FRIEDRICH, M., GROOTES, P. M., GUIL-

DERSON, T. P., HAFLIDASON, H., HAJDAS, I., HATTÉ, C., HEATON, M., HOFFMANN, D. L., HOGG, A. G., HUGHEN, K. A., KAISER, K. F., KROMER, B., MANNING, S., NIU, M., REIMER, R. W., RICHARDS, D. A., SCOTT, E. M., STAFF, R. A., TURNEY, C. S. M. & VAN DER PLICHT, J. 2013. INTCAL13 and Marine13 Radiocarbon Age Calibration Curves 0-50,000 Years cal BP. *Radiocarbon,* 55**,** 1869-1887.

REINECKE, P. 1900. Zur jüngeren Steinzeit in West- und Süddeutschland. *Westdeusche Zeitschrift für Geschichte und Kunst,* 19**,** 209-270.

REVILLA ANDÍA, M. L. 1985. *Carta arqueológica de Soria: Tierra de Almazán*, Soria: Diputación Provincial de Soria.

RICE, P. M. 1987. Pottery Manufacturing Technology: An Ethnographic Overview. *Pottery Analysis: A Sourcebook*, Chicago: University of Chicago Press, 113-167.

RIEDE, F. 2012. A possible Brommian shaft-smoother from the site of Møllehøje, north-western Denmark *Mesolithic Miscellany,* 22**,** 10-18.

RIQUET, R., GUILAINE, J. & COFFYN, A. 1963. Les campaniformes Françaises. *Gallia Préhistoire,* 6**,** 63-128.

ROBINSON, D. E. 2003. Neolithic and Bronze Age Agriculture in Southern Scandinavia – Recent Archaeobotanical Evidence from Denmark. *Environmental Archaeology,* 8**,** 145-165.

ROBINSON, W. S. 1951. A Method for Chronologically Ordenin Archaeological Deposits. *American Antiquity,* 16**,** 293-301.

ROGERS, E. M. 1979. Network analysis of the diffusion of innovations. *In:* HOLLAND, P. W. & LEINHARDT, S. (eds.) *Perspectives on Social Network Research*, Princeton: Centre for Advanced Study, 137-165.

ROGERS, E. M. 2003. *The Diffusion of Innovations (5th edition)*, New York: Free Press.

ROJO GUERRA, M. A. & DEL VAL RECIO, J. 1990. Quintanilla de Abajo. *Numantia,* 3**,** 324-325.

ROJO GUERRA, M. A., GARRIDO PENA, R. & GARCÍA, I. (eds.) 2005. *El Campaniforme en la Península Ibérica y su contexto europeo / Bell Beakers in the Iberian Peninsula and their European context*, Valladolid: Universidad de Valladolid.

ROJO-GUERRA, M. A., GARRIDO-PENA, R., GARCÍA-MARTÍNEZ DE LAGRÁN, Í., JUAN-TRESERRAS, J. & MATAMALA, J. C. 2006. Beer and Bell Beakers: drinking rituals in Copper Age Inner Iberia. *Proceedings of the Prehistoric Society,* 72**,** 243-266.

ROSTHOLM, H. 1986. Lustrup og andre bopladsfund fra Herning-Egnen. *In:* ADAMSEN, C. & EBBESEN, K. (eds.) *Stridsøksetid i Sydskandinavien: beretning fra et symposium 28.-30.X. 1985 i Vejle* (Arkæologiske skrifter 1), København: Forhistorisk Arkæologisk Institut, København Universitet, 301-317.

ROUSSEAU, J. 1996. Site campaniforme de Sauveterre, commune d'Olonne-sur-Mer (Vendée). *Revue Archéologique de l'Ouest,* 13**,** 75-77.

ROUSSOT-LARROQUE, J. 1976. Les civilisations néolithiques en Aquitaine. *La Préhistoire française : les civilisations néolithiques et protohistoriques de la France*, Paris: CNRS, 338-350.

ROUSSOT-LARROQUE, J. 1995. La Sequence Néolithique de la Lède du Gurp et sa Chronologie. *Revue Archéologique de l'Ouest Supplément,* 7**,** 75-87.

ROUSSOT-LARROQUE, J. 2002. Pointes de Palmela trouvées en France: atlantique ou méditerranée? *Pirineus i veïns al 3r mil·leni AC. De la fi del neolític a l'edat del bronze entre l'Ebre i la Garona. XII col·loqui internacional d'arqueologia de Puigcerdà, 10-12 de november del 2000, Puigcerdà*, Puigcerdà: Institut d'Estudis Ceretans, 407-420.

ROUSSOT-LARROQUE, J. & VILLES, A. 1988. Fouilles pré- et protohistoriqes à La Lède du Gurp (Grayan-let-L'Hôpital, Gironde). *Revue Archéologique de Bordeaux,* 79**,** 19-60.

ROUX, V. 1990. The psychological analysis of technical activities: a contribution to the study of craft specialisation. *Archaeological Review from Cambridge,* 9**,** 142-153.

ROUX, V. 2003. A Dynamic Systems Framework for Studying Technological Change: Application to the Emergence of the Potter's Wheel in the Southern Levant. *Journal of Archaeological Method and Theory,* 10, 1-30.

ROUX, V. & COURTY, M.-A. 1998. Identification of Wheel-fashioning Methods: Technological Analysis of 4th-3rd Millennium BC Oriental Ceramics. *Journal of Archaeological Science,* 25, 747-763.

ROVIRA, S., BLASCO, C., RÍOS, P., MONTERO, I. & CHAMÓN FERNÁNDEZ, J. 2011. *La Arqueometalurgia* (Yacimientos calcolíticos con campaniforme de la región de Madrid: nuevos estudios), Madrid: Manero Digital.

ROVIRA, S. & MONTERO RUÍZ, I. 2013. Iberia: Technological development of Prehistoric metallurgy. *In:* BURMEISTER, S., HANSEN, S., KUNST, M. & MÜLLER-SCHEESSEL, N. (eds.) *Metal Matters. Innovative Technologies and Social Change in Prehistory and Antiquity* (Mémoire de la Société Préhistorique Française), Rahden: Verlag Marie Leidorf GmbH, 231-239.

ROWLEY-CONWY, P. A. 1985. The Single Grave (Corded Ware) Economy at Kalvø. *Journal of Danish Archaeology,* 4, 79-86.

RŮŽIČKOVÁ, P. 2009. Bow-Shaped Pendants of the Bell Beaker Culture. *Acta Archaeologica Carpathica,* 44, 37-72.

RYAN, J., BESSE, M. & DESIDERI, J. 2018. Bell Beaker Archers: Warriors or an Ideology? *In:* KLEIJNE, J. P. (ed.) *Think global, act local. Bell Beakers in Europe. Proceedings of the Bell Beaker Workshop Kiel 2017* (Journal of Neolithic Archaeology), Kiel: Christian-Albrechts Universität Kiel.

RYE, O. S. 1981. *Pottery Technology: Principles and reconstruction*, Washington DC: Taraxacum Press.

SACKETT, J. R. 1990. Style and Ethnicity in archaeology: the case for isochrestism. *In:* CONKEY, M. W. & HASTORF, C. A. (eds.) *The Uses of Style in Archaeology* (New Perspectives in Archaeology), Cambridge: Cambridge University Press, 32-43.

SALANOVA, L. 2000. *La question du Campaniforme en France et dans les îles anglo-normandes: productions, chronologie et rôles d'un standard céramique* (Documents Préhistoriques 13), Paris: CTHS.

SALANOVA, L., BRUNET, P., COTTIAUX, R., HAMON, T., LANGRY-FRANÇOIS, F., MARTINEAU, R., POLLONI, A., RENARD, C. & SOHN, M. 2011. Du Néolithique Récent a l'Âge du Bronze dans le Centre Nord de la France: Les étapes de l'evolution chrono-culturelle. *Revue Archéologique de Picardie. Numéro spécial,* 28, 77-101.

SALANOVA, L., PRIETO-MARTÍNEZ, M. P., CLOP-GARCÍA, X., CONVERTINI, F., LANTES-SUÁREZ, O. & MARTÍNEZ-CORTIZAS, A. 2016. What are large-scale Archaeometric programmes for? Bell beaker pottery and societies from the third millennium BC in Western Europe. *Archaeometry,* 58, 722-735.

SALANOVA, L. & TCHÉRÉMISSINOFF, Y. 2011. Conclusion générale. Impact des pratiques funéraires Campaniformes en France. *In:* SALANOVA, L. & TCHÉRÉMISSINOFF, Y. (eds.) *Les sépultures individuelles campaniformes en France* (Gallia Préhistoire supplement 41), Nanterre: CNRS, 195-199.

SALANOVA, L. & TCHÉRÉMISSINOFF, Y. (eds.) 2011. *Les sépultures individuelles campaniformes en France* (Gallia Préhistoire supplement 41), Nanterre: CNRS.

SANGMEISTER, E. 1963. La civilisation du vase Campaniforme. *In:* GIOT, P. R. (ed.) *les Civilisations Atlantiques du Néolithique à l'^age du Fer. Actes du premier Colloque Atlantique, Brest, 11-9-1961*, Rennes: Laboratoire d'Anthropologie Préhistorique, 25-56.

SANGMEISTER, E. 1964. Die Schmalen "Armschutzplatten". *In:* VON USLAR, R. & NARR, K. J. (eds.) *Studien aus Alteuropa I: Kurt Tackenberg zum 65. Geburtstag am 30. Juni 1964*, Köln: Böhlau, 93-122.

SANGMEISTER, E. 1966. Die Datierung des Rückstroms der Glockenbecher und ihre Auswirkung auf die Chronologie der Kupferzeit in Portugal. *Palaeohistoria,* 12, 395-407.

SANGMEISTER, E. 1974. Zwei Neufunde der Glockenbecherkultur in Baden-Württemberg. Ein Beitrag zur Klassifizierung der Armschutzplatten in Mitteleuropa. *Fundberichte aus Baden-Württemberg,* 1, 103-156.

SANGMEISTER, E. & DE LA CRUZ JIMÉNEZ GÓMEZ, M. 1995. *Zambujal. Teil 3: Kupferfunde aus den Grabungen 1964 bis 1973* (Madrider Beiträge 5.3), Mainz: Philipp von Zabern.

SANGMEISTER, E. & SCHUBART, H. 1972. Zambujal. *Antiquity,* 46, 191-197.

SANTOS, N. C. 1994. Notícia sobre o sítio calcolítico de Casal de Gaitadas (Loures). *V Jornadas Arqueológicas*, Lisboa: Associação dos Arqueólogos Portugueses, 163-173.

SARAUW, T. 2006. *Bejsebakken. Late Neolithic Houses and Settlement Structure*, Copenhagen: Det Kongelige Danske Videnskabernes Selskab.

SARAUW, T. 2006. Bejsebakken: a Bell Beaker site in northern Jutland. *In:* HERVA, V.-P. (ed.) *People, Material Culture and Environment in the North: Proccedings of the 22nd Nordic Archaeological Conference University of Oulu, 18-23 August 2004*, Oulu: University of Oulu, 338-347.

SARAUW, T. 2007. On the Outskirts of the European Bell Beaker Phenomenon – the Danish Case. *jungsteinSITE.de*.

SARAUW, T. 2008. Danish Bell Beaker Pottery and Flint Daggers – the Display of Social Identities? *European Journal of Archaeology,* 11, 23-47.

SAVORY, H. N. 1984. Um corte através da fortificação interior do castro calcolítico de Vila Nova de S. Pedro, Santarém (1959). *Clio Arqueologia,* 1, 19-29.

SCHARL, S. 2016. Patterns of Innovation Transfer and the Spread of Copper Metallurgy to Central Europe. *European Journal of Archaeology*, 1-30.

SCHIFFER, M. B. 2003. Comments II: Properties, performance characteristics and behavioural theory in the study of technology. *Archaeometry,* 45, 163-183.

SCHINDLER, R. 1955. Die entdeckung zweier jungsteinzeitlicher Wohnplätze unter dem Marschschlick im Vorgelände der Boberger Dünen und ihre Bedeutung für die Steinzeitforschung Nordwestdeutschlands. *Hammaburg,* 9-10, 1-17.

SCHINDLER, R. 1960. *Die Bodenaltertümer der Freien und Hansestadt Hamburg* (Veröffentlichungen des Museums für Hamburgische Geschichte, Abteilung Bodendenkmalpflege 1), Hamburg: Christians.

SCHIRNIG, H. 1972. Brandbestattungen in einem Riesenbecher bei Ripdorf, Kreis Uelzen. *Neue Ausgrabungen und Forschungen in Niedersachsen,* 7, 60-68.

SCHIRREN, C. M. 1997. Neue Funde des Spätneolithikums aus Mecklenburg und Vorpommern. *Archäologische Berichte aus Mecklenburg-Vorpommern,* 4, 29-36.

SCHLICHT, E. 1959. Bentheimer Becher. *Jahrbuch des Heimatvereins der Grafschaft Bentheim,* 49, 198-202.

SCHMIDT, H. 1913. Zur vorgeschichte Spaniens. *Zeitschrift für Ethnologie,* 45, 238-253.

SCHMIDT-THIELBEER, E. 1955. Ein Friedhof der frühen Bronzezeit bei Nohra, Kr. Nordhausen. *Jahresschrift für Mitteldeutsche Vorgeschichte,* 39, 93-114.

SCHOKNECHT, U. 1988. Kurze Fundberichte 1986. *Bodendenkmalpflege in Mecklenburg Jahrbuch,* 1987, 35, 326.

SCHONEVELD, J. & GEHASSE, E. F. 2001. *Archeologie in de Betuweroute: Boog C-Noord, een vindplaats bij Meteren op de overgang van Neolithicum naar Bronstijd* (Rapportage Archeologische Monumentenzorg 84), Amersfoort: ROB.

SCHONEVELD, J. & KRANENDONK, P. 2002. *Archeologie in de Betuweroute: Drie erven uit de Midden-Bronstijd bij Lienden* (Rapportage Archeologische Monumentenzorg 89), Amersfoort: ROB.

SCHRANIL, J. 1928. *Die Vorgeschichte Böhmens und Mährens*, Berlin: Walter de Gruyter.

SCHREURS, J. (ed.) 2008. *Vindplaats(en) van de trechterbekercultuur te Oostrum (gemeente Dongeradeel, Friesland). De resultaten van het waarderend archeologisch onderzoek te Oostrum-Terplaene en Oostrum-Mellemawei in 2006 en 2007* (Rapportage Archeologische Monumentenzorg 164), Amersfoort: RACM.

SCHREURS, J. 2016. Haelen-Napoleonsweg: vondstenrijk, maar sporenarm. *In:* AMKREUTZ, L. W. S. W., BROUNEN, F. T. S., DEEBEN, J. H. C., MACHIELS, R., VAN OORSOUW, M. F. & SMIT, B. I. (eds.) *Vuursteen verzameld. Over het zoeken en onderzoeken van steentijdvondsten en -vindplaatsen* (Nederlandse Archeologische Rapporten 50), Amersfoort: Rijksdienst voor het Cultureel Erfgoed, 385-390.

SCHROLLER, H. 1933. Die Untersuchung eines Hügelgrabes bei Neerstedt, Gem. Dötlingen (Amt Wildeshausen). *Oldenburger Jahrbuch,* 37, 105-120.

SCHUBART, H. 1965. As duas fases de ocipação do túmulo de cúpula do Monte Outeiro, nos arredores de Aljustrel. *Revista de Guimarães,* 75, 195-204.

SCHUBART, H., DA VEIGA FERREIRA, O. & MONTEIRO, J. A. 1969. A fortificação eneolítica da Columbeira – Bombarral. *O Arqueológo Português,* III, 20-32.

SCHUHMACHER, T. X. 2014. Dancing in the Dark? The westernmost "Cypriot" knot-headed pin from Aïn Smene (Morocco). *Cuadernos de Prehistoria y Arqueología Universidad Autónoma de Madrid,* 40, 41-50.

SCHUHMACHER, T. X. 2017. Ivory Exchange Networks in the Chalcolithic of the Western Mediterranean. *In:* BARTELHEIM, M., BUENO RAMÍREZ, P. & KUNST, M. (eds.) *Key Resources and Socio-Cultural Developments in the Iberian Chalcolithic* (RessourcenKulturen Band 6), Tübingen: Tübingen Library Publishing, 291-312.

SCHULDT, E. 1966. Vier Großsteingräber von Serrahn, Kreis Güstrow. *Bodendenkmalpflege in Mecklenburg Jahrbuch,* 1965, 24-53.

SCHULDT, E. 1974. Die steinzeitliche Inselsiedlung im Malchiner See bei Basedow, Kreis Malchin. *Bodendenkmalpflege in Mecklenburg Jahrbuch,* 1973, 7-65.

SCHÜLE, W. & PELLICER CATALAN, M. 1966. *El Cerro de La Virgen, Orce (Granada I)* (Excavaciones Arqueológicas en España 46), Madrid: Servicio Nacional de Excavaciones Arqueológicas.

SCHUTE, I. A. 2009. *Plangebied fietspad N225. Gemeente Rhenen. Archeologisch vooronderzoek: een inventariserend veldonderzoek (kartering en waardering)* (RAAP Rapport 1864), Weesp: RAAP Archeologisch Adviesbureau.

SCHUTE, I. A. & HEUNKS, E. 1997. *Gemeente Nijmegen, de Waalsprong: archeologisch onderzoek, fase A/B, deel 4* (RAAP Rapport 242), Weesp: RAAP Archeologisch Adviesbureau.

SCHUURMAN, E. I. 2011. *Plangebied Zilverzandtracé te Holten Gemeente Rijssen-Holten Inventariserend veldonderzoek (proefsleuven) en opgraving* (RAAP Rapport 2271), Weesp: RAAP Archeologisch Adviesbureau.

SCHWABEDISSEN, H. 1953. Moorsiedlung Heidmoor, Gem. Berlin, Kr. Segeberg. *Germania,* 31, 231-232.

SCHWABEDISSEN, H. 1953. Moorsiedlung Oldesloe-Wolkenwehe, Kr. Stormarn. *Germania,* 31, 230-231.

SCHWABEDISSEN, H. 1955. Siedlung Heidmoor, Gem. Berlin, Kr. Segeberg. *Germania,* 33, 256-258.

SCHWABEDISSEN, H. 1958. Untersuchung mesolithisch-neolithischer Moorsiedlungen in Schleswig-Holstein. *In:* KRAMER, W. (ed.) *Neue Ausgrabungen in Deutschland*, Berlin: Gebr. Mann, 26-42.

SCHWABEDISSEN, H. & MÜNNICH, K. O. 1958. Zur Anwendung der C 14-Datierung und anderer naturwissenschaftlicher Hilfsmittel in der Ur- und Frühgeschichtsforschung. *Germania,* 36, 133-149.

SCHWANTES, G. 1936. Der neolithische Urnenfriedhof von Sande. *In:* SCHWANTES, G. (ed.) *Festschrift zur Hundertjahrfeier des Museums vorgeschichtlicher Altertümer in Kiel*, Neumünster: Wachholtz, 79-92.

SCHWARZ, M. 2008. *Studien zur Sozialstruktur der Glockenbecherkultur* (Saarbrücker Beiträge zur Altertumskunde 85), Bonn: Verlag Dr. Rudolf Habelt GmbH.

SCHWARZBERG, H. 1994. Schönfelder Kultur. *In:* BEIER, H.-J. & EINICKE, R. (eds.) *Das Neolithikum im Mittelelbe-Saale-Gebiet und in der Altmark. Eine Übersicht und ein Abriß zum Stand der Forschung* (Beiträge zur Ur- und Frühgeschichte Mitteleuropas Band 4), Wilkau-Hasslau, 243-255.

SCHWEEN, J. 1995. … warum die Einzelgrableute von Lohbrügge-Sande ihre Toten verbrannten. *Lichwark Heft,* 60, 26-30.

SCHWEEN, J. 2002. Eine neolithische Siedlung mit Funden der Trichterbecherkultur, Schönfelder Kultur und Einzelgrabkultur/Glockenbecherkultur am Schiffwasser in Hamburg-Bergedorf (Fpl. 18, 71, 72, 73). *Hammaburg,* 13, 31-49.

SEREGÉLY, T. 2008. *Endneolithische Siedlungsstrukturen in Oberfranken I* (Universitätsforschungen zur Prähistorischen Archäologie 154), Bonn: Verlag Dr. Rudolf Habelt GmbH.

SERGANT, J. 2009. Een tweede vindplaats van de Deûle-Escaut groep in de Vlaamse Zandstreek. De site van Hertsberge – *Papenvijvers 3* (gem. Oostkamp, West-Vlaanderen, België). *Notae Praehistoricae,* 29, 93-99.

SERGANT, J. 2010. De finaal-neolithische(?) vindplaats van Hertsberge 'Papenvijvers 3' (West-Vlaanderen, België): opgravingscampagne 2010. *Notae Praehistoricae,* 30, 81-85.

SERGANT, J. & CROMBÉ, P. 2001. Steentijdvondsten uit de monding van de Rupel te Wintam. *VOBOV-info,* 54, 5-15.

SHENNAN, S. J. 1989. Introduction: archaeological approaches to cultural identity. *In:* SHENNAN, S. J. (ed.) *Archaeological approaches to cultural identity* (New World Archaeology 10), London/New York: Routledge, 1-32.

SHENNAN, S. J. 2000. Population, Culture History, and the Dynamics of Culture Change. *Current Anthropology,* 41, 811-835.

SHERIDAN, J. A. 2013. Plus ça change…? Developments in Shetland, c 2500-1800 BC. *In:* MAHLER, D. L. (ed.) *The Border of Farming. Shetland and Scandinavia, Neolithic and Bronze Age Farming. Papers from the symposium in Copenhagen, September 19th to the 21st 2012*, Copenhagen: The National Museum of Denmark, 47-72.

SHERRATT, A. G. 1987. Cups that Cheered: The Introduction of Alcohol to Prehistoric Europe. *In:* WALDREN, W. & KENNARD, R. C. (eds.) *Bell Beakers of the Western Mediterranean* (British Archaeological Reports: International Series 331), Oxford: Archaeopress, 81-114.

SHERRATT, A. G. 1993. What would a Bronze-Age world system look like? Relations between temperate Europe and the Mediterranean in Later Prehistory. *Journal of European Archaeology,* 1, 1-57.

SIEMANN, C. 2003. *Flintdolche Norddeutschlands in ihrem grabrituellen Umfeld* (Universitätsforschungen zur prähistorischen Archäologie 97), Bonn: Verlag Dr. Rudolf Habelt GmbH.

SIEMONS, H. A. R. & BULTEN, E. E. B. 2014. *Archeologie in het Wateringse Veld, gemeente Den Haag. Van steentijd tot nieuwe tijd* (Haagse Oudheidkundige Publicaties 17), Den Haag: Gemeente Den Haag.

SIER, M. M. & SMITS, E. 1998. *Aanvullend Archeologisch Onderzoek in het tracé van de Betuweroute, vindplaats 36/37 Dodewaard/Viaduct Dalwagen-Zuid en Dalwagen-Zuid* (Rapportage Archeologische Monumentenzorg 34), Amersfoort: ROB.

SIMÓN GARCÍA, J. L. 1998. *La metalurgia prehistórica en el País valenciano* (Trabajos Varios del Servicio de Investigaciones Prehistoricas), Valencia: Museu de Prehistòria de València.

SIMONSEN, J. 1983. A Late Neolithic House Site at Tastum, Northwestern Jutland. *Journal of Danish Archaeology,* 2, 81-89.

SIMONSEN, J. 1986. Nogle Nordvestjyske bopladsfund fra Nekeltgravskulturen og dese topografi. *In:* ADAMSEN, C. & EBBESEN, K. (eds.) *Stridsøksetid i Sydskandi-*

navien: beretning fra et symposium 28.-30.X. 1985 i Vejle, København: Forhistorisk arkœologisk institut, 292-300.

SIMONSEN, J. 1986. Settlements from the Single Grave Culture in NW-Jutland. A Preliminary Survey. *Journal of Danish Archaeology,* 5, 135-151.

SIMPSON, D. D. A. 1971. Beaker houses and settlements in Britain. *In:* SIMPSON, D. D. A. (ed.) *Economy and Settlement in Neolithic and Early Bronze Age Britain and Europe. Papers Delivered at a Conference Held in the University of Leicester, December 1969*, Leicester: Leicester University Press, 131-152.

SIMPSON, D. D. A. 2004. Making an Impression: Beaker combs. *In:* CLEAL, R. M. J. & POLLARD, J. (eds.) *Monuments and Material Culture, papers in honour of an Avebury archaeologist: Isobel Smith*, Salisbury: Hobnob Press, 207-214.

SIMS, D. W., SOUTHALL, E. J., HUMPHRIES, N. E., HAYS, G. C., BRADSHAW, C.J.A., PITCHFORD, J. W., JAMES, A., AHMED, M. Z., BRIERLEY, A. S., HINDELL, M. A., MORRITT, D., MUSYL, M. K., RIGHTON, D., SHEPARD, E. L. C., WEARMOUTH, V. J., WILSON, R. P., WITT, M. J. & METCALFE, J. D. 2008. Scaling laws of marine predator search behaviour. *Nature,* 451, 1098-1103.

SKJØLSVOLD, A. 1973. Slettabø i Ogna. Foreløpig orientering om en boplass med bosetning fra yngre steinalder og bronsealdet. *Viking,* 36, 5-82.

SKJØLSVOLD, A. 1977. *Slettabøboplassen. Et bidrag til diskusjonen om forholdet mellom fangstog bondesamfunnet i yngre steinalder og bronsealder.* (Skrifter 2), Stavanger: Arkeologisk Museum i Stavanger.

SKOUSEN, H. 1998. Rønberg Strandvolde – en kystboplads ved Limfjorden. *Kuml,* 1997-1998, 29-73.

SKOV, T. 1977. En hustomt med klokkebægerkeramik fra Stendis. *Holstebro Museums Årsskrift,* 1977, 39-50.

SKOV, T. 1982. A Late Neolithic House Site with Bell Beaker Pottery at Stendis, Northwestern Jutland. *Journal of Danish Archaeology,* 1, 39-44.

SMIT, B. I. 2010. *Valuable Flints. Research strategies for the study of early prehistoric remains from the pleistocene soils of the Northern Netherlands* (Groningen Archaeological Studies 11), Groningen: Groningen University.

SMIT, B. I. & BRINKKEMPER, O. 2012. *Boren in het Boornedal. Onderzoeksgebied Oldeboorn, gemeente Boarnsterhim. Een geo-archeologisch onderzoek* (Rapportage Archeologische Monumentenzorg 208), Amersfoort: ROB.

SMIT, B. I., BRINKKEMPER, O., KLEIJNE, J. P., LAUWERIER, R. C. G. M. & THEUNISSEN, E. M. (eds.) 2012. *A Kaleidoscope of Gathering at Keinsmerbrug (the Netherlands). Late Neolithic Behavioural Variability in a Dynamic Landscape* (Nederlandse Archeologische Rapporten 43), Amersfoort: Rijksdienst voor het Cultureel Erfgoed.

SOARES, J., BARBIERI, N. & TAVARES DA SILVA, C. 1972. Povoado Calcolítico do Moinho da Fonte do Sol (Quinta do Anjo – Palmela). *Arqueología e História,* IV, 235-268.

SOARES, J. & TAVARES DA SILVA, C. 1975. Ocupação pré-histórica do Pedrão e o Calcolítico da região de Setúbal. *Setúbal Arqueológica,* 1, 53-154.

SOARES, J. & TAVARES DA SILVA, C. 1977. O Grupo de Palmela. No quadro da cerâmica campaniforme em Portugal. *O Arqueológo Português,* III, 101-112.

SOBIERAJ, J. 2003. Reception of some Bell Beakers' Cultural Patterns by Corded Ware Societies in Southeastern Baltic Area. *In:* CZEBRESZUK, J. & SZMYT, M. (eds.) *The Northeast Frontier of Bell Beakers. Proceedings of the symposium held at the Adam Mickiewicz University, Poznań (Poland), May 26-29 2002* (British Archaeological Reports: International Series 1155), Oxford: Archaeopress, 117-122.

SOUSA, A. C. 1998. *O Neolítico final e o Calcolítico na área da Ribeira de Cheleiros* (Trabalhos de Arqueológia 11), Lisboa: Instituto Português de Arqueológia.

SOUVILLE, G. 1965. Influences de la Péninsule Ibérique sur les Civilisations post-Néolithiques du Maroc. *In Memoriam: Do Abade Henri Breuil* (Revista da Faculdade de Letras de Lisboa III Ser. 10), Lisboa: Universidad de Lisboa, 409-422.

SPANJER, M. 1998. *Aanvullend Archeologisch Onderzoek in het tracé van de Betuweroute, vindplaats 35 Dodewaard/Dalwagen-Noord* (Rapportage Archeologische Monumentenzorg 21), Amersfoort: ROB.

SPINDLER, K. 1969. Die Kupferzeitliche Siedlung von Penedo/Portugal. *Madrider Mitteilungen,* 10, 45-116.

SPINDLER, K. 1971. Eine Kupferzeitliche Siedlung von Pico Agudo/Portugal. *Madrider Mitteilungen,* 12, 51-71.

SPINDLER, K. 1976. Die neolithische Parede-Gruppe in Mittelportugal. *Madrider Mitteilungen,* 17, 21-75.

SPINDLER, K. 1981. *Cova da Moura. Die Besiedlung des Atlantischen Küstengebietes Mittelportugals vom Neolithikum bis na das Ende der Bronzezeit* (Madrider Beiträge 7), Mainz: Philipp von Zabern.

SPINDLER, K. & GALLAY, G. 1972. Die Tholos von Pai Mogo/Portugal. *Madrider Mitteilungen,* 13, 38-108.

SPINDLER, K. & GALLAY, G. 1973. *Kupferzeitliche Siedlung und Begräbnisstätten von Matacães in Portugal* (Madrider Beiträge 1), Mainz: Philipp von Zabern.

STAMPFUß, R. 1929. *Die jungneolithischen Kulturen in Westdeutschland*, Bonn: L. Röhrscheid.

STAMPFUß, R. 1940. Nordische Siedlungskeramik am Niederrhein. *Mannus,* 32, 115-130.

STAMPFUß, R. 1963. Hünxe, Kr. Dinslaken. *Bonner Jahrbücher,* 163, 504-507.

STAMPFUß, R. 1974. Riesenbecherfunde des Spätneolithikums und der frühen Bronzezeit von der Wittenhorst, Gemeinde Haldern, Kr. Rees. *Ausgrabungen am Niederrhein,* Bonn, 9-39.

STANGE, H. 1978. Funde der Oberschnurkeramik aus Plöwen, Kr. Pasewalle. *Ausgrabungen und Funde,* 23, 123-127.

STEAD, I. M., FLOUEST, J.-L. & RIGBY, V. 2006. *Iron Age and Roman burials in Champagne*, Oxford: Oxbow Books.

STEGEN, K. 1954. Der nordwestdeutsche Riesenbecher der jüngeren Steinzeit. *Germania,* 32, 269-284.

STENBERGER, M. 1960. Östlicher Einfluss in der schwedischen Wohnplatzkultur der jüngeren Steinzeit. *Swiatowit,* 23, 201-217.

STENBERGER, M., DAHR, E. & MUNTHE, H. 1943. *Das Grabfeld von Västerbjers auf Gotland* (Numrerade monografier 1), Stockholm: Wahlström & Widstrand.

STIEREN, A. 1929. Westfalen/Neolithikum und ältere Bronzezeit. *In:* EBERT, M. (ed.) *Reallexikon der Vorgeschichte 14*, Berlin, 285-295.

STOKKEL, P. J. A. 2014. *Steynhof Gemeente Den Haag Inventariserend veldonderzoek-proefsleuven en archeologische begeleiding. Vondsten en sporen uit het neolithicum.* (Haagse Archeologische Rapportage 1225), Den Haag: Gemeente Den Haag.

STRAHL, E. 1990. *Des Endneolithikum im Elb-Weser-Dreieck* (Veröffentlichungen der archäologischen Sammlungen des Landesmuseums Hannover 36), Hannover: Landesmuseum Hannover.

STRAHM, C. 1982. Zu den Begriffen Chalkolithikum und Metallikum. *Il passaggio dal neolitico all'età del bronzo nell'Europa centrale e nella regione alpina. Problemi cronologici e terminologici. Atti del X Simposio internazionale sulla fine del neolitico e gli inizi dell'età del bronzo in Europa, Lazise – Verona 8-12 aprile 1980*, Verona, 13-26.

STRAHM, C. 2004. Das Glockenbecher-Phänomen aus der Sicht der Komplementär-Keramik. *In:* CZEBRESZUK, J. (ed.) *Similar but different. Bell beakers in Europe*, Poznań: Adam Mickiewicz University, 101-126.

STRAHM, C. 2004. Le phénomène campaniforme et les composantes autochtones non campaniformes. *Bulletin de la Société Préhistorique Française,* 101, 201-206.

STRAHM, C. 2007. L'introduction de métallurgie en Europe. *In:* GUILAINE, J. (ed.) *Le Chalcolithique et la construction des inégalités*, Paris: Errance, 47-72.

STRÖMBERG, M. 1968. Ett senneolitiskt grophus i Valleberga. *Ale,* 1968**,** 1-15.

STRUVE, K. W. 1955. *Die Einzelgrabkultur in Schleswig-Holstein und ihre kontinentalen Beziehungen* (Vor- und frühgeschichtliche Untersuchungen aus dem Schleswig-Holsteinischen Landesmuseum fürf Vor- und Frühgeschichte in Schleswig und dem Institut für Ur- und Frühgeschichte der Universität Kiel Neue Folge 11), Neumünster: Karl Wachholtz.

ŠTURMS, E. 1970. *Die Steinzeitlichen Kulturen des Baltikums* (Antiquitas Reihe 3 Band 9), Bonn: Kabelt.

ŠUMBEROVÁ, R., MALYKOVÁ, D., VEPREKOVÁ, J. & PECINOVSKÁ, M. 2010. Sídelní aglomerace v prostoru dnešního Kolína. Záchranný výzkum v trase obchvatu města. *Archeologické rozhledy,* 62**,** 661-679.

SZÉCSÉNYI-NAGY, A., ROTH, C., BRANDT, G., RIHUETE-HERRADA, C., TEJEDOR-RODRIGUEZ, C., HELD, P., GARCIA-MARTINEZ-DE-LAGRAN, I., ARCUSA MAGALLON, H., ZESCH, S., KNIPPER, C., BANFFY, E., FRIEDRICH, S., MELLER, H., BUENO-RAMIREZ, P., BARROSO BERMEJO, R., DE BALBIN BEHRMANN, R., HERRERO-CORAL, A. M., FLORES FERNANDEZ, R., ALONSO FERNANDEZ, C., JIMENEZ ECHEVARRIA, J., RINDLISBACHER, L., OLIART, C., FREGEIRO, M.-I., SORIANO, I., VINCENTE, O., MICO, R., LULL, V., SOLER DIAZ, J., LOPEZ PADILLA, J. A., ROCA DE TOGORES MUNOZ, C., HERNANDEZ PEREZ, M. S., JOVER MAESTRE, F. J., LOMBA MAURANDI, J., AVILES FERNANDEZ, A., LILLIOS, K. T., SILVA, A. M., MAGALHAES RAMALHO, M., OOSTERBEEK, L. M., CUNHA, C., WATERMAN, A. J., ROIG BUXO, J., MARTINEZ, A., PONCE MARTINEZ, J., HUNT ORTIZ, M., MEJIAS-GRACIA, J. C., PECERO ESPIN, J. C., CRUZ-AUNON BRIONES, R., TOME, T., CARMONA BALLESTERO, E., CARDOSO, J. L., ARAUJO, A. C., LIESAU VON LETTOW-VORBECK, C., BLASCO BOSQUED, C., RIOS MENDOZA, P., PUJANTE, A., ROYO-GUILLEN, J. I., ESQUEMBRE BEVIA, M. A., DOS SANTOS GONCALVES, V. M., PARREIRA, R., MORAN HERNANDEZ, E., MENDEZ IZQUIERDO, E., VEGA DE MIGUEL, J., MENDUINA GARCIA, R., MARTINEZ CALVO, V., LOPEZ JIMENEZ, O., KRAUSE, J., PICHLER, S. L., GARRIDO-PENA, R., KUNST, M., RISCH, R., ROJO-GUERRA, M. A., HAAK, W. & ALT, K. W. 2017. The maternal genetic make-up of the Iberian Peninsula between the Neolithic and the Early Bronze Age. *Nature Scientific Reports,* 7**,** 15644.

TALON, M., BERNARD, V., BILLAND, G., COTTIAUX, R., PASTRE, J. F., PERNAUD, J. M. & PROST, D. C. 1995. Le niveau organique du Néolithique récent du site stratifié de la «Station d'Epuration» à La Croix-Saint-Ouen (Oise). *Revue Archéologique de Picardie. Numéro spécial***,** 83-103.

TAVARES DA SILVA, C. 1971. O povoado pré-histórico da Rotura. Notas sobre a cerâmica. *Actas do II Congresso Nacional de Arqueoiogia*, Lisboa, 175-192.

TCHÉRÉMISSINOFF, Y. 2006. *Les sépultures simples et plurielles du Campaniforme et du Bronze ancien dans le Bassin rhodanien et ses zones d'influences* (British Archaeological Reports: International Series 1531), Oxford: BAR Publishing.

TEMPEL, W. D. 1978. Bericht über die Ausgrabung des Megalithgrabes I in Ostenwalde, Gemeinde Werlte, Kreis Aschendorf-Hümmling. *Neue Ausgrabungen und Forschungen in Niedersachsen,* 12**,** 1-31.

TEN ANSCHER, T. J. 2012. *Leven met de Vecht. Schokland-P14 en de Noordoostpolder in het Neolithicum en de Bronstijd*, Zutphen: Wöhrmann Print Service.

TEN ANSCHER, T. J. 2014. *Bureaustudie ten behoeve van de instandhouding van de archeologische waarden in het werelderfgoedgebied Schokland, kavels E170/E171, gemeente Noordoostpolder* (RAAP Rapport 2713), Weesp: RAAP Archeologisch Adviesbureau.

TEN ANSCHER, T. J. & BOSMAN, W. J. 2010. Vlaardingen- en Enkelgrafcultuur in Velserbroek, gemeente Velsen. *In:* VERHART, L. B. M. & DE RIDDER, T. (eds.) *Vlaardingen-cultuur* (Westerheem Special 2), Eindhoven: AWN, 172-179.

TEN ANSCHER, T. J. & VAN DER ROEST, J. 1997. *Aanvullend Archeologisch Onderzoek in het tracé van de Betuweroute, vindplaats 21 Valburg Zettense Veld-West* (Rapportage Archeologische Monumentenzorg 12), Amersfoort: ROB.

TEUBNER, B. & TUIJN, W. 2010. Vlaardingen-cultuur in Wijchen en omgeving. *In:* VERHART, L. B. M. & DE RIDDER, T. (eds.) *Vlaardingen-cultuur* (Westerheem Special 2), Eindhoven: AWN, 180-185.

THANOS, C. S. I. 1995. *Een Late Bekernederzetting in het Hollands Veengebied. Een intersite-analyse van de late beker- en bronstijd bewoning te Molenaarsgraaf, Ottoland-Kromme Elleboog en Ottoland-Oosteind.* MA Thesis, Leiden University.

THEUNISSEN, E. M. 1993. Once again Toterfout-Halve Mijl. *Analecta Praehistorica Leidensia,* 26**,** 29-43.

THEUNISSEN, E. M., BRINKKEMPER, O., LAUWERIER, R. C. G. M., SMIT, B. I. & VAN DER JAGT, I. M. M. 2014. *A Mosaic of Habitation at Zeewijk (the Netherlands). Late Neolithic Behavioural Variability in a Dynamic Landscape* (Nederlandse Archeologische Rapporten 47), Amersfoort: Rijksdienst voor het Cultureel Erfgoed.

THEUNISSEN, E. M. & DE KORT, J. W. 2009. *Een potbeker langs de Fliert. Over een toevalsvondst van een kuil met een hamerbijl en potbekerscherven aan het Buddezand te Twello (gemeente Voorst, Gelderland)* (Rapportage Archeologische Monumentenzorg 179), Amersfoort: Rijksdienst voor het Cultureel Erfgoed.

THOMAS, N. 1991. *Entangled Objects: Exchange, Material Culture, and Colonialism in the Pacific* Cambridge: Harvard University Press.

THORVILDSEN, K. 1939. Dobbeltjættestuen paa Kyndeløse mark. *Fra Nationalmuseets Arbejdsmark,* 1939**,** 19-28.

THOUVENOT, S., ALLARD, P., COTTIAUX, R., MARTINEAU, R. & MONCHABLON, C. 2014. Le site d'habitat du Néolithique Récent de Presles-et-Boves, Les Bois-Plantés (Aisne). *In:* COTTIAUX, R. & SALANOVA, L. (eds.) *La Fin du IVe Millénaire dans le Bassin Parisien. le Néolithique Récent entre Seine, Oise et Marne (3500-2900 avant notre ère)* (Revue Archéologique de l'Est supplement 34), Dijon/Paris: Société Archéologique de l'Est, 27-92.

THURNAM, J. 1872. On Ancient British Barrows, especially those of Wiltshire and the adjoining counties (Part II: Round Barrows). *Archaeologia,* 43**,** 285-544.

TICHELMAN, G. 2005. *Archeologisch Onderzoek in het kader van De Maaswerken: Inventariserend Veldonderzoek (IVO), waarderende fase Well-Aijen* (ADC Rapport 404), Amersfoort: ADC Archeoprojecten.

TICHELMAN, G. 2006. *Het villacomplex Kerkrade-Holzkuil* (ADC Rapport 155), Amersfoort: ADC Archeoprojecten.

TILANDER, I. 1963. A Late Neolithic Settlement in Furulund, Scania. *Meddelanden från Lunds Universitets Historiska Museum,* 1962-1963**,** 123-135.

TIMPSON, A., COLLEDGE, S., CREMA, E. R., EDINBOROUGH, K., KERIG, T., MANNING, K., THOMAS, M. G. & SHENNAN, S. J. 2014. Reconstructing regional population fluctuations in the European Neolithic using radiocarbon dates: a new case-study using an improved method. *Journal of Archaeological Science,* 52**,** 549-557.

TIPPING, R. 1994. "Ritual" Floral Tributes in the Scottish Bronze Age – Palynological Evidence. *Journal of Archaeological Science,* 21**,** 133-139.

TITE, M. S., KILIKOGLOU, V. & VEKENIS, G. 2001. Review Article: Strength, Toughness and Thermal Shock Resistance of Ancient Ceramics, and their Influence on Technological Choice. *Archaeometry,* 43**,** 301-324.

TKÁČ, P. 2012. *Osídlenie lokality Olomouc-Slavonín „Horní lán" v neskorom eneolite.* MA Thesis, Masarykova univerzita.

TOCIK, A. & BUDINSKY-KRICKA, V. 1987. Z archeologických zbierok na Slovensku. *Zbornik Slovenského Národného Múzea,* LXXXI Historia 27**,** 63-93.

TOCIK, A. & LICHARDUS, J. 1964. Neolitická jama vo Výčapoch Opatovciach. *Památky archeologické,* 55**,** 246-278.

TOUSSAINT, M. & BECKER, A. 1994. Une sépulture du Michelsberg: le Trou de la Heid à Comblain-au-Pont (Province de Liège, Belgique). *Bulletin de la Société Préhistorique Française,* 91**,** 77-84.

TREINEN, F. 1970. Les Poteries Campaniformes en France I: Typologie des poteries campaniformes françaises. *Gallia Préhistoire,* 13**,** 53-107.

TREINEN, F. 1970. Les Poteries Campaniformes en France II: Groupes géographiques et éléments culturels campaniformes. *Gallia Préhistoire,* 13**,** 263-332.

TRIMPE BURGER, J. A. 1977. Brabers bij Haamstede, een opgraving 1956-1957. *Kroniek van het Land van de Zeemeermin (Schouwen-Duiveland),* 2**,** 40.

TUREK, J. 1993. *Osídlení z oboobí zvoncovitých pohárů v povodí řeky bíliny v severozápaoních Čechách.* MA Thesis, Univerzita Karlova.

TUREK, J. 1995. Nálezy období zvoncovitých pohárů v povodí řeky Bíliny v severozápadních Čechach. *In:* BLAŽEK, J. & MEDUNA, P. (eds.) *Archeologické výzkumy v severozápadních Čechách*, Praha: Ústav Archeologické Památkové Péče Severozápadních Čech, 123-134.

TUREK, J. 1995. Sídlištní nálezy kultury se šňůrovou keramikou v Čechách. *Archeologické rozhledy,* 47**,** 91-101.

TUREK, J. 1996. Osídlení Pražské kotliny v závěru eneolitu. Nástin problematiky období zvoncovitých pohárů. *Archaeologica Pragensia,* 12**,** 5-58.

TUREK, J. 2012. Origin of the Bell Beaker phenomenon. The Moroccan connection. *In:* FOKKENS, H. & NICOLIS, F. (eds.) *Background to Beakers. Inquiries into regional cultural backgrounds to the Bell Beaker complex*, Leiden: Sidestone Press, 191-203.

TUREK, J. 2013. The Bell Beaker culture. *In:* NEUSTUPNÝ, E. (ed.) *The Eneolithic* (3), Praha: Archeologický ústav AV ČR, 154-178.

TUREK, J., DVOŘÁK, P. & PEŠKA, J. 2003. Archaeology of Beaker Settlements in Bohemia and Moravia. An Outline of the Current State of Knowledge. *In:* CZEBRESZUK, J. & SZMYT, M. (eds.) *The Northeast Frontier of Bell Beakers. Proceedings of the symposium held at the Adam Mickiewicz University, Poznań (Poland), May 26-29 2002* (British Archaeological Reports: International Series 1155), Oxford: Archaeopress, 183-208.

TUREK, J. & PEŠKA, J. 2001. Bell Beaker settlement pattern in Bohemia and Moravia. *In:* NICOLIS, F. (ed.) *Bell beakers today. Pottery, people, culture, symbols in prehistoric Europe. Proceedings of the International Colloquium Riva del Garda (Trento, Italy), 11-16 May 1998*, Trento: Provincia autonoma di Trento, Servizio beniculturali, Ufficio beni archeologici, 411-428.

UENZE, S. V. O. 1961. Neue Riesenbecher aus Nordhessen. *Fundberichte aus Hessen,* 1**,** 1-9.

UERPMANN, H.-P. 1995. Domestication of the Horse – When, Where, and Why? *Le cheval et les autres équides: aspects de l'histoire de leur insertion dans les activités humaines* (Colloques d'histoire des connaissances zoologiques 6), Liège: Université de Liège, 15-20.

UERPMANN, H.-P. & UERPMANN, M. 2003. *Zambujal. Teil 4: Die Stein- und Beinartefakte aus den Grabungen 1964 bis 1973* (Madrider Beiträge 5.4), Mainz: Philipp von Zabern.

UFKES, A. 1990. Een bijzondere scherf uit Kolhorn (N.-H.). *Paleo-Aktueel,* 2**,** 30-33.

UFKES, A. 2005. *Een nederzetting uit de Vroege Bronstijd te Tiel-Medel. Een archeologische opgraving te Tiel-Medel 'Oude Weiden', vindplaats 5, gemeente Tiel (Gld.)* (ARC Rapport 124), Groningen: ARC.

ULLRICH, M. 2008. *Endneolithische Siedlungskeramik aus Egersheim, Mittelfranken. Untersuchungen zur Chronologie von Schnurkeramik- und Glockenbechern an Rhein, Main und Neckar* (Universitätsforschungen zur Prähistorischen Archäologie 160), Bonn: Verlag Dr. Rudolf Habelt GmbH.

VAARS, J. P. L. 2004. *Archeologische opgravingen aan de Hoogdorperweg te Heemskerk* (Hollandia Reeks 24), Zaandijk: Hollandia.

VALAMOTI, S.-M. 2016. Millet, the late comer: on the tracks of Panicum miliaceum in prehistoric Greece. *Archaeological and Anthropological Sciences,* 8**,** 51-63.

VAN AMERONGEN, Y. F. 2016. *Wild West Frisia. The Role of Domestic and Wild Resource Exploitation in Bronze Age Subsistence* (Archaeological Studies Leiden University 33), Leiden: Leiden University Press.

VAN BEEK, B. L. 1990. *Steentijd te Vlaardingen, Leidschendam en Voorschoten. De vondstverspreiding in Laat-Neolithische nederzettingen in het Hollandse kustgebied.* PhD Thesis, Universiteit van Amsterdam.

VAN DEN BROEKE, P. W. 2013. *Laat-prehistorische steenstructuren in Nijmegen-Noord. Archeologisch onderzoek op De Boel* (Archeologische Berichten Nijmegen – Rapport 34), Nijmegen: Gemeente Nijmegen.

VAN DER BEEK, H. S. M. 2007. *Archeologie in de Betuweroute: Evalueren, beschermen en begeleiden. Archeologische tracébegeleiding en fysieke bescherming in de Betuweroute* (Rapportage Archeologische Monumentenzorg 103), Amersfoort: ROB.

VAN DER HEIJDEN, F. J. G. 1999. *Aanvullend Archeologisch Onderzoek in Puttershoek, vindplaats 'De Grienden'* (ADC Rapport 7), Amersfoort: ADC Archeoprojecten.

VAN DER LEEUW, S. E. 1976. Neolithic beakers from the Netherlands: The potter's point of view. *In:* LANTING, J. N. & VAN DER WAALS, J. D. (eds.) *Glockenbecher Symposion Oberried 1974*, Bussum/Haarlem: Fibula-Van Dishoeck, 81-118.

VAN DER MIJLE MEIJER, R. A., BULTEN, E. E. B., STOKKEL, P. J. A. & RIEFFE, E. C. (eds.) 2010. *Westvlietweg, gemeente Den Haag. Archeologisch onderzoek naar bewoningssporen uit het midden- en laat-neolithicum op een duintje achter de oudste strandwal* (Haagse Archeologische Rapportage 0919), Den Haag: Gemeente Den Haag.

VAN DER ROEST, J. 2009. *Archeologisch onderzoek bedrijventerrein Leersum – gem. Utrechtse Heuvelrug Inventariserend veldonderzoek d.m.v. proefsleuven – fase 2* (Grontmij Archeologische Rapporten 615), Houten: Grontmij.

VAN DER SANDEN, W. A. B. 1997. Aardewerk uit natte context in Drenthe: het vroeg- en laat-neolithicum en de vroege bronstijd. *Nieuwe Drentse Volksalmanak,* 116**,** 127-141.

VAN DER VALK, L. & HIRSCHEL, R. 2010. Een noodopgraving van een vroege Vlaardingen-vindplaats aan de Frekeweg, Gemeente Leidschendam-Voorburg: lessen geleerd(?). *In:* VERHART, L. B. M. & DE RIDDER, T. (eds.) *Vlaardingen-cultuur* (Westerheem Special 2), Eindhoven: AWN, 120-133.

VAN DER VEKEN, B. & PRANGSMA, N. M. (eds.) 2011. *Wonen en begraven in Didam-Kerkwijk, gemeente Montferland. Een archeologische opgraving* (ADC Rapport 1942), Amersfoort: ADC Archeoprojecten.

VAN DER WAALS, J. D. 1962. Sporen van bewoning en begraving uit Neolithicum en Bronstijd bij hoeve "De Schipborg", gem. Anlo. *Nieuwe Drentse Volksalmanak,* 80**,** 43-92.

VAN DER WAALS, J. D. 1988. Polderperspectieven. Enkele gedachten bij Swifterbant en Kolhorn. *Westerheem,* 37**,** 44-56.

VAN DER WAALS, J. D. 1989. Excavation of two beaker domestic sites near Kolhorn. General introduction. *Palaeohistoria,* 31**,** 139-149.

VAN DER WAALS, J. D. 1989. Kolhorn, southern site: the well. General description. *Palaeohistoria,* 31**,** 151-156.

VAN DER WAALS, J. D. 1998. Zwei neolithische Brunnen in den Niederlanden: Kolhorn und Emmerhout. *In:* KOSCHIK, H. (ed.) *Brunnen der Jungsteinzeit, Internationales Symposium in Erkelenz, 27. bis 29. Oktober 1997* (Materialien zur Bodendenkmalpflege im Rheinland 11), Bonn: Landschaftsverband Rheinland, 165-176.

VAN DER WAALS, J. D. & GLASBERGEN, W. 1955. Beaker types and their distribution in the Netherlands. *Palaeohistoria,* 4**,** 3-46.

VAN DER WAALS, J. D. & GLASBERGEN, W. 1959. De twee Bekerculturen. *In:* BOGAERS, J. E., GLASBERGEN, W. & GLAZEMA, P. (eds.) *Honderd Eeuwen Nederland: Antiquity and Survival* (Honderd Eeuwen Nederland 5/6), 's Gravenhage: Luctor et Emergo, 100-124.

VAN GIFFEN, A. E. 1925/1927. *Die Bauart der Einzelgräber : Beitrag zur Kenntnis der älteren individuellen Grabhügelstrukturen in den Niederlanden* (Mannus-Bibliothek 44), Leipzig: Kabitzsch.

VAN GIFFEN, A. E. 1962. Grafheuvels uit de Midden-Bronstijd met nederzettingssporen van de klokbekercultuur bij Oostwoud. *Westfrieslands Oud en Nieuw,* 29, 199-209.

VAN GIFFEN, A. E. 1966. Nederzettingsporen van de vroege klokbekercultuur bij Oostwoud (N.H.). *In:* GLASBERGEN, W., GROENMAN-VAN WAATERINGE, W., VAN GIFFEN, A. E. & BAKKER, J. A. (eds.) *In het voetspoor van A.E. van Giffen*, Groningen: Wolters, 66-71.

VAN GIJN, A. L. 2015. The cultural biography of the Scandinavian daggers in the northern Netherlands. *In:* FRIEMAN, C. J. & ERIKSEN, B. V. (eds.) *Flint daggers in prehistoric Europe*, Oxford: Oxbow Books, 76-82.

VAN HEERINGEN, R. M. 1998. Binnenmaas: Puttershoek-Sportlaan. *Archeologische kroniek van Holland over 1997, II: Zuid Holland* (Holland 30), Amersfoort: ROB, 353-355.

VAN HOOF, L. G. L., VAN WIJK, I. M. & VAN DER LINDE, C. M. 2013. *Zwervende erven op de löss? Onderzoek van een nederzetting uit de vroege ijzertijd en van sporen uit de Stein-groep te Hof van Limburg (gemeente Sittard-Geleen)* (Archol Rapport 33), Leiden: Archol.

VAN IJZENDOORN, A. E. L. 1972. Zweedse rotstekeningen en het "sieraad" van Velsen. *Westerheem,* 21, 19-22.

VAN IMPE, L. 1983. Het oudheidkundig bodemonderzoek in Donk (Gem. Herk-de-Stad) 1977-1982. *Miscellanea Archaeologica in honorem H. Roosens* (Archaeologia Belgica 255), Brussel, 65-94.

VAN IMPE, L., MAES, K. & VYNCKIER, G. 1987. Archeologie tussen Gete en Herk (gem. Herk-de-Stad) Interimverslag 1986. *Archaeologica Belgica,* III, 117-126.

VAN IMPE, L., STROBBE, P. & VYNCKIER, G. 1985. Het bodemonderzoek in Donk in 1984. *Archaeologica Belgica,* I, 51-52.

VAN ITERSON SCHOLTEN, F. R. & DE VRIES-METZ, W. H. 1981. A Late Neolithic Settlement at Aartswoud 1. The Trial Excavation in 1972. *Helinium,* 21, 105-135.

VAN KAMPEN, J. & VAN DEN BRINK, V. 2013. *Archeologisch onderzoek op de Habraken te Veldhoven. Twee unieke nederzettingen uit het Laat Neolithicum en de Midden Bronstijd en een erf uit de Volle Middeleeuwen* (Zuidnederlandse Archeologische Rapporten 52), Amsterdam: ACVU-HBS.

VAN LONDEN, H. & VAN DEN BROEKE, P. W. 1995. *5000 jaar wonen op veen en klei. Archeologisch onderzoek in het reconstructiegebied Midden-Delfland*, Utrecht: LBL.

VAN NUENEN, F. 2008. *Tilburg Katsbogte/Tradepark 58. Inventariserend veldonderzoek door middel van proefsleuven* (BAAC Rapport A-07.0473), Den Bosch: BAAC.

VAN REGTEREN ALTENA, J. F. 1958. Nieuwe opgravingen van de Neolithische nederzetting te Zandwerven, gem. Spanbroek. *Westfrieslands Oud en Nieuw,* 24, 144-159.

VAN REGTEREN ALTENA, J. F. 1959. Nieuwe opgravingen van de Neolithische nederzetting te Zandwerven, gem. Spanbroek, II. *Westfrieslands Oud en Nieuw,* 25, 155-156.

VAN REGTEREN ALTENA, J. F. & BAKKER, J. A. 1966. De Neolithische woonplaats te Zandwerven (N.H.). *In:* GLASBERGEN, W., GROENMAN-VAN WAATERINGE, W., VAN GIFFEN, A. E. & BAKKER, J. A. (eds.) *In het voetspoor van A.E. van Giffen*, Groningen: Wolters, 33-40.

VAN REGTEREN ALTENA, J. F., BAKKER, J. A., CLASON, A. T., GLASBERGEN, W., GROENMAN-VAN WAATERINGE, W. & PONS, L. J. 1962. The Vlaardingen Culture (I). *Helinium,* 2**,** 3-35.
VAN REGTEREN ALTENA, J. F., BAKKER, J. A., CLASON, A. T., GLASBERGEN, W., GROENMAN-VAN WAATERINGE, W. & PONS, L. J. 1962. The Vlaardingen Culture (II). *Helinium,* 2**,** 97-103.
VAN REGTEREN ALTENA, J. F., BAKKER, J. A., CLASON, A. T., GLASBERGEN, W., GROENMAN-VAN WAATERINGE, W. & PONS, L. J. 1962. The Vlaardingen Culture (III). *Helinium,* 2**,** 215-243.
VAN REGTEREN ALTENA, J. F., BAKKER, J. A., CLASON, A. T., GLASBERGEN, W., GROENMAN-VAN WAATERINGE, W. & PONS, L. J. 1963. The Vlaardingen Culture (IV). *Helinium,* 3**,** 39-54.
VAN REGTEREN ALTENA, J. F., BAKKER, J. A., CLASON, A. T., GLASBERGEN, W., GROENMAN-VAN WAATERINGE, W. & PONS, L. J. 1963. The Vlaardingen Culture (V). *Helinium,* 3**,** 97-120.
VAN STEIN CALLENFELS-VOSSNACK, A. 1973. Over de "dubbele ring", ook wel genoemd "het sieraad" van Velsen. *Westerheem,* 22**,** 29-30.
VAN VEEN, M. M. A. 1989. *Voorschoten-De Donk. Bewoning op de Oude Duinen, vanaf het late neolithicum tot in de Romeinse tijd.* MA Thesis, Leiden University.
VAN WIJNGAARDEN-BAKKER, L. H. 1975. Horses in the Dutch Neolithic. *In:* CLASON, A. T. (ed.) *Archaeozoological Studies*, Amsterdam: Elsevier, 341-344.
VAN WILGEN, L. R. 2001. *Archeologische Begeleiding Riooltracé Bestemmingsplan Maaldrift II, Wassenaar*, Heinenoord: SOB Research.
VAN WILGEN, L. R. 2007. *Inventariserend Veldonderzoek door middel van proefsleuven/Archeologische Begeleiding Bouwlocatie Akerboom-Maaldrift II, Wassenaar, Gemeente Wassenaar*, Heinenoord: SOB Research.
VANDER LINDEN, M. 2006. *Le phénomène campaniforme dans l'Europe du 3ème millénaire avant notre ère. Synthèse et nouvelles perspectives* (British Archaeological Reports: International Series 1470), Oxford: Archaeopress.
VANDER LINDEN, M. 2007. What linked the Bell Beakers in the third millennium BC Europe. *Antiquity,* 81**,** 343-352.
VANDKILDE, H. 1996. *From Stone to Bronze. The Metalwork of the Late Neolithic and Earliest Bronze Age in Denmark* (Jutland Archaeological Society Publications 32), Højbjerg: Jutland Archaeological Society.
VANDKILDE, H. 2005. A Review of the Early Late Neolithic Period in Denmark: Practice, Identity and Connectivity. *Offa,* 61/62**,** 75-109.
VANMOERKERKE, J. 1986. A Neolithic site at Asper-Jolleveld. *In:* VERMEULEN, F. & DE CEUNYNCK, R. (eds.) *The Roman Settlement and Cemetery at Asper (Gavere, East Flanders)* (Scholae Archaeologicae 5), Gent, 161-168.
VANMONTFORT, B. L. L. 2004. Les Flandres durant la fin du 4e et le début du 3e millénaire avant notre ère. *In:* VANDER LINDEN, M. & SALANOVA, L. (eds.) *Le troisième millénaire dans le nord de la France et en Belgique. Actes de la journée d'études SRBAP-SPF, 8 mars 2003, Lille* (Anthropologica et Praehistorica 115), Brussel: SRBAP, 9-25.
VANMONTFORT, B. L. L., COLLET, H. & CROMBÉ, P. 2009. Les Industries Lithiques Taillées des IVe et IIIe Millénaires dans les Bassins de l'Escaut et de la Meuse (Belgique). *In:* DIAS-MEIRINHO, M.-H., LÉA, V., GERNIGON, K., FOUÉRÉ, P., BRIOIS, F. & BAILLY, M. (eds.) *Les industries lithiques taillées des IVe et IIIe millénaires en Europe occidentale (actes coll. int. Toulouse, avr. 2005)* (British Archaeological Reports: International Series 1884), Oxford: Archaeopress.
VAQUER, J. 2004. Les enceintes du Néolithique final-Chalcolithique en Languedoc occidental. Historique et bilan de 40 ans de recherches. *Bulletin de la Société Préhistorique Française,* 101**,** 501-512.

VARBERG, J. 2015. Bloody daggers: A discussion of the function of Late Neolithic flint daggers from a South Scandinavian point of view. *In:* FRIEMAN, C. J. & ERIKSEN, B. V. (eds.) *Flint daggers in prehistoric Europe*, Oxford: Oxbow Books, 92-102.

VERDUIN, J. 2012. *Opgraving aan De Domeynen te Sint Pancras, Gemeente Langedijk* (Hollandia Reeks 372), Zaandijk: Hollandia.

VERGNAUD, L. & FOUÉRÉ, P. 2006. Le site de la Tuilerie Est à Cavignac (Gironde), témoignage d'un petit bâtiment artenacien? *In:* FOUÉRÉ, P., CHEVILLOT, C., COURTAUD, P., FERULLO, O. & LEROYER, C. (eds.) *Paysages et peuplements – Aspects culturels et chronologiques en France méridionale. Actes des 6e récontres méridionales de préhistoire récente, Perigeux, oct. 2004*, Périgeux: ADRAPH, 521-546.

VERHART, L. B. M. 1992. Settling or trekking? The Late Neolithic house plans of Haamstede-Brabers and their counterparts. *Oudheidkundige Mededelingen van het Rijksmuseum van Oudheden te Leiden,* 72**,** 73-99.

VERHART, L. B. M. 2000. *Times fade away. The neolithization of the southern Netherlands in an antropological and geographical perspective* (Archaeological Studies Leiden University 6), Leiden: Leiden University Press.

VERHART, L. B. M. 2010. *De geur van veen. Vlaardingen en de ontdekking van de Vlaardingen-cultuur*, Utrecht: Matrijs.

VERHELST, E. M. P. 2011. *Wroeten in de Valendries. Bewoningssporen uit de Late Bronstijd en de Vroeg Romeinse tijd op het Martensterrein in Wijchen* (RAAP Rapport 2125), Weesp: RAAP Archeologisch Adviesbureau.

VERHELST, E. M. P. 2012. *Plangebied Parijsch-Zuid, Gemeente Culemborg. Archeologisch vooronderzoek: een inventariserend veldonderzoek door middel van proefsleuven* (RAAP Rapport 2523), Weesp: RAAP Archeologisch Adviesbureau.

VERLINDE, A. D. 1969. Three new Bell-Beakers from the Netherlands. *Berichten van de Rijksdienst voor het Oudheidkundig Bodemonderzoek,* 19**,** 269-272.

VERLINDE, A. D. 1971. Spätneolithische und frühbronzezeitliche Siedlungsspuren auf der Meerloer Heide, Gem. Meerlo, Prov. Limburg und ihre Stellung. *Analecta Praehistorica Leidensia,* 4**,** 26-46.

VERLINDE, A. D. 1983. Rechteren, gem. Dalfsen. *In:* VERLINDE, A. D. (ed.) *Archeologische Kroniek van Overijssel over 1982*, Amersfoort: ROB, 119-120.

VERLINDE, A. D. & THEUNISSEN, E. M. 2001. Tubbergen-Vasse. *Archeologische Kroniek van Overijssel over 2000***,** 165-169.

VERWERS, G. J. 1972. *Das Kamps Veld in Haps in Neolithikum, Bronzezeit und Eisenzeit* (Analecta Praehistorica Leidensia 5), Leiden: Leiden University Press.

VIGNERON, E. 1981. Eléments campaniformes de la grotte Saint-Vérédème, Sanilhac (Gard). *Bulletin de la Société Préhistorique Française,* 78**,** 88-96.

VILLES, A. 1985. Sur les rapports S.O.M./Artenac dans le Bassin parisien. *Revue Archéologique de Picardie,* 3-4**,** 27-38.

VINK, J. & BOSMAN, W. J. 2010. De ontdekking van Velsens Vroege Bronstijd. *Westerheem,* 61**,** 338-348.

VINSKI-GASPARINI, K. 1957. Zlatni nalaz iz progra u srijemu. *Vjesnik za arheologiju i historiju dalmatinsku,* 56**,** 6-10.

VISWANATHAN, G. M., AFANASYEV, V., BULDYREV, S. V., MURPHY, E. J., PRINCE, P. A. & STANLEY, H. E. 1996. Lévy flight search patterns of wanderign albatrosses. *Nature,* 381**,** 413-415.

VISWANATHAN, G. M., BULDYREV, S. V., HAVLIN, S., DA LUZ, M. G. E., RAPOSO, E. P. & STANLEY, H. E. 1999. Optimizing the success of random searches. *Nature,* 401**,** 911-914.

VLIERMAN, K. 1985. *Neolithische en middeleeuwse vondsten op de kavels oz35 en oz36 in zuidelijk flevoland* (RIJP rapport 1985 -51 abw), Lelystad: Rijksdienst voor de IJsselmeerpolders.

VOELKEL, G. 1963. Riesenbecher aus dem Kriese Lüchow-Dannenberg. *Nachrichten aus Niedersachsens Urgeschichte,* 32, 97-104.
VOELKEL, G. 1968. Weitere Riesenbecher aus dem Kreis Lüchow-Dannenberg. *Nachrichten aus Niedersachsens Urgeschichte,* 37, 128-130.
VOIGT, T. 1956. Bemerkenswerte spätneolithische Brandgrabfunde von Biederitz, Kreis Burg. *Jahresschrift für Mitteldeutsche Vorgeschichte,* 40, 109-127.
VON DEN DRIESCH, A. & BOESSNECK, J. 1976. Die Fauna vom Castro do Zambujal. *Studien uber fruhe Tierknochenfunde von der Iberischen Halbinsel,* 5, 4-129.
VON DEN DRIESCH, A. & RICHTER, B. 1976. Tierknochenfunde aus Penedo de Lexim. *Studien uber fruhe Tierknochenfunde von der Iberischen Halbinsel,* 5, 144-157.
VONS, P. 1970. De vervaardiging van barnsteen-kralen te Velsen in de Vroege Bronstijd. *Westerheem,* 19, 34-35.
VONS, P. 1971. Velsen. *Haerlem Jaarboek,* 1970, 261-262.
VONS, P. 1975. Opgravingen bij het Noordzeekanaal. *In:* GEMSER, H. & SCHAAFSMA, S. (eds.) *Een kerk en een handvol huizen. Grepen uit de geschiedenis van het dorp Velsen*, Velsen, 12-14.
VŠIANSKÝ, D., KOLÁŘ, J. & PETŘÍK, J. 2014. Continuity and changes of manufacturing traditions of Bell Beaker and Bronze Age encrusted pottery in the Morava river catchment (Czech Republic). *Journal of Archaeological Science,* 49, 414-422.
WALLAERT-PÊTRE, H. 2001. Learning How to Make the Right Pots: Apprenticeship Strategies and Material Culture, a Case Study in Handmade Pottery from Cameroon. *Journal of Anthropological Research,* 57, 471-493.
WARMUTH, V., ERIKSSON, A., BOWER, M. A., BARKER, G., BARRETT, E., HANKS, B. K., LI, S., LOMITASHVILI, D., OCHIR-GORYAEVA, M., SIZONOV, G. V., SOYONOV, V. & MANICA, A. 2012. Reconstructing the origin and spread of horse domestication in the Eurasian steppe. *Proceedings of the National Academy of Sciences,* 109, 8202-8206.
WASMUS, F. 2011. *Once upon a dune in the west. On the Vlaardingen culture, its chronology and the pottery of the site Voorschoten-De Donk.* MA Thesis, Leiden University.
WASSINK, J. C. L. 1981. *Ottoland – Kromme-Elleboog. Een Laat-neolithische – vroege-bronstijd nederzetting in de Alblasserwaard, provincie Zuid Holland.* MA Thesis, Leiden University.
WATERBOLK, H. T. 1960. Preliminary report on the excavations at Anlo in 1957 and 1958. *Palaeohistoria,* 8, 59-90.
WATERBOLK, H. T. 1971. Working with Radiocarbon Dates. *Proceedings of the Prehistoric Society,* 37, 15-33.
WATERBOLK, H. T. 1977. Opgravingen rond het Witteveen op het Noordse Veld bij Zeijen, gem. Vries (1949-1953). *Nieuwe Drentse Volksalmanak,* 94, 177-203.
WAWRUSIEWICZ, A., JANUSZEK, K. & MANASTERSKI, D. 2015. *Obiekty obrzędowe Pucharów Dzwonowatych z Supraśla. Złożenie darów – przejęcie terenu czy integracja kulturowa? Ritual features of Bell Beakers in Supraśl. The offering – taking possession of the land or cultural integration?* , Białystok: Muzeum Podlaskie w Białymstoku.
WEGEWITZ, W. 1961. Eine Schädelbestattung der Einzelgrabkultur. *Nachrichten aus Niedersachsens Urgeschichte,* 29, 6-17.
WEIDELE, D., VAN GARDEREN, M., GOLITKO, M. & FEINMAN, G. M. 2016. On graphical representations of similarity in geo-temporal frequency data. *Journal of Archaeological Science,* 72, 105-116.
WEINER, J. 2013. Technologische und ergologische Erkenntnisse zu den Stein-, Knochen-, Zahn- und Geweihartefakten aus dem schnurkeramischen Doppelgrab von Gaimersheim, Lkr. Eichstätt. *Bayerische Vorgeschichtsblätter,* 78, 23-69.
WENDRICH, W. & BARNARD, H. 2008. The Archaeology of Mobility: Definitions and Research Approaches. *In:* BARNARD, H. & WENDRICH, W. (eds.) *The Archaeology*

of Mobility: Old World and New World. Nomadism, Los Angeles: Cotsen Institute Press, 1-21.

WERNER, J. 1951. Die ältesten Gürtelhaken. *Festschrift für G. Schwantes zum 65. Geburtstag*, Neumünster, 151-156.

WESSELINGH, D. 1993. Oss-IJsselstraat: Iron Age graves and a native Roman settlement *Analecta Praehistorica Leidensia,* 26**,** 111-138.

WETZEL, G. 1969. Ein Dünenwohnplatz bei Lanz, Kreis Ludwigslust. *Bodendenkmalpflege in Mecklenburg Jahrbuch,* 1967**,** 129-169.

WETZEL, G. 1976. Ein “Pot Beaker” aus der Altmark (?). *Jahresschrift für Mitteldeutsche Vorgeschichte,* 60**,** 247-251.

WETZEL, G. 1979. *Die Schönfelder Kultur* (Veröffentlichungen des Landesmuseums für Vorgeschichte in Halle 31), Berlin: Landesmuseum für Vorgeschichte Halle.

WHITTLE, A. W. R., HEALY, F. & BAYLISS, A. (eds.) 2011. *Gathering Time. Dating the Early Neolithic Enclosures of Southern Britain and Ireland,* Oxford: Oxbow books.

WIESENTHAL, G. 1953. *Darmstadts Bodenurkunden* (Schriftenreihe der Naturschutzstelle Darmstadt-stadt “Naturschutz, Landschaftspflege, Heimatkunde” Heft 6), Darmstadt: Naturschutzstelle Darmstadt.

WIESSNER, P. 1983. Style and Social Information in Kalahari San Projectile Points. *American Antiquity,* 48**,** 253-276.

WILLIAMS, G. L. 2009. *Van onder de es. Een archeologische opgraving aan de Elderinkweg te Hengelo, gemeente Bronckhorst* (ADC Rapport 1576), Amersfoort: ADC Archeoprojecten.

WINNICKA, K. 2017. Late Neolithic V-perforated buttons from a female burial in SE Poland: a comprehensive study of raw material, bone technology and use-life. *Analecta Praehistorica Leidensia,* 47**,** 59-74.

WINTERHOLLER, B. 2004. *Untersuchungen zur Mobilität archäologischer Gruppen anhand von Strontiumisotopenverhältnissen*, Freiburg: B. Winterholler.

WIRTH, K. 1994. *Archsum/Melenknop: ein Fundplatz des Spätneolithikums und der älteren Bronzezeit.* PhD Thesis, Christian-Albrechts Universität Kiel.

WOBST, H. M. 1977. Stylistic behaviour and information exchange. *In:* CLELAND, C. (ed.) *For the Director: Research Essays in Honor of James B. Griffin* (Anthropological Papers), Ann Arbor: Museum of Anthropology, University of Michigan, 317-342.

WOJCHIECHOWSKI, W. 1976. Sztylety krzemienne typu skandynáwskiego w Polsce zachodniej. *Studia Archeologiczne,* 7**,** 37-94.

WOODWARD, A. B. & HUNTER, J. R. 2012. *Ritual in Early Bronze Age Grave Goods,* Oxford: Oxbow books.

ZAGORSKIS, F. 2004. *Zvejnieki (Northern Latvia) Stone Age Cemetery* (British Archaeological Reports: International Series 1292), Oxford: Archaeopress.

ZAGWIJN, W. H. 1997. Een landschap in beweging. De duinen van Holland sinds het Neolithicum. *In:* HALLEWAS, D. P., SCHEEPSTRA, G. H. & WOLTERING, P. J. (eds.) *Dynamisch Landschap. Archeologie en geologie van het Nederlandse kustgebied,* Amersfoort: ROB, 93-130.

ZAPATOCKÝ, M. 1960. Sídliste kultury zvoncovitých pohárù u Kozel na Neratovicku – Die Siedlungsstätte der Glockenbecherkultur bei Kozly in Neratowitzer Gegend. *Archeologické rozhledy,* 51**,** 5-26.

ZBYSZEWSKI, G. & DA VEIGA FERREIRA, O. 1958. Estação Pré-histórica da Penha Verde (Sintra). *Comunicações dos Serviços Geológicos de Portugal,* 39**,** 37-57.

ZBYSZEWSKI, G. & DA VEIGA FERREIRA, O. 1959. Segunda Campanha de Escavações n Penha Verde (Sintra). *Actas e Memorias do I Congresso Nacional de Arqueología,* Lisboa, 401-406.

ZBYSZEWSKI, G., DA VEIGA FERREIRA, O., LEITÃO, M., NORTH, C. T. & NORTON, J. 1976. Découverte d’un silo préhistorique près de Verdelha dos Ruivos (Vialonga), Portugal. *Madrider Mitteilungen,* 17**,** 76-79.

ZEEBROEK, M. & WARMENBOL, E. 2015. La transition Néolithique/Âge du Bronze à Heinsch "La Pierre Celtique" (Arlon, BE) À propos d'un nouveau gobelet campaniforme. *Notae Praehistoricae,* 35, 147-156.

ZEILER, J. T. 2017. *De paarden van Velsen (en andere dieren). Archeozoologisch onderzoek van dierlijke resten uit Velserbroek-Hofgeest (Bronstijd) en Velsen-Zuid/Gassleuf (Laat-Neolithicum/Vroege Bronstijd en Midden Bronstijd)* (ArchaeoBone rapport 152), Haren: ArchaeoBone.

ZICH, B. 1987. Zur Nordwestgrenze der Aunjetitzer Kultur. *Prähistorische Zeitschrift,* 62, 52-77.

ZICH, B. 1994. "In Flintbek stand ein Steinzeithaus …" Ein Hausfund von der Wende des Neolithikums zur Bronzezeit aus Flintbek, Kreis Rendsburg-Eckernförde. *Archäologische Nachrichten aus Schleswig-Holstein,* 4/5, 18-47.

ZICH, B. 1996. *Studien zur regionalen und chronologischen Gliederung der nördlichen Aunjetitzer Kultur* (Vorgeschichtliche Forschungen 20), Berlin: De Gruyter.

ZIJL, W., NIEKUS, M. J. L. T., PLOEGAERT, P. H. J. I. & MOREE, J. M. 2011. *Rotterdam Beverwaard Tramremise. De opgraving van de top van een donk met sporen uit het Mesolithicum en Neolithicum (vindplaats 13-83)* (BOORrapport 439), Rotterdam: BOOR.

ZIMMERMANN, T. 2007. *Die ältesten kupferzeitlichen Bestattungen mit Dolchbeigabe* (Monographien des Römisch-Germanischen Zentralmuseums Band 71), Mainz: RGZM.

ZVELEBIL, M. 1986. Mesolithic prelude and Neolithic revolution. *In:* ZVELEBIL, M. (ed.) *Hunters in transition: mesolithic societies of temperate Europe and their transition to farming*, Cambridge: Cambridge University Press, 5-15.

ZVELEBIL, M. 1998. Agricultural Frontiers, Neolithic Origins, and the Transition to Farming in the Baltic Basin. *In:* ZVELEBIL, M., DOMAŃSKA, L. & DENNELL, R. (eds.) *Harvesting the Sea, Farming the Forest: The emergence of Neolithic societies in the Baltic region.*, Sheffield: Continuum International Publishing Group, 9-27.

ZVELEBIL, M. & ROWLEY-CONWY, P. A. 1984. Transition to Farming in Northern Europe: A Hunter-Gatherer Perspective. *Norwegian Archaeological Review,* 17, 104-127.

АРТЕМЕНКО, И. И. 1964. Неолитические стоянки и курганы эпохи бронзы близ с. Ходосовичи Гомельской областьси БССР. *In:* БАДЕР, Н. А. (ed.) *Памятники каменного и бронзового веков Евразии*, Москва, 31-38.

ПОПОВ, Р. 1914. *Предисторическата Денева могила при с. Салманово* (ИБАД IV), София.

Appendix A
Settlement sites and assemblages

This appendix presents the settlements dataset and the assemblages of material culture and ecological remains found. All the data is presented in frequencies (number of sherds/vessels, artefacts and zoological and botanical remains), based on a literature survey. If frequencies are unknown, either a 999 placeholder is noted for the pottery frequencies and a + is noted for zoological and botanical remains (these records are not used in the analysis). For unknown ^{14}C date lab codes, a settlement-specific number is given, purely for identification and reference with respect to the analysis.

Consecutively settlements (table 1 and 2), settlement pottery frequencies (table 3), settlement Bell Beaker pottery characteristics (table 4), settlement stone and flint artefacts and raw materials (table 5 and 6), settlement metal artefacts (table 7), settlement zoological and botanical remains (table 8 and 9) and settlement ^{14}C dates (table 10) are presented.

- Table 1 Settlement sites
- Table 2 Settlement overview
- Table 3 Settlement pottery frequencies
- Table 4 Settlement Bell Beaker pottery decoration
- Table 5 Settlement stone artefacts
- Table 6 Settlement stone raw materials
- Table 7 Settlement metal artefacts
- Table 8 Settlement zoological remain
- Table 9 Settlement botanical remains
- Table 10 Settlement radiocarbon dates

Appendix B
Bayesian analysis: ^{14}C dates and model specifications

In this appendix all the Bayesian models are described and the radiocarbon dates that have been used to create the models are presented. First all models are described, after which the ^{14}C data is given in tabular form.

- Table 1 Torres Vedras – Zambujal Bayesian model & radiocarbon dates
- Table 2 Velsen – Noordzeekanaal Bayesian model & radiocarbon dates
- Table 3 Ljodberg – Mortens Sande II Bayesian model & radiocarbon dates
- Table 4 Vlaardingen – Arij Koplaan Bayesian model & radiocarbon dates
- Table 5 Grayan-et-l'Hôpital – La Lède du Gurp Bayesian model & radiocarbon dates
- Table 6 Slavonín – Horni Ián Bayesian model & radiocarbon dates
- Table 7 Mittelfranken – Ergersheim Bayesian model & radiocarbon dates

Torres Vedras – Zambujal

The settlement of Zambujal is a enclosed settlement, consisting of numerous wall remains, cultural layers and features on a hillside overlooking the Sizandro valley. The models of Zambujal are based on a combining of the *Bauphasen* 0-5 and *Ausbauphasen* 1a-5b as published by Kunst (2007) and Kunst/Lutz (2008) latest. As some ^{14}C dates are assigned to multiple phases or phases with a "?" it can become unclear how this relates to the overall sequence of the site. This uncertainty is also incorporated in the model. Three different models were created, related to the contextual evidence and the material that was used for dating. In total 43 radiocarbon dates are known from Zambujal in one form or another. Out of these 43 dates, 1 date (KN-J-116) was proven to be unreliable from the start, as no original measurement could be retrieved.

The first model takes 38 out of the remaining 42 radiocarbon dates into consideration, excluding the dates for which no context was known, and dates that come from disturbances. The first model divides the different stratigraphic phases to which radiocarbon dates could be assigned into 7 modelled phases, corresponding to the phases 0-5 within the Zambujal sequence. Phase 3 in our model is then further subdivided into a sequence of several dates, while phase 5 consists of 2 sub-phases (5.1 and 5.2). Sub-phase 5.1 again contains an additional sequence. This first model gives a very poor agreement index (Aoverall = 0.0%). Many dates, and most notably the charcoal dates, do not fit with each other, and possibly suffer from an old wood effect, contamination or problems related to context and reworking.

The second model discards all charcoal dates and only takes animal bone and cereal based ^{14}C dates, adding up to a total of 12 radiocarbon dates. Because there are less radiocarbon dates available for this model, the phasing will be less complex. Two combined phases are distinguished here, phase 0/1/2/3 and phase 4/5. For phase 0/1/2/3 a separate second sequence can be made in which four phases are distinguished, representing the specific phases 0-3. This excludes two dates that cannot be assigned within this sequence but do fall within this phase (because these dates predate phases 4 and 5). For phase 4 and 5 we take the two ^{14}C dates that with certainty postdate the first three occupation phases. While there are still several outliers, and the agreement index is still somewhat low (Aoverall = 55.2%), in general this model fits.

Velsen – Noordzeekanaal

The settlement of Velsen Noordzeekanaal consists of several cultural layers interlaced with dune sand, on top of a Late Neolithic beach barrier (Kleijne 2015; Vink/Bosman 2010). The natural formation of this specific beach barrier has also been dated starts the occupation sequence of our Bayesian model. This date was taken from shell fragments (*Cardium edule*; GrN-5853) within the beach barrier deposits.

The traces of human occupation consist of various layers, together with ploughmarks and dug features, within this dune formation sequence. These cultural layers correspond with peat layers in the lower dune valley and separated by dune sand on the higher dune ridges. Geomorphologically this can be understood as the development of soils within the dune (dry occupation horizons on the higher dune parts, wet peaty soils in the lower parts), separated by phases of aeolian sedimentation. In total, this site has come up with nine ^{14}C dates, of which eight were organic samples recovered from the different peat deposits (GrN-5968, GrN-5969, GrN-5970, GrN-5971, GrN-5972, GrN-5973, GrN-5974, GrN-5975). These peat deposits match the aforementioned cultural layers spatially and chronologically. The cultural layers are associated with Late Neolithic/Early Bronze Age, Middle Bronze Age and Late Bronze Age material culture. This material culture consists of pottery, animal bone remains, amber production waste (Vons 1970) and several bone tools (Clason 1974), among which an hourglass pendant (see paragraph 6.3.2.2; Kleijne 2016). Because the depth is known of these peat samples (as they were taken for a palynological study; Zagwijn 1996), a standard P_Sequence model was used and a depth model was created (Bronk Ramsey 2008). The end model shows a good agreement (Aoverall= 105%).

Ljodberg – Mortens Sande II

The settlement of Mortens Sande II consists of four occupation horizons in a coastal dune sequence (Liversage 1987).

In total 4 ^{14}C dates could be assigned to two of the cultural layers. Cultural layer O, associated with a Corded Ware settlement, has produced a single date of charcoal (K-4768). The subsequent cultural layer A, containing the remains of Bell Beaker settlement material and several dug features, has produced three ^{14}C dates from charcoal (K-4047, K-4766, K-4767). Wood species and ages have not been identified. Dated material include are one sample of mixed charcoal from horizon A, and three of unknown origin. The Bayesian model consists of a straightforward sequence with two phases. Overall agreement is good (Aoverall = 84%), although the sample of mixed charcoal seems to be on the young side for the Bell Beaker phase with an agreement of 69%. Perhaps here the sample dated included some intrusive material, stemming from the later Early Bronze Age occupation phase.

Vlaardingen – Arij Koplaan

The settlement of Vlaardingen Arij Koplaan has a well-documented stratigraphy for *werkput 9* (Van Beek 1990, 112-123; Amkreutz 2013b, 250-256). Here Late Neolithic Vlaardingen occupation is found in a cultural layer on the levee of a gully and in the gully itself. Additionally, Bell Beaker material culture is found in a superimposing layer on this levee.

All samples were taken from these black occupation layers. The date associated with Vlaardingen group material culture is taken from a charcoal sample (GrN-2480), while the Bell Beaker dates have been taken from charcoal as well (GrN-2158, GrN-2419, GrN-3097) and from a wooden post (GrN-2481). Wood species and ages have not been identified. Other trenches have also produced Vlaardingen group material and associated radiocarbon dates from the sandy levees and the accompanying gully filling (GrN-2303, GrN-2304, GrN-2306, GrN-2487, GrN-4114). These separate dates are not included in the Bayesian analysis, but independently they support the outcomes of the model with regard to the first occupation phase.

A fairly simple two-phase model was constructed, based on the single Vlaardingen radiocarbon date (charcoal sample) and four Bell Beaker radiocarbon dates (three charcoal samples, one wood sample) coming from the occupation layer. The model is in good agreement (Aoverall = 120.7).

Grayan-et-l'Hôpital – Lède du Gurp

The settlement of Lède du Gurp is known for its long occupation history, starting in the Late Paleolithic until well into the Early Bronze Age (Guibert *et al* 1996; Roussot-Larroque/Villes 1988; Roussot-Larroque 1995, 2002). Unfortunately, not the complete sequence has been published.

All these different occupation phases are found in stratigraphic succession to one other, sometimes separated by layers of naturally accumulated material. In total seven phases can be distinguished: Late Palaeolithic (4 radiocarbon dates), Sauveterrien Mesolithic (4 dates), Early Neolithic Cardial (a second sequence with 3 dates (of which one is a Thermoluminescence (TL) date) and a separate phase named 'surface artificielle/fosse' with 4 radiocarbon dates), Middle Neolithic (1 date), Late Neolithic Artenac (1 date), Campaniforme/Bell Beaker (3 dates) and Bronze Ancien/Early Bronze Age (1 date). Out of the 21 known dates, 6 are of charcoal, while 3 are wood, 5 are of unknown sample material and a single TL date is present.

Of interest to us here are the Artenac (Ly-6047), Bell Beaker (Ly-7965, Ly7966 and Ly-7967) and Early Bronze Age (Beta-118449) associated samples. Associated with either the Bell Beaker or Early Bronze Age phase is a copper arrowhead of the Palmela type (Roussot-Larroque 2002, see paragraph 6.3.2.3). The model, in which all the different phases are put together, shows a good agreement (Aoverall = 109.3%).

Slavonin – Horní Ian

The settlement of Horni Ian consists of many features dug into loess soils. These features have produced 32 radiocarbon dates, based on charcoal and bone samples.

One of these dates has a δ13C value of -15.28‰, this date is not taken into consideration here.[24]

The Horni Ian settlement provides evidence for multi-phased occupation during the Late Neolithic. And although it has not provided a stratigraphic sequence, and therefore no relatively clear-cut phasing, the site can still be used to approximate

24 Further analysis on the diet of animals and humans during the Bell Beaker phenomenon in the Czech Republic should be done in order to really assess the variability within the $\delta^{13}C$ ranges, and possible dietary influences, as also the human remains from Horní pole show (Peska 2011).

the interval between the three cultural phenomena present (Globular Amphora, Corded Ware and Bell Beaker). For this we use the association between ^{14}C dates and the pottery typology, while assuming that there indeed exists a chronological sequence from earliest (Globular Amphora) to later (Corded Ware) and latest (Bell Beaker) pottery styles. In a similar way, Higham *et al* (2007) modelled various phases of use at the Late Neolithic cemetery phases at Varna, Bulgaria. The first attempted model tries exactly this.

It separates the radiocarbon dates purely based on cultural association. The first phase consists of all pits in which radiocarbon dates are associated with Globular Amphora pottery. All the radiocarbon dated pits in which Corded Ware pottery is found belong to phase 2, whereas phase 3 comprises of radiocarbon dates from pits in which Bell Beaker pottery was found. The end result of this model is that several dates from phase 2 (Corded Ware) and phase 3 (Bell Beaker) do not fit and the model is in poor agreement (Aoverall = 1.8%). Several dates from the Corded Ware pits are too young and possibly represent intrusive charcoal. This also means that some pits containing Corded Ware material culture were still in use or partially open when Bell Beaker material culture was being introduced. This indicates a short transition from the Corded Ware to the Bell Beaker phenomenon at this site.

This problem forces us to find another way of distinguishing these phenomena at the site. Unfortunately most of the pottery found in the features is not the characteristic Corded Ware or Bell Beaker, but Common Ware (*Begeleitkeramik*). In order to find a chronological development in Common Ware vessels, that could be used as a further discriminant in defining features to their associated cultural phenomena, the pottery vessel shapes were analysed (see paragraph 7.2). A separate Principal Component Analysis of the metric data from this particular settlement was carried out to look for a chronological development in the vessel shape and tis typological designation (see fig. B.1). This however shows that there is no correlation between vessel shape and typology and similarly no correlation between vessel shape and ^{14}C chronology.

The second model, therefore combines the Corded Ware and Bell Beaker dates in a single phase (phase 2) and uses the radiocarbon dated pits containing Early Bronze Age pottery as phase 3. Here, the model is in good overall agreement (Aoverall = 92.3%).

Mittelfranken – Ergersheim

The settlement of Ergersheim consists of a sinkhole in which five, stratigraphically separated, layers containing material culture dating to the Late Neolithic and Bronze Age are have been found (Ullrich 2008).

The five phases of occupation can be related to a Neolithic phase with little remains, a Corded Ware, a Bell Beaker, a Middle Bronze Age and finally an Urnfield phase. In total, 14 ^{14}C dates were taken from these phases, of which a relatively straightforward sequence Bayesian model using five phases and double boundaries could be constructed. The phases that are of interest to us here are the Corded Ware, Bell Beaker and Middle Bronze Age occupation phases. From the Corded Ware occupation layer four ^{14}C dates were taken, one sample from bone (Erl-2486) and three from charcoal (Hv-17309, Hv-17310, Hv-17311). The Bell Beaker occupation has produced four samples, three of which were bone samples (Erl-2485, Erl-2487, Erl-2488) and a single sample was taken from charcoal (Hv-17312). The six Middle Bronze Age radiocarbon dates are coming from five bone samples (UtC-11192, UtC-11193, UtC-11194, UtC-11195, UtC-11196) and a single charcoal sample (Hv-17313). Wood and animal species and ages have not been identified and neither is there any information regarding isotope variability. The model consists of 5 phases within a sequence. An overall high agreement can be noted (Aoverall = 92.4%).

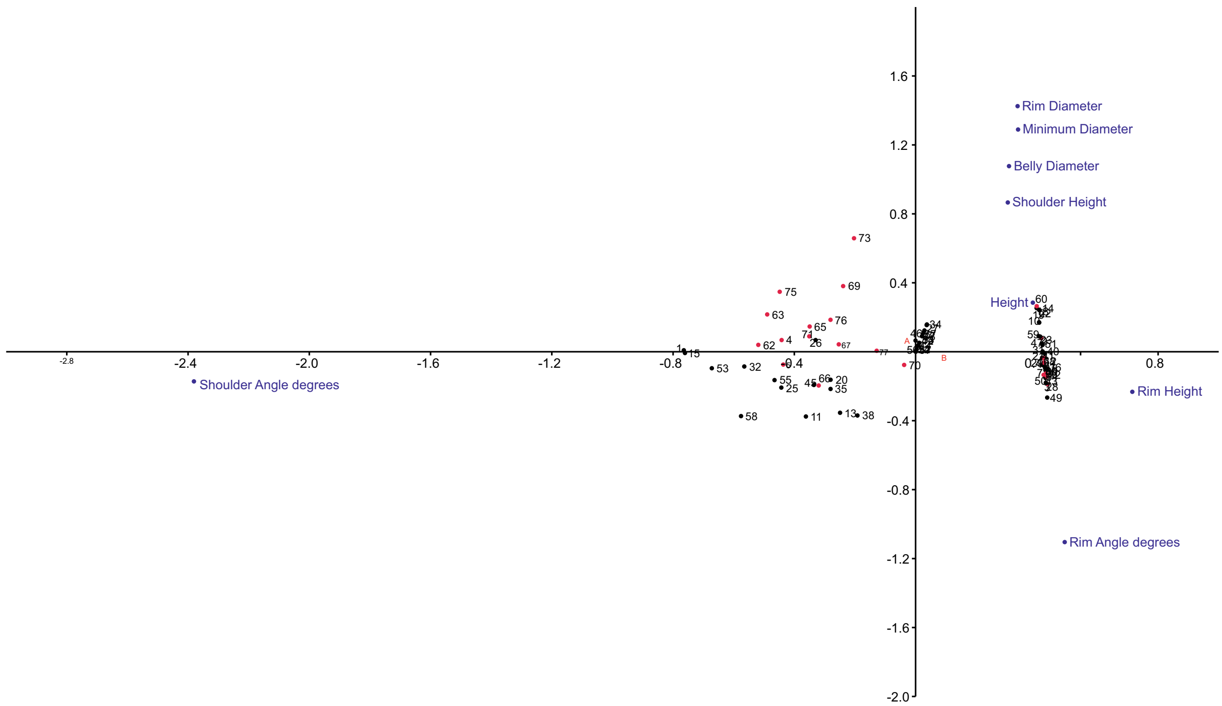


Fig. B.1 Principal Component Analysis of Common Ware metric data from Slavonín Horni Ián.

Appendix C
Common Ware vessels and metrics

This appendix presents the Common Ware dataset, with the metric data gathered per vessel, dating evidence, typological characterisations and illustration references, decoration characteristics and temper types.

Appendix D
Analysed pottery assemblages

This appendix presents the technological analysis of pottery assemblages. The dataset is digitally available at https://doi.org/10.17026/dans-2aa-t6vp

- Table 1 Velsen Waterland
- Table 2 Rhenen N225
- Table 3 Oudenaarde Donk NEO5
- Table 4 Medemblik Oostwoud
- Table 5 Haarlem Schoterweg
- Table 6 Deventer Skibaan
- Table 7 Molenaarsgraaf
- Table 8 Tastum
- Table 9 Gaasemosen
- Table 10 Lanz 14
- Table 11 Süttorf 18
- Table 12 Holubice I
- Table 13 Česka I
- Table 14 Kelčice I
- Table 15 Těšetice III

Appendix E
Bone pendants and plates

This appendix records all the bone, stone and amber hourglass and anchor type pendants and bone and antler belt plates from the Late Neolithic in Central and Western Europe, primarily found in funerary contexts. The pendants were previously inventoried as part of a larger Neolithic pendant dataset, including earlier Neolithic examples (Kleijne 2016). That particular inventory can now be considered outdated.

- Table 1 List of bone pendants
- Table 2 List of bone pendants, context data and metric data
- Table 3 List of bone plates
- Table 4 List of bone plates, context data and metric data

Appendix F
Palmela points

This appendix records the copper and bronze Palmela points associated with the Bell Beaker phenomenon and Early Bronze Age in Western Europe and Northern Africa. Associations and ^{14}C dated points are not recorded exhaustively.

- Table 1 List of Palmela points
- Table 2 List of Palmela points, context data and radiocarbon dates

Summary

This thesis focuses on processes, mechanisms and practices of innovation associated with the advent of the Bell Beaker phenomenon in Western Europe, between roughly 2600 and 2000 years before Christ. The Bell Beaker phenomenon is a name given by archaeologists to a specific material uniformity observed in the archaeological record. This apparent uniformity, first discovered under Bronze Age round barrows (as opposed to the Stone Age long barrows) and in inhumation graves across Europe, has been debated since the late 19th century. Early researchers found similarities in a distinctive pottery shape, technology and decoration style and funerary objects across Europe, from Portugal to Poland and from Ireland to Italy. From these moments of discovery onwards, the "Bell Beaker culture" was established. In the 1920s, the appearance of this "culture" was conceived as a migratory, or even invasive, event spreading across Western Europe. Associated with this invasion were the specific Bell Beaker pottery vessel and changes in burial traditions, but also innovative practices such as copper metallurgy and changes in social organisation. With the technical development of radiocarbon dating and a steady increase in finds from across Europe since the 1960s, this migration hypothesis developed into the famously convoluted Rückstrom theory, giving both a point of origin and a sense of direction to this migration. In the 1970s, the study of cultural processes and developments also reached the Bell Beaker phenomenon, with two different explanatory models: the Beaker network model, advocating the study of relationships between sites from a more neutral perspective, and the Dutch model, providing evidence for continuity and tradition instead of migration in Bell Beaker funerary assemblages in the Netherlands. Since the 1970s, these two newer models have been used on regional scales and they paved the way for the "Bell Beaker Phenomenon" model that developed in the 1990s. This model emphasizes the importance of regional traditions and continuity in daily life as a contrast to the innovative role of the Bell Beaker. However, on a European-wide scale, the migration hypothesis, favouring an Iberian origin, remained the most important way of explaining the apparent cultural uniformity since the 1980s, even until the present day. This is illustrated by the interpretation favoured in the recent surge of studies into ancient human DNA. The subfield of population genomics, focusing on the modelling of past human populations, has until quite recently mainly reiterated the Bell Beaker migration hypothesis as the explanation for the observed patterns in (primarily Central German) Bell Beaker genome spatial variation. There are, however, some problems we must face. Firstly, this interpretation, the continued use of a migration hypothesis as the explanation, is at odds with both the Dutch model and the Bell Beaker network model, and the principles behind the Bell Beaker phenomenon interpretation. Secondly, a critical examination of its underlying data for the Rückstrom theory and the current migration models suggest they are heavily biased towards burial assemblages. These models favour interpretations based on the special character of these funerary assem-

blages: when one looks at burials, one will always find rapid changes, quickly adopted innovations, new wealthy elites or swift migration events or even invasions. And finally this perspective assumes a uniform and an external impulse for an uncritical process of adoption: as if everyone in Europe adopted the Bell Beaker phenomenon in the first place, and on top of that everyone adopted it in the same way.

Therefore, this thesis does not focus on the burial evidence, but it interprets the adoption of the Bell Beaker phenomenon from a settlement perspective by comparing various human daily practices from settlements across different regions of Europe and their development through time and space. Settlements have been notoriously absent from comparative studies of the Bell Beaker phenomenon, even in terms of regional studies. This absence is mostly caused by the lack of uniformity in appearances between settlements from, for instance, Portugal versus the Czech Republic. Also the lack of 'proper' house plans in many parts of Europe has hindered systematic research and even inspired migration theories. However, when we move beyond this appearance we see a wealth of data that can be used to study various aspects of innovation: *i.e.* studying processes in detail, looking at reinvention and rejection, unravelling the mechanisms of innovation diffusion and communication networks, and coming to terms with human practices, skills and creativity in the innovation process.

Following this research problem, the main research question of this thesis can be presented as follows:

> How have local communities across Europe adopted the Bell Beaker phenomenon?

This question can be divided into three distinct questions related to processes, mechanisms and practices of innovation.

1. How did the adoption process of the Bell Beaker phenomenon take place in temporal terms?
2. What social landscapes and mechanisms characterise the adoption of the Bell Beaker phenomenon?
3. How should we understand the process of reinvention, the interplay between tradition and adoption of an innovation, when considering the Bell Beaker phenomenon?

In order to answer these research questions, we selected all settlements dating between 2600-2000 BC from six areas of Europe: the Portuguese Estremadura, Western France, Northern France, the Lower Rhine Area, Southern Scandinavia/Northern Germany and the Czech Republic. In terms of the theory and methodology used, the research fields of innovation, technology and network analysis will provide the necessary underpinnings.

The study of innovation is mainly dominated by the 1960s work of the sociologist E.M. Rogers, who generalised the processes taking place in present day societies when agricultural and medical innovations are adopted. Rogers' work focused specifically on the innovation processes and the various stages and attitudes towards reinvention, and the various different aspects leading to successful innovations. An important dimension was added in the 1970s by M. Granovetter, who first connected innovation to social network analysis with his 'Strength of Weak Ties' model. This model is based on the ways job knowledge is transmitted between individuals and communities. In this model, information (and thus innovation) is more easily transmitted from people with whom one shares a heterogenous, instead of a homogenous, interaction. This is highlighted by the presence of cliques: these networks, in which homogenous relationships between entities dominate, are less open for new information and innovations. This highlighted a change in research perspective from processes of innovation towards the study of entities and mechanisms of innovation. A further anthropological perspective on innovation was given by P. Lemonnier and the sociological study of technology since the 1990s. From these studies, it became clear that, through practices, the choices made by craftsmen and wider society influences the processes of reinvention. Specifically, the pottery production sequence is a well-studied example in which different choices are influenced differently and innovations are played out differently.

In archaeology, these studies have been recognised and taken aboard only rarely. It was M. Zvelebil's seminal work into the Neolithisation process that paved the way, by relating Rogers' three different stages to the three ways in which Mesolithic hunter-gatherer communities adopt the Neolithic way of life. In doing so, Zvelebil moves beyond the evolutionary wave of advance models that dominated the 1980s literature on Neolithisation processes. Later work focused not only on the development of agriculture, but people such as C. Strahm also use this model to explain the spread of metallurgy throughout Europe.

The use of networks in archaeology is a fairly recent development, which has focused mainly on GIS and least-cost-path analyses. Recent studies of networks of innovation include the exchange of obsidian in Mayan society, the earliest copper artefacts in the Balkans and communication networks in Baden and Corded Ware Central Europe. The latter two have been the main influence in this study, focusing on communication networks as the mechanism for understanding cliques and patterns in human practices. A large degree of uniformity in settlement practices is understood as clique, in which it will be more difficult to adopt and sustain an innovation such as the Bell Beaker phenomenon. Similarly, the absence of any connection between settlements might also be an explanation for the lack of communication between communities and the delayed adoption of an innovation.

Studying innovation practices in pottery production, archaeologists have in the past mainly looked at forming and specifically the development of wheel throwing practices. The study of coil-built pottery sequences has focused mainly on identifying specific coiling techniques, and distinguishing various ways in which skills and creativity play a role. These are important elements of innovation when considering potters' acquisition of new techniques of making vessels and the difficulties that they face when changing their motor habits. Changing vessel shapes, the identification of certain levels of skill, and finding creativity will be used to see how reinvention is being shaped at this local level.

Thus, with the past research theories and methodologies about innovation from sociological, anthropological and archaeological perspectives in our mind, we can develop this into methods that can be used to study innovation and the regional adoption of the Bell Beaker phenomenon in Europe in the later 3rd millennium BC.

For the study of the various innovation processes (adoption, reinvention and rejection) and other aspects of innovations (temporality, sustainability and impact), it was chosen to focus mainly on pottery frequencies and percentages found on settlements. This follows the work of Zvelebil and L. Kooijmans, who practically use percentages of wild and domestic animal remains in their analysis of Neolithisation processes. A strict chronological resolution is obtained by taking both the median of ^{14}C dates and performing an aoristic analysis on these dates. These frequencies will be chronologically arranged, for a possible visual resemblance to the well-known S-curves as found by both Rogers and Zvelebil. Additionally, the frequencies of sites and their respective percentages can inform us about the moment of adoption and the impact of the Bell Beaker phenomenon.

The analysis shows that in most study areas the Bell Beaker innovation process is limited to the availability phase. The subsequent substitution and consolidation phases are not achieved. In all cases, Bell Beaker pottery represents only a minority of the total pottery percentage found on settlements. The so-called Common Ware vessels are not substituted by Bell Beaker vessels, and thus remain relatively unaffected by the appearance of this new pottery style. The only study area in which Bell Beaker pottery was not adopted, and after a very short availability phase, was abandoned, is Northern France. Here, several settlements are found in the Seine valley, the coastal area and the Meuse Valley, but this presence remains short-lived. The contemporaneous occupation of so-called Gord and Deûle/Escaut settlements on the sandy soils represents a remarkable contrast in terms of pottery assemblages (no Bell Beaker presence) and can thus be interpreted as an active rejection against the Bell Beaker phenomenon.

Additionally, looking at pottery frequencies and percentages shows that regionally a large variety exists in the composition of settlement pottery assemblages, when considering the presence or absence of older or younger pottery. Settlements in the Czech Republic are relatively 'clean' whereas the settlements in the Lower Rhine Area almost unequivocally are 'contaminated' by either older Corded Ware or Vlaardingen pottery, or younger Barbed Wire pottery.

Site frequencies show that there is a difference in numbers of low and high percentage Bell Beaker settlements between regions in Europe. A very low impact is seen in Northern France, while in Western France, the Portuguese Estremadura and Lower Rhine Area the impact is high with many new relatively large Bell Beaker settlements appearing.

Another look at processes of innovation is provided with the chronological analysis of specific settlements' occupation histories. Several settlements, where a good stratigraphy, various subsequent cultural units and multiple ^{14}C dates could be obtained, were chosen for detailed Bayesian modelling. This technique allows for the calculation of more detailed chronologies of habitation, intervals between habitation phases and of occupation spans. The Bayesian models focus on the Bell Beaker-associated occupation phases, the calculated span of these phases and the interval between the preceding occupation, the Bell Beaker phase and the subsequent habitation. Thus, insight is gained into temporal aspects that further illuminate the adoption process regionally. An additional benefit of these Bayesian models will be that for the first time we will gain an understanding of the general spread of the Bell Beaker phenomenon across Europe beyond the spatial modelling of radiocarbon dates. Thereby, it will be possible to test the current diffusionist models by giving a qualitative insight into settlement occupation histories as a proxy for the European-wide distribution.

The spans and intervals found at seven Bell Beaker settlements show a regionally varied picture. A very short interval is noted for the occupation at Zambujal in Portugal and possibly also at Horni Ian in the Czech Republic, while a larger interval existed between Corded Ware and Bell Beaker occupations at at Ergersheim in Germany and even longer at La Lède du Gurp in Western France. At Mortens Sande II in Denmark and at Vlaardingen in the Netherlands, the interval between the Corded Ware/Vlaardingen and Bell Beaker occupations, respectively, is less long, but still considerable. These seven settlements can serve as proxies in order to understand the wider patterns in regional occupation histories. Short intervals between settlement occupation horizons are interpreted as a sign of quick adoption, whereas slow adoption is found at settlements that show a more considerable interval. Instead, the span of occupation can inform us about the sustainability of the Bell Beaker occupation. At some settlements, such as Horni Ian and Lède du Gurp, the relatively long Bell Beaker occupation phase points to a sustainable use of Bell Beaker material culture, whereas at Zambujal or Mortens Sande II, the Bell Beaker phase was shorter-lived instead and thus the innovation had a less sustainable character.

When we compare our results of the various Bayesian analyses with the current diffusionist models for the spread of the Bell Beaker phenomenon, there seems to be a less distinct origin. In both the Portuguse Estremadura and the Lower Rhine Area, the Bell Beaker phenomenon appears around 2600 BC. Around 2500 BC, communities in the Czech Republic and Western France adopt the Bell Beaker phenomenon and only around 2350 BC do Bell Beaker settlements appear in Southern Scandinavia.

A second analysis focuses on mechanisms of diffusion, studying the ways in which the Bell Beaker phenomenon spread across Europe: studying the associated new objects, practices and technologies that spread, independent from any discussion of its origin and spatial diffusion. This relates to the age-old question: What does the Bell Beaker phenomenon constitute? What does it mean to be part of a "Beaker network"? Subsequent topics within this analysis include the movement of objects and practices, the movement of people and the movement of ideas.

The movement of objects and practices will be approached by looking at the two types of distributions and a treatment of evidence for pottery mobility: Firstly by analysing specific new practices on settlements, such as domesticated horses, specialised flint artefacts, domesticated spelt wheat and metallurgy, and secondly by looking at the wider temporal, spatial and contextual distribution of bone plates, pendants and copper Palmela points. These objects were found on several settlements within the study areas, and a wider analysis highlights their significance for the diffusion of Bell Beaker ideas and practices.

Domesticated horses are known in specific areas of Europe from before the Bell Beaker period, but in the Lower Rhine Area and possibly Southern Scandinavia/Northern Germany the earliest examples might be associated to the Bell Beaker phenomenon. Similarly, evidence for metallurgical practices is known from both the Iberian Peninsula and the Czech Republic, predating the Bell Beaker phenomenon, but Bell Beaker associated metallurgy is found on settlements in the Czech Republic and the Lower Rhine Area. This can possibly be linked to new types of objects, such as cushion stones and 'metalworkers graves', hinting at changing values associated with the adoption of the Bell Beaker phenomenon. The spread of spelt wheat is less studied, but shows a concentration on two Swiss and several Danish Bell Beaker settlements, but these seem to be the only occurrences associated with the Bell Beaker phenomenon. Evidence for pottery exchange associated with the Bell Beaker phenomenon is limited to regional exchange in the Czech Republic and some instances in Western France. However most pottery remains locally produced. In sum, there is not one object or innovation associated with the spread of the Bell Beaker phenomenon across Europe: the adoption of new practices and new objects is in most instances regionally varied. The specific objects studied – bone plates, pendants and copper Palmela points – show, however, that exchange networks superseding the regional network do exist. The pendants and plates show a distribution throughout Central and Eastern Europe and are mainly associated with both Bell Beaker and Corded Ware graves. The Palmela points are primarily found in Western and Southwestern Europe and are associated with Bell Beakers in all sorts of contexts. This difference might indicate a more variable role in terms of value for the Palmela points, whereby supra-regional values determine size and shape, whereas regional values determine use and deposition. Contrastingly, pendants and plates show continuity in shape, size and context from the Corded Ware to the Bell Beaker phenomenon.

Next to the movement of objects and practices, we study the movement of ideas through an analysis of communication networks and cliques. A study of communication networks and cliques through the analysis of settlement material culture will inform us about the heterophility between communities: the ways in which communities vary within the regions of Europe. Following the 'Strength of Weak Ties' model, communities that form close knitted cliques based on their settlement material culture will have more difficulty in adopting the Bell Beaker phenomenon. When we study these networks, based on the calculated frequencies in settlement material culture from all the six study areas, we can see various differences in terms of betweenness centrality (the measurement of centrality of a node within the network), settlement types and geographical distribution, and the strengths of the links between nodes, based on the calculated Brainerd-Robinson coefficient.

This analysis shows that a large variety in networks between regions exists. Especially in terms of link strength, the variability is striking. The strongly linked networks of Czech Republic and Northern France versus the relatively weak link strength in Southern Scandinavia/Northern Germany are clearly the result of different communication networks playing a role in the adoption of the Bell Beaker phenomenon. The clique that developed in Northern France consists of Gord and Deûle/Escaut settlements, and shows no communication with Bell Beaker settlements. In contrast, the network in Southern Scandinavia/Northern Germany is very fragmented and apparently settlements are very varied here. Interestingly, this area is known for both its specialised flint dagger production, apparently not significantly affecting the communication networks, and its late Bell Beaker adoption.

A final aspect of mechanisms into the diffusion of Bell Beaker phenomenon is the study of the movement of people. Two different scales of analysis, the individual and the community, associated with two distinct methods of analysis, isotopic analyses on the elements of Strontium and Oxygen and the study of ancient DNA, will be scrutinized closely. When we consider the isotopic analyses that have been carried out, we largely see local individuals and a minority of individuals that can be recognised as regionally mobile. Only in a very seldom instance, isotope evidence hints at a mobility that is beyond the regional scale, such as the Amesbury Archer found in Britain. On a larger scale, ancient DNA evidence has recently reinvigorated the Bell Beaker (and likewise Corded Ware) migration debate, but a different perspective on the presented evidence must be put forth here. Several problems exist, related to sample selection (not every Bell Beaker grave is the same) and sample bias (only a very small selection of individuals was chosen to be buried in a 'classic' Bell Beaker grave). The final problem is how to reconcile these different datasets, different spatial and temporal scales, and create an understanding of Bell Beaker mobility which recognises a regional mobility pattern and leaves open the long-distance population migration as envisaged by aDNA. A proposed solution is to see the extreme long-distance mobility from a biological interpretation as a Lévy-flight, coinciding with a more regional mobility pattern, and mainly regional exchange mechanisms of objects and ideas.

The third and final analysis shows us how daily practices change with the appearance of the Bell Beaker phenomenon. Specifically for Northern Europe, North West Europe and Central Europe, a specific focus on the reinvention process will give us insight into the regional specific ways in which the interplay between tradition and innovation takes place. A first study involves the change in forming practices of Common Ware pottery. It is already well-understood that Common Ware pottery is largely traditional in its types of vessels as Marie Besse has shown. Because of this continuity, the specific practices of forming these vessels and regional variability and differences between tradition and innovation can be studied closely here. By taking a metric approach, using quantitative data and Principal Component Analysis, these developments can be illustrated. The forming stage in prehistoric pottery manufacture is intricately related to social aspects beyond the potter's choice, but also deeply rooted into traditional practices and learned behaviour. Next to this focus on changing forming traditions, the potter's own choices during this period of innovation will be studied by looking at his skills in forming and decorating vessels and creativity in dealing with decoration motifs.

The pottery forming analysis is focused on Northwest and Central Europe. This analysis shows continuity in shapes between (at least) the Dutch Vlaardingen and the various types of Common Ware vessels, specifically the Riesenbecher, French and Danish Common Ware, and to a lesser degree Potbeker vessels. Technologically, Vlaardingen, Common Ware and Riesenbecher are also closely related. Other types of settlement pottery predating the Bell Beaker phenomenon (such as undecorated Funnelbeaker vessels or Corded Ware settlement pottery) were not analysed. From this is becomes quite clear that the reinvention process of the Bell Beaker phenomenon in Northwest and Central Europe was a gradual process of changing traditions. Instead of Common Ware pottery, the thin-walled (and highly decorated) Potbeker vessels more closely resemble Bell Beaker vessels. The Potbeker vessels thus represent a specific regional reinvention practice unique for this time period:

decoration motifs and vessel technology are primarily adopted from the Bell Beaker pottery tradition, whereas shape and decoration techniques (nail impressions, warts and holes beneath the rim) represent traditional elements also seen in Riesenbecher, Corded Ware settlement pottery and Vlaardingen vessels. A cultural break between the Western French Artenac and Bell Beaker communities, based on the Common Ware vessel shapes, was argued for by some researchers. From the data gathered here from several Artenac and Common Ware vessels this is less clear, but more data is needed to study these changes in pottery forming practices and include them within a wider analysis of settlement patterns. Thus, in Western France there might be a more abrupt change, involving new potting practices and the learning of new motor habits, possibly associated with the arrival of new people. In Northern France a similar situation exists, with Gord and Deûle/Escaut settlements, on the one hand, and Bell Beaker settlements on the other. At least we can state that Bell Beaker Common Ware pottery here is not different from other Common Ware vessels. Only a comparison of the shapes of Northern French Common Ware and Gord and Deûle/Escaut pottery can lead to more insights into the interplay and the probable rejection process that became apparent through other sources of data. Recent studies into Common Ware pottery from the Iberian Peninsula have also identified interesting changes that need further investigation.

The final analysis into changing practices of pottery production focuses on skills and creativity, specifically the skills of potters in adopting the Bell Beaker phenomenon. A technological analysis of settlement pottery fro Northwest and Central Europe shows that, in general, potters are good in their work: coils are well attached, vessel walls are very thin when needed and temper sizes are small and, in most cases, decoration motifs are executed with care. Notable are the exceptions: on the settlement of Lanz 14 in Northern Germany, Bell Beaker decoration motifs are not very well executed. This shows a lack of skill in this part of the production process. Apparently, it was not particularly important to be precise and meticulous, but to merely have geometric motifs from spatula impressions would be enough. This lack of skill can also be seen against the light of other developments in Northern Germany: a low sustainability of the Bell Beaker innovation and low link strength in the Bell Beaker communication networks. For the aspect of creativity within the production process, the unique geometric motifs in the Czech Republic and the unique Potbeker decoration motifs in the Lower Rhine Area must be mentioned. These show that a sustainable innovation existed that could be moulded and reworked.

In sum, we have discussed the processes, mechanisms and practices of innovation associated with the Bell Beaker phenomenon from a settlement perspective in six different study areas of Europe. In doing so, we've answered our main research questions. The adoption process of the Bell Beaker phenomenon was restricted to the availability phase in all study areas, but took place at different moments in time, with very different results in terms of impact and sustainability, and with regionally varied products of reinvention. This varied reinvention can be understood when looking at it from the perspective of the impact and sustainability of the innovation, and the strength of communication networks between different communities within a region. The mechanisms of Bell Beaker adoption reviewed here focus on the regional exchange of material culture (pottery, flint and copper artefacts) and ideas about funerary practices, the regional mobility of people and long-distance mobility of certain individuals following the principles of the Strength of Weak Ties model.

Finally, this shows that local communities across Europe adopted the Bell Beaker phenomenon differently and it might be better to speak about different Bell Beaker phenomena altogether.

Zusammenfassung

Diese Dissertation konzentriert sich auf die Prozesse, Mechanismen und Praktiken der Innovation, die mit dem Auftreten des Glockenbecherphänomens in Westeuropa zwischen etwa 2600 v. Chr. und 2000 v. Chr. einhergehen. Das Glockenbecherphänomen ist eine von Archäologen verwendete Bezeichnung für eine spezifische materielle Uniformität, die man in archäologischen Funden beobachtet. Diese angebliche Gleichförmigkeit, die zunächst unter bronzezeitlichen, runden Grabhügeln (im Gegensatz zu steinzeitlichen Langbetten) und in Körpergräbern in ganz Europa entdeckt wurde, wurde seit dem späten 19. Jahrhundert wissenschaftlich diskutiert. Frühe Forscher fanden Ähnlichkeiten in einer unverkennbaren Keramikform, -technologie und -verzierung sowie in Grabbeigaben in ganz Europa von Portugal bis Polen und von Irland bis Italien. Ab diesem Entdeckungszeitpunkt an, wurde die „Glockenbecherkultur" gegründet. In den 1920er Jahren wurde das Auftreten dieser „Kultur" als ein Ereignis erachtet, das sich durch migratorisches und sogar invasives Verhalten kennzeichnete, und sich über ganz Europa ausbreitete. Verbunden mit dieser Invasion sind die spezifische Glockenbecherkeramik und Veränderungen in den Bestattungstraditionen aber auch innovative Praktiken wie Kupfermetallurgie und Veränderungen in der Sozialorganisation. Mit der technischen Entwicklung der Radiokarbon-Datierung und einem stetigen Zuwachs der Funde aus ganz Europa seit den 1960er Jahren wurde die Migrationshypothese zur bekannten verwickelten Rückstrom-Theorie, die der Migration einen Ausgangspunkt und eine Richtung verliehen hat. In den 1970er Jahren befasste sich das Studium kultureller Prozesse und Entwicklungen auch mit dem Glockenbecherphänomen und lieferte zwei verschiedene Erklärungsmodelle: das Beaker-Netzwerkmodell, das die Untersuchung von Beziehungen zwischen den Fundorten aus einer neutraleren Perspektive befürwortet, und dem niederländischen Modell, das Beweise für Kontinuität und Tradition anstatt Migration in niederländischen Glockenbechergrabensembles vorlegt. Seit den 1970er Jahren wurden diese zwei neueren Modelle auf Regionalebene implementiert und sie bereiteten den Weg für das Model des „Glockenbecherphänomenons", das sich in den 1990er Jahren entwickelte. Dieses Modell betont die Bedeutung regionaler Traditionen und Kontinuität im Alltag als Kontrast zur innovativen Rolle des Glockenbechers. Auf europaweiter Ebene blieb jedoch die Migrationshypothese, die einen iberischen Ursprung favorisiert, der wichtigste Weg, um die anscheinende kulturelle Gleichmäßigkeit seit den 1980er Jahren zu erklären – sogar bis heute. Diese wird durch die Interpretation, die in der jüngsten Welle von Studien über aDNA bevorzugt wird, dargestellt. Dieses Teilgebiet der Bevölkerungsgenomik, das sich auf die Modellierung vergangener menschlicher Bevölkerungen konzentriert, hat bis vor Kurzem hauptsächlich die Glockenbechermigrationshypothese als die Erklärung für das beobachtete Muster in der räumlichen Variation der (vor allem mitteldeutschen) Glockenbechergenomen wiederholt. Es gibt jedoch einige Probleme, denen wir uns stellen müssen. Erstens diese Interpretation – die fortgesetzte Verwendung der Migrationsthese als einziger Erklärung – widerspricht sowohl dem niederländischen als auch dem Glockenbechernetzwerkmodell sowie den Prinzipien, die hinter der Interpretation des Glockenbecherphänomens stehen. Zweitens deuten eine kritische Prüfung der zugrundeliegenden Daten für die Rückstromtheorie und die gegenwärtigen Migrationsmodelle an, dass sie ziemlich einseitig auf Grabassemblagen ausgerichtet sind. Diese Modelle bevorzugen Interpretationen, die sich auf den speziellen Charakter dieser Grabausstattungen stützen: wenn man Bestattungen betrachtet, findet man immer schnelle Entwicklungen, schnell adoptierte Innovationen, neue reiche Eliten, rasche Migrationsereignissen oder sogar Invasionen. Schließlich setzt diese Perspektive einen gleichmäßigen und externen Impuls für einen unkritischen Prozess der Aneignung voraus: als ob jedermann in Europa das Glockenbecherphänomenon angenommen und darüber hinaus dieses in der gleichen Art und Weise übernommen hätte.

Deshalb konzentriert sich diese Arbeit nicht auf das Bestattungsmaterial, sondern interpretiert die Annahme des Glockenbecherphänomens aus einer Siedlungsperspektive durch den Vergleich unterschiedlicher menschlicher Alltagspraktiken von Siedlungen in diversen Regionen Europas und ihre Entwicklung durch Zeit und Raum. Bisher fehlten Siedlungen offenkundig in Vergleichsstudien zum Glockenbecherphänomen – auch in regionalen Studien. Diese Abwesenheit ist primär durch das Fehlen einer Einheitlichkeit in Erscheinungsformen zwischen Siedlungen – z.B. zwischen Portugal und der Tschechischen Republik – zurückzuführen. Auch das Fehlen von ‚richtigen' Hausplänen in vielen Teilen Europas hat die systematische Erforschung gehindert und sogar zu Migrationstheorien inspiriert. Aber wenn wir über dieses Erscheinungsbild hinausgehen, sehen wir eine Fülle von Daten, die für eine Untersuchung unterschiedlicher Aspekten der Innovation benutzt werden können: wir sollten Prozesse im Detail untersuchen, Neuerfindungen und Ablehnungen betrachten, die Mechanismen der Diffusion von Innovationen und Kommunikationsnetzwerke aufdecken und menschlichen Praktiken, Fertigkeiten und die Kreativität während des Innovationsprozesses aufarbeiten.

Im Hinblick auf dieses Forschungsproblem, lässt sich die Hauptforschungsfrage dieser Dissertation wie folgt präzisieren:

> Wie haben lokale Gemeinschaften in ganz Europa das Glockenbecherphänomen übernommen?

Diese Frage kann in drei verschiedene Fragestellungen in Bezug auf Prozesse, Mechanismen und Praktiken unterteilt werden:

1. Wie erfolgte der Annahmeprozess des Glockenbecherphänomens zeitlich?
2. Welche sozialen Mechanismen charakterisieren die Adoption des Glockenbecherphänomens?
3. Wie sollen wir den Prozess der Neuerfindung und das Zusammenspiel zwischen Tradition und der Annahme einer Innovation verstehen, wenn wir das Glockenbecherphänomen betrachten?

Um diese Forschungsfragen zu beantworten, haben wir Siedlungen aus sechs Regionen Europas ausgewählt, die zwischen 2600-2000 v. Chr. datieren: die portugiesische Estremadura, Westfrankreich, Nordfrankreich, das Niederrheingebiet, Südskandinavien/Norddeutschland und die Tschechische Republik. Im Hinblick auf die angewandte Theorie und Methodologie werden die Forschungsfelder Innovation, Technologie und Netzwerkanalyse die notwendigen Grundlagen bereitstellen.

Die Erforschung der Innovation wird hauptsächlich durch die Arbeit des Soziologen E.M. Rogers während der 1960er Jahren dominiert, der die Prozesse, die gegenwärtigen Gesellschaften bei der Übernahme von landwirtschaftlichen und medizinischen Innovationen adoptieren, verallgemeinerte. Rogers' Arbeit konzentrierte sich vor allem auf Innovationsprozesse und die diversen Phasen und Einstellungen zur

Neuerfindung sowie die unterschiedlichen Aspekten, die zur erfolgreichen Innovation führen. Eine wesentliche Dimension wurde in den 1970er Jahren durch M. Granovetter hinzugefügt, der als erster Innovation mit der sozialen Netzwerkanalyse durch sein ‚Strength of Weak Ties' Modell verknüpfte. Dieses Modell basiert auf der Art und Weise, wie Arbeitswissen zwischen Individuen und Gemeinschaften ausgetauscht wird. In diesem Modell wird Information (und daher Innovation) leichter zwischen Menschen, mit denen man eine heterogene anstatt eine homogene Interaction teilt, übertragen. Dies kann durch das Vorhandensein von Cliquen verdeutlicht werden: Die Netzwerke, in der homogene Beziehungen zwischen Einheiten dominieren, sind für neue Information und Innovationen weniger offen. Diese Erkenntnis zeigte eine Veränderung der Forschungsperspektive von der Erforschung von Innovationsprozessen hin zur Untersuchung von Einheiten und Mechanismen der Innovation. Eine weitere anthropologische Perspektive auf Innovation wurde seit den 1990er Jahren durch P. Lemonnier und die soziologische Untersuchung von Technologie präsentiert. Aufgrund dieser Studien wurde es klar, dass mittels Praktiken die Entscheidungen von Handwerker und die breitere Gesellschaft die Prozesse der Neuerfindung beeinflussen. Insbesondere sind die Produktionsabläufe der Keramikherstellung ein gut untersuchtes Beispiel, in dem unterschiedlichen Entscheidungen unterschiedlich beeinflusst und Innovationen unterschiedlich ausgespielt werden.

In der Archäologie wurden die genannten Studien nur selten anerkannt und berücksichtigt. Die bahnbrechende Arbeit von M. Zvelebil über Neolithisierungsprozesse ebnete den Weg, indem er Rogers' drei verschiedene Phasen auf die drei Arten, in denen mesolithische Jäger- und Sammlergemeinschaften die neolithische Lebensweise annahmen, in Beziehung gesetzt hat. Damit ging Zvelebil über die evolutionäre Bewegung von fortgeschrittenen Modellen hinaus, die die Forschungsliteratur über Neolithisierungsprozesse in den 1980er Jahren dominierten. Spätere Untersuchungen konzentrierten sich nicht nur auf die Entwicklung der Landwirtschaft, sondern Forscher wie Strahm nutzten dieses Modell auch, um die Verbreitung der Metallurgie in ganz Europa zu erklären.

Die Verwendung von Netzwerken in der Archäologie ist eine ziemlich neue Entwicklung, die sich hauptsächlich mit GIS und Least-Cost-Path-Analysen befasst hat. Neuere Untersuchungen zu Innovationsnetzwerken umfassen den Austausch von Obsidian in der Maya-Gesellschaft, die frühesten Kupferartefakte auf dem Balkan und Kommunikationsnetzwerke in der Badener und der schnurkeramischen Kulturen Zentraleuropas. Die beiden letzteren waren das Hauptaugenmerk dieser Studie, in der auf Kommunikationsnetzwerke, als der Mechanismus um Cliquen und Mustern in menschlichen Praktiken zu verstehen, konzentriert wurde. Ein hohes Maß an Gleichmäßigkeit in Siedlungspraktiken wird als Clique aufgefasst, in der es schwieriger ist, eine Innovation wie das Glockenbecherphänomen zu übernehmen und aufrechtzuerhalten. Gleichermaßen gibt das Fehlen jeglicher Verbindung zwischen Siedlungen auch eine Erklärung für einen Mangel an Kommunikation zwischen Gemeinschaften und die verzögerte Annahme einer Innovation.

In der Vergangenheit haben sich Archäologen bei der Erforschung innovativer Praktiken in der Keramikproduktion hauptsächlich auf der Formgebung und insbesondere die Entwicklung von Praktiken in Zusammenhang mit der Töpferscheibe fokussiert. Bei der Untersuchung von Keramiksequenzen mit Gefäßen in Wulsttechnik, ging es hauptsächlich darum, spezifische Wickeltechniken zu identifizieren und verschiedene Arten zu identifizieren, in denen Fertigkeiten und Kreativität eine Rolle spielten. Diese sind wichtige Elemente der Innovation, wenn man die Aneignung neuer Herstellungstechniken der Töpfer und die Schwierigkeiten bei der Änderung ihrer motorischen Gewohnheiten bedenkt. Die Veränderung der Gefäßformen und die Identifizierung bestimmter Stufen der Fertigkeiten sowie die

Erkennung von Kreativität wird genutzt, um festzustellen, wie Neuerfindungen auf lokaler Ebene gestaltet wird.

Mit den bisherigen Forschungstheorien und -methoden zur Innovation aus soziologischen, anthropologischen und archäologischen Perspektiven zur Hand können wir daher diese zu Methoden entwickeln, die der Erforschung der Innovation und der regionalen Aneignung des Glockenbecherphänomens in Europa im späten 3. Jahrtausend v. Chr. dienen.

Für die Untersuchung der verschiedenen Innovationsprozesse (Aneignung, Neuerfindung, und Ablehnung) und andere Aspekte der Innovation (Zeitlichkeit, Nachhaltigkeit und Auswirkungen) wurde entschieden, den Schwerpunkt hauptsächlich auf die Häufigkeit und Prozentanteile von Töpferwaren in Siedlungen zu setzen. Dies folgt der Arbeit von Zvelebil und Louwe Kooijmans, die in ihrer Analyse von Neolithisierungsprozessen die Prozentanteile von Wild- und Haustierresten verwenden. Eine stringente chronologische Auflösung wird erzielt, in dem man den Median der ^{14}C Daten nimmt und eine aoristische Analyse dieser Daten ausführt. Die Frequenzen werden chronologisch angeordnet, um eine mögliche visuelle Ähnlichkeit zu den bekannten S-Kurven von Rogers und von Zvelebil zu erzielen. Darüber hinaus können uns die Häufigkeit der Standorte und ihre jeweiligen Prozentanteile über den Zeitpunkt der Adoption und die Auswirkungen des Glockenbecherphänomens informieren.

Die Analyse zeigt, dass der Innovationsprozess des Glockenbecherphänomens in die meisten Untersuchungsbereichen auf die Verfügbarkeitsphase begrenzt ist. Die nachfolgenden Substitutions- und Konsolidierungsphasen werden nicht erreicht. In alle Fällen macht Glockenbecherkeramik nur eine Minderzahl des in Siedlungen gefundenen gesamten Keramikanteils aus. Die sogenannten „Common Ware" Gefäße werden nicht durch Glockenbechergefäße ersetzt und bleiben daher durch das Aussehen des neuen Keramikstils relativ unbeeinflusst. Das einzige Untersuchungsgebiet, wo Glockenbecherkeramik nicht angenommen und nach einer sehr kurzen Verfügbarkeitsphase aufgegeben wurde, ist Nordfrankreich. Hier werden zwar einige Siedlungen im Seine-Tal, im Küstengebiet und im Maas-Tal gefunden, aber dieses Vorkommen ist nur von kurzer Dauer. Die zeitgleiche Besiedlung von sogenannten Gord- und Deûle/Escaut Siedlungen auf sandigem Böden stellt eine bemerkenswerte Kontrast im Hinblick auf die Keramikassemblagen (keine Glockenbecherpräsenz) dar und kann daher als eine aktive Ablehnung gegen des Glockenbecherphänomens interpretiert werden.

Zusätzlich zeigt sich bei der Beachtung von Keramikhäufigkeiten und -anteilen, dass eine regional große Vielfalt in der Zusammensetzung der Assemblagen von Siedlungskeramik vorliegt, wenn man das Vorhandensein oder Fehlen von älterer oder jüngerer Töpferware in Betracht zieht. Siedlungen in der Tschechischen Republik sind relativ ‚sauber', während Siedlungen im Niederrheingebiet fast zweifelsfrei durch entweder ältere Schnurkeramik, Vlaardingen Keramik oder durch jüngere Stacheldraht („Barbed Wire") Keramik ‚kontaminiert' sind.

Siedlungshäufigkeiten zeigen, dass es zwischen Regionen in Europa einen Unterschied in der Anzahl der Siedlungen mit niedrigem und hohem Glockenbecheranteile gibt. Ein sehr niedriger Einfluss ist in Nordfrankreich erkennbar, während in Westfrankreich, der portugiesischen Estremadura und dem Niederrheingebiet der Einfluss mit vielen neuen relativ großen Glockenbechersiedlungen hoch ist.

Ein weiterer Blick auf die Innovationsprozesse wird mit einer chronologischen Analyse von spezifischen Siedlungsgeschichten gewonnen. Einige Siedlungen, wo eine gute Stratigraphie, verschiedene nachfolgende kulturelle Einheiten und mehrfache ^{14}C Daten erhalten werden konnten, wurden für eine detaillierte Bayessche Modellierung ausgewählt. Diese Methode ermöglicht eine Berechnung von detaillierteren Siedlungschronologien, von Intervallen zwischen Siedlungsphasen und von Besiedlungszeitspannen. Die bayesschen Modelle konzentrieren sich auf die Siedlungsphasen, die in Verbindung mit dem Glockenbecherphänomen stehen, die berechnete Zeitspanne dieser Phasen und das Intervall zwischen einer vorhergehenden Besetzung, die Glockenbecherphase und einer nachfolgenden Besiedlung. Auf diese Weise wird Einsicht in zeitliche Aspekte gewonnen, die den Aneignungsprozess auf regionaler Ebene weiter beleuchten. Ein weiterer Vorteil der bayesschen Modelle besteht darin, dass wir – über eine räumliche Modellierung von Radiokarbondaten hinaus – erstmals ein Verständnis für die allgemeine Verbreitung des Glockenbecherphänomens in ganz Europa erhalten. Damit wird es möglich, die aktuellen Diffusionsmodelle zu testen, indem man einen qualitativen Einblick in der Siedlungsgeschichte als Proxy für die europaweite Distribution liefert.

Die Zeitspannen und Intervalle, die in sieben Glockenbechersiedlungen gefunden wurden, zeigen ein regional unterschiedliches Bild. Ein sehr kurzes Intervall wird für die Siedlung in Zambujal, Portugal und möglicherweise auch in Horni Ian in der Tschechischen Republik verzeichnet, während ein längeres Intervall zwischen Schnurkeramik- und Glockenbechersiedlungen bei Ergersheim in Deutschland und ein noch längeres in La Lède du Gurp in Westfrankreich existierte. Bei Mortens Sande II in Dänemark und Vlaardingen in den Niederlanden ist das Intervall zwischen Schnurkeramik/Vlaardingen und Glockenbecherbesiedlung weniger lang, aber noch immer signifikant. Diese sieben Siedlungen können als Proxys dienen, um die breiteren Muster in regionalen Besiedlungsgeschichten zu begreifen. Kurze Intervalle zwischen Siedlungshorizonten werden als ein Zeichen einer schnellen Aneignung interpretiert, während eine langsame Adoption wird in Siedlungen gefunden, die längeren Intervalle aufweisen. Die Zeitspanne der Besiedlung hingegen kann uns über die Nachhaltigkeit der Glockenbecherbesiedlung informieren. Bei manchen Siedlungen, wie Horni Ian und Lède du Gurp, zeigt die eine relativ lange Glockenbechersiedlungsphase auf einer nachhaltige Nutzung von Glockenbecher Materialkultur, während bei Zambujal oder Mortens Sande II, die Glockenbecherphase eher kurzlebig war, so dass die Innovation einen weniger nachhaltigen Charakter aufweist.

Wenn wir unsere Ergebnisse der verschiedenen bayesschen Analysen mit den aktuellen diffusionistischen Modellen für die Verbreitung des Glockenbecherphänomens vergleichen, scheint ein weniger ausgeprägter Ursprung vorzuliegen. In sowohl der portugiesischen Estremadura als auch im Niederrheingebiet erschien das Glockenbecherphänomen um 2600 v. Chr. Um 2500 v. Chr. übernahmen Gemeinschaften in der Tschechischen Republik und Westfrankreich das Glockenbecherphänomen und erst um 2350 v. Chr. erschienen Glockenbechersiedlungen in Südskandinavien.

Eine zweite Analyse konzentriert sich auf Diffusionsmechanismen und untersucht die Art und Weise, wie sich das Glockenbecherphänomen über Europa ausbreitete: die damit verbundenen neuen Objekte, Praktiken und Technologien werden analysiert, unabhängig von jeglicher Diskussion über deren Ursprung und räumliche Diffusion. Dies ruft die uralte Frage auf: Was macht das Glockenbecherphänomen aus? Was bedeutet es, Teil eines „Becher-Netzwerks“ zu sein? Nachfolgende Themen innerhalb dieser Analyse umfassen die Bewegung von Objekten und Praktiken, die Bewegung von Menschen und die Bewegung von Ideen.

Die Bewegung von Objekten und Praktiken wird näher betrachtet, in dem man die zwei Distributionstypen untersucht und die Beweise für die Mobilität von Keramik berücksichtigt: Erstens durch eine Analyse spezifischer neuer Praktiken in Siedlungen, wie z.B. domestizierte Pferde, spezialisierte Feuersteinartefakte, domestizierte Dinkel und Metallurgie, und zweitens durch die Betrachtung der breiteren zeitlichen, räumlichen und kontextuellen Verbreitung von Knochenplatten und Anhängern sowie kupfernen Palmela-Punkten. Diese Objekte wurden in einigen Siedlungen innerhalb der Untersuchungsgebiete gefunden und eine breitere Analyse unterstreicht ihre Bedeutsamkeit für die Verbreitung von Glockenbecherideen und -praktiken.

Domestizierte Pferde sind in bestimmte Gebieten Europas vor der Glockenbecherzeit bekannt, aber im Niederrheingebiet und möglicherweise auch in Südskandinavien und Norddeutschland können die frühesten Beispiele der domestizierten Pferden mit dem Glockenbecherphänomen in Verbindung gebracht werden. Ebenso gibt es Hinweise auf metallurgische Praktiken vor dem Glockenbecherphänomen sowohl auf der Iberischen Halbinsel als auch in der Tschechischen Republik, aber Metallurgie, die mit dem Glockenbecherphänomen verbunden ist, wird in Siedlungen in der Tschechischen Republik und im Niederrheingebiet gefunden. Dies kann möglicherweise in Verbindung mit neuen Objekttypen, wie z.B. Kissensteinen und ‚Gräber von Metallarbeitern', gebracht werden, die darauf hindeuten, dass Werteänderungen mit der Annahme des Glockenbecherphänomens verbunden waren.

Die Verbreitung von Dinkel ist weniger untersucht, aber Konzentrationen in zwei Schweizer und einigen dänischen Glockenbechersiedlungen sind bekannt, obwohl diese scheinen die einzigen Vorkommnisse zu sein, die mit dem Glockenbecherphänomen zusammenhängen. Hinweise auf den Tausch von Keramik, der mit dem Glockenbecherphänomen einhergeht, sind beschränkt auf den regionalen Austausch in der Tschechischen Republik und in einigen Fällen in Westfrankreich. Jedoch werden die meisten Keramiken lokal hergestellt. Zusammenfassend stellt man fest, dass es nicht ein Objekt oder eine Innovation gibt, die mit dem Glockenbecherphänomen in ganz Europa verbunden ist: Die Annahme neuer Praktiken und Objekten ist in den meisten Fällen regional unterschiedlich. Die spezifisch untersuchten Objekte, wie Knochenplatten, Anhänger und kupferne Palmela-Punkte zeigen jedoch, dass Tauschnetzwerke, die an der Stelle von regionalen Netzwerken traten, existierten. Die Anhänger und die Platten weisen eine Verbreitung in ganz Mittel- und Osteuropa auf und sind hauptsächlich mit sowohl Glockenbecher- als auch Schnurkeramikbestattungen verbunden. Die Palmela-Punkte sind vor allem in West- und Südwesteuropa zu finden und sind mit Glockenbecher in allerlei Kontexten verbunden. Dieser Unterschied könnte darauf hindeuten, dass die Palmela-Punkte einer variablen Rolle in Bezug auf ihrer Wert hatten, wobei überregionale Werte die Größe und Form und regionaler Werte den Gebrauch und die Deposition der Punkte bestimmen. Im Gegensatz dazu zeigen Anhänger und Platten eine Kontinuität in Form, Größe und Kontext vom Schnurkeramik- zum Glockenbecherphänomen.

Neben der Bewegung von Objekten und Praktiken untersuchten wir die Bewegung von Ideen durch eine Analyse von Kommunikationsnetzwerken und Cliquen. Die Untersuchung der Kommunikationsnetzwerke und Cliquen – durch eine Analyse von materieller Kultur in Siedlungen – wird uns Aufschlüsse über die Heterophilität zwischen Gemeinschaften geben, d.h. die Art und Weise, in der sich Gemeinschaften in europäische Regionen voneinander unterscheiden. Nach dem „Strength of Weak Ties" Modell werden es Gemeinschaften, die enggestrickte Cliquen auf der Basis ihrer materiellen Kultur in den Siedlungen formen, schwerer haben, das Glockenbecherphänomen zu übernehmen. Wenn wir diese Netzwerke untersuchen, können wir – auf der Grundlage der berechneten Häufigkeit in der Materialkultur der Siedlungen in allen sechs Untersuchungsgebieten – beobachten, dass es basierend auf dem berechneten Brainerd-Robinson-Koeffizienten diverse Unterschiede in Bezug auf ‚betweenness' Zentralität (die Messung der Zentralität eines Knotens innerhalb des Netzwerks), Siedlungstypen, geographische Distribution und die Stärken der Verbindungen zwischen den Knoten gibt.

Diese Analyse zeigt, dass es eine große Vielfalt an Netzwerken zwischen Regionen gibt. Besonders in Bezug auf die Verbindungsstärke ist die Variabilität auffällig. Die stark vernetzten Netzwerke der Tschechischen Republik und Nordfrankreichs sind gegenüber der relativ schwachen Verbindungsstärke in Südskandinavien und Norddeutschland klar das Ergebnis der verschiedenen Kommunikationsnetzwerke, die bei der Annahme des Glockenbecherphänomens eine Rolle spielen. Die Clique, die sich in Nordfrankreich entwickelte, besteht aus Gord und Deûle/Escaut Siedlungen, und zeigt keine Kommunikation mit Glockenbechersiedlungen. Im Gegensatz dazu ist das Netzwerk in Südskandinavien und Norddeutschland sehr fragmentiert und Siedlungen sind dort offensichtlich sehr vielfältig. Interessanterweise ist dieses Gebiet sowohl für seine spezialisierte Feuersteindolchproduktion, die offensichtlich die Kommunikationsnetzwerke nicht wesentlich beeinflusst, und seine späte Annahme des Glockenbecherphänomens bekannt.

Ein letzter Aspekt der Mechanismen zur Diffusion des Glockenbecherphänomens befasst sich mit einer Analyse von Menschen. Zwei verschiedene Analyseskalen – auf der Ebene des Individuums und der der Gemeinschaft – werden dann mit zwei bestimmten Analysemethoden (Isotopenanalysen an den Elementen Strontium und Sauerstoff sowie die Untersuchung von aDNA), genau unter die Lupe genommen. Wenn wir die Isotopenanalysen, die bereits durchgeführt worden sind, betrachten, sehen wir hauptsächlich lokale Individuen und eine kleine Anzahl von Menschen, die als regional mobil erachtet werden können. Nur in sehr seltenen Fällen deuten die Isotopennachweise auf eine Mobilität, die außer einer regionalen Skala hinausgeht, so z.B. der Amesbury Archer in Großbritannien. In größerem Maßstab haben aDNA Hinweise die Glockenbecher- sowie Schnurkeramikmigrationsdebatte neulich wiederbelebt, aber eine unterschiedliche Perspektive zu den vorgelegten Beweisen muss hier präsentiert werden. Es gibt einige Probleme mit der Stichprobenauswahl (nicht jedes Glockenbechergrab ist gleich) und Selektionsverzerrungen (nur eine sehr kleine Auswahl von Individuen wurde ausgesucht, um in einem ‚klassischen' Glockenbechergrab begraben zu werden). Schließlich besteht das letzte Problem darin, wie man diese unterschiedlichen Datensätzen sowie räumliche und zeitliche Skalen miteinander in Einklang bringt, um ein Bild der Glockenbechermobilität zu schaffen, das ein regionales Mobilitätsmuster feststellt und zugleich eine Fernbevölkerungswanderung als Teil der vorgestellten aDNA Analyse offen lässt. Eine vorgeschlagene Lösung ist die extreme Fernmobilität mittels einer biologischen Interpretation als eine Lévy-flight zu betrachten, die aber mit einem eher regionalen Mobilitätsmuster und vorwiegend regionalen Austauschmechanismen von Objekten und Ideen korrespondiert.

Die dritte und letzte Analyse zeigt uns, wie Alltagspraktiken sich mit dem Auftritt des Glockenbecherphänomens ändern. Insbesondere für Nordeuropa, Nordwesteuropa und Mitteleuropa wird uns ein spezifischer Fokus auf den Neuerfindungsprozess Einblick in die regionalen Besonderheiten des Wechselspiels zwischen Tradition und Innovation bieten. Eine erste Studie umfasst Änderungen der Formgebungspraktiken von Common Ware („Begeleitkeramik") Keramiken. Es ist schon wohlverstanden, dass Common Ware Keramik, wie von Marie Besse gezeigt, weitestgehend traditionelle Gefäßtypen aufweist. Aufgrund dieser Kontinuität, können hier die spezifischen Formgebungspraktiken verbunden mit diesen Gefäßen und der regionalen Variabilität sowie Unterschiede zwischen Tradition und Innovation genau untersucht werden. Anhand eines metrischen Ansatzes, wobei quantitative Daten und Principal Component Analysis angewandt werden, können wir die Entwicklungen darstellen. Die Formgebungsphase in der prähistorischen Keramikherstellung ist sehr eng mit sozialen Aspekten jenseits der Töpferwahl verbunden, aber auch tief verwurzelt in traditionellen Praktiken und erlerntem Verhalten. Außer ein Fokus auf die Veränderungen solcher Formgebungstraditionen, werden die Entscheidungen des Töpfers während einer Innovationsphase untersucht, indem Fähigkeiten beim Formen und Dekorieren der Gefäße und bei der Kreativität im Umgang mit Dekorationsmotiven analysiert werden.

Die Analyse der Keramikformgebung konzentriert sich auf Nordwest- und Mitteleuropa. Diese Analyse zeigt eine Kontinuität in den Formen zwischen (zumindest) dem niederländischen Vlaardingen und den verschiedenen Typen von Common Ware Gefäßen, insbesondere die Riesenbecher, französische und dänische Common Ware und im geringeren Maße Potbeker Gefäße. Andere Arten von Siedlungskeramik, die das Glockenbecherphänomen zeitlich vorangehen (z.B. nichtverzierte Funnelbeakergefäße oder Corded Ware Siedlungskeramik) wurden nicht analysiert. Daraus wird deutlich, dass der Neuerfindungsprozess des Glockenbecherphänomens in Nordwest- und Mitteleuropa ein allmählicher Veränderungsprozess der Traditionen war. Anstatt der Common Ware Keramik ähnelten die dünnwandigen (und hoch dekorierten) Potbekergefäße den Glockenbechergefäßen. Daher stellen die Potbekergefäße eine spezifische regionale Neuerfindungspraxis dar, die für diese Periode einzigartig ist: Verzierungsmotive und Gefäßtechnologie sind vorwiegend der Glockenbechertradition übernommen, während Form und Verzierungstechniken (Nagelabdrücke, Warzen und Löcher unter dem Rand) traditionelle Elemente repräsentieren, die auch in Riesenbecher, Corded Ware Siedlungskeramik und Vlaardingen Gefäße zu finden sind.

Ein kultureller Bruch zwischen den westfranzösischen Artenac und Glockenbechergemeinschaften basierend auf den Formen von Common Ware Gefäßen wurde von einigen Forschern vertreten. Aus den Daten, die hier von einigen Artenac und Common Ware Gefäßen gesammelt wurde, ist dies weniger ersichtlich, aber mehr Daten werden benötigt, um diese Veränderungen in der Töpfereipraxis zu untersuchen und sie in eine breitere Analyse von Siedlungsmustern einzubeziehen. Deshalb könnte es in Westfrankreich einen abrupteren Veränderung gegeben haben, in der neue Töpfereipraktiken und das Erlernen neuerer Handfertigkeiten eine Rolle spielten, vielleicht in Verbindung mit der Ankunft neuer Menschen. Eine ähnliche Situation existiert in Nordfrankreich mit Gord und Deûle/Escaut Siedlungen einerseits und Glockenbechersiedlungen andererseits. Zumindest können wir anmerken, dass Glockenbecher Common Ware unterschiedet sich hier nicht von anderen Common Ware Gefäße. Nur ein Vergleich der Formen von nordfranzösischer Common Ware und Gord und Deûle/Escaut Keramik können zu mehr Erkenntnisse in das Zusammenspiel und den wahrscheinlichen Ablehnungsprozess führen, der durch andere Datenquellen offensichtlich wurde. Neuere Studien zur Common Ware Keramik der Iberischen Halbinsel haben auch interessante Veränderungen ergeben, die weiter analysiert werden müssen.

Die abschließende Analyse der sich verändernden Praktiken der Keramikproduktion befassen sich mit Fertigkeiten und Kreativität, insbesondere die Fertigkeiten der Töpfer bei der Übernahme des Glockenbecherphänomens. Eine technologische Analyse der Siedlungskeramik von Nordwestern- und Mitteleuropa zeigen, dass Töpfer ihr Handwerk im Allgemeinen gut ausführen: Spulen sind gut befestigt, Gefäßwände sind, wenn nötig, sehr dünn und Tempergrößen sind klein und in den meisten Fällen, werden Verzierungsmotiven sorgfältig ausgeführt. Auffallend sind die Ausnahmen: Auf der Siedlung Lanz 14 in Norddeutschland wurden Glockenbecherdekorationsmotive nicht gut umgesetzt. Dies zeigt ein Mangel an Fertigkeiten bei diesem Teil des Produktionsprozesses. Anscheinend war es nicht besonders wichtig, genau und akribisch zu sein, wobei die geometrischen Motive von Spachtelabdrücken ausreichten. Dieser Mangel an Geschick kann im Hinblick auf andere Entwicklungen in Norddeutschland interpretiert werden: eine geringe Nachhaltigkeit der Glockenbecherinnovation und ein niedriger Verbindungsstärke in Glockenbecher Kommunikationsnetzwerken. Bezüglich des Kreativitätsaspektes innerhalb des Produktionsprozesses sollen die einzigartigen geometrischen Motive in der Tschechischen Republik und die einmaligen Potbeker Dekorationsmotiven im Niederrheingebiet erwähnt werden. Diese zeigen, dass eine nachhaltige Innovation existierte, die geformt und überarbeitet werden konnte.

Zusammengefasst haben wir die Prozesse, Mechanismen und Praktiken der Innovation, die mit dem Glockenbecherphänomen zusammenhängen, aus einer Siedlungsperspektive in sechs verschiedene Untersuchungsgebieten in Europa analysiert. Hierbei haben wir unsere Hauptforschungsfragen beantwortet. Der Aneignungsprozess des Glockenbecherphänomens beschränkte sich in allen Forschungsregionen auf die Verfügbarkeitsphase, erfolgte aber zu unterschiedlichen Zeitpunkten mit sehr unterschiedlichen Ergebnissen im Hinblick auf Wirkung und Nachhaltigkeit. Diese vielfältige Neuerfindung kann man dann verstehen, wenn man sie aus der Perspektive der Auswirkung und Nachhaltigkeit der Innovation und der Stärke der Kommunikationsnetzwerke zwischen verschiedenen Gemeinschaften innerhalb einer Region betrachtet. Die hier analysierten Mechanismen der Glockenbecheradoption konzentrierten sich auf den regionalen Austausch der materiellen Kultur (Töpferware, Feuerstein, Kupferartefakte) und die Vorstellungen über Bestattungspraktiken, die regionale Bewegung von Menschen und Fernmobilität bestimmter Individuen nach den Prinzipen des ‚Strength of Weak Ties' Modell.

Schließlich wurde gezeigt, dass sich lokale Gemeinschaften in ganz Europa das Glockenbeckerphänomen unterschiedlich aneigneten und dass es eventuell besser wäre insgesamt von verschiedenen Glockenbecherphänomenen zu sprechen.

Acknowledgements

During the course of this research, I received help from many people, museums and institutes. All of them are thanked here. First of all, I thank my supervisors Professor Harry Fokkens and Professor Johannes Müller and Dr. Martin Furholt.

Several people working at archaeological depots, commercial companies and museums have assisted me or allowed me to analyse their material. From the Netherlands these are Ivar Schute (RAAP West, Leiden), Judith Jansen (Provinciaal Depot Overijssel, Deventer), Paul van Kempen (Afdeling Archeologie, Gemeente Haarlem), Luc Amkreutz and Jeroen Rensen (both Rijksmuseum van Oudheden, Leiden), Mark Phlippeau (now Provinciaal Depot Zuid-Holland), Jean Roefstra, Martin Veen, Kees Zwaan and Rob van Eerden (all Provinciaal Depot Noord-Holland and Provincie Noord-Holland), from Belgium Delphine Degroote (Provinciaal Archeologisch Museum, Velzeke), from Denmark John Simonsen (Museum Salling, Skive) and Uffe Rasmussen (Moesgård Museum, Højbjerg), from Germany Ulrike Weller (Landesmuseum Hannover, Niedersachsen) and Lars Saalow (Landesamt für Kultur und Denkmalpflege Mecklenburg-Vorpommern), from the Czech Republic Zdeněk Hájek (Moravské zemské muzeum Brno), David Rožnovský (Jihomoravské muzeum ve Znojmě), Hana Čižmářová (Muzeum a galerie v Prostějově) and Jaroslav Peška (Archaeological Centre Olomouc).

Various libraries have given me access to their collection and helped me with finding literature or retrieving and scanning obscure documentation. The Cultural Heritage Agency library in Amersfoort was always a safe haven on my adventures in the Netherlands. The University Library of Kiel for all the *Fernleihe* copies of obscure journal articles, the Ibero-Amerikanisches Institut in Berlin for its vast collection of Portuguese and Spanish archaeology journals and books, and finally the library of the Carolus University in Prague, helped me tremendously.

Help with literature, advice on methods and their published and unpublished data also came from Jan Kolař, Julien Ripoche, Andrew Fitzpatrick, Alex Gibson, Marta dal Corso, Professor Marie Besse, Professor Olivier Lemercier, Matthias Merkl, Jan Vanmoerkerke, Knut Ingvar Austvoll, Stijn Arnoldussen, Quentin Bourgeois, Professor David Fontijn, Simone Bloo, Dominique Franke, Christoph Rinne, Martin Hinz, Marc Vander Linden, Elena Leghissa, Sandra Beckerman, Jurrien Moree and Simone Bloo. Specifically at the WAC8 in Kyoto, the discussions with Professor Silviane Scharl, Catharine Frieman, Miljana Radivojiević and Samantha Leggett were of great help and inspiration.

At the Graduate School Human Development in Landscapes, several colleagues and friends who undertook similar journeys or aided me on mine must be mentioned. Fellow Dutch Welmoed Out (now Moesgård Museum), for making me acquainted with Kiel when I started here and always being available as a mentor. Maren Biederbick (now Deutsches Medizinhistorisches Museum, Ingolstadt), Veronika

Egetenmeyr and Natàlia Égüez for the long and pleasant talks about life, work and everything else. The Graduate School office and technical staff: Jirka Menke, Sabine Zeller, Florian Bauer, Kay Schmütz and Mara Weinelt for giving me the research opportunities and financial and material aid needed. Macrobotanical help came from Yasmin Dannath who analysed the charcoal samples and Eileen Kücükkaraca translated the English summary into German. Both the Collaborative Research Centre (CRC) 1266 'Scales of Transformation' and the Graduate School are thanked for the support in financing and publishing this PhD Thesis.

The copyrights of several images was granted by Jane Brayne and Wessex Archaeology (Figure 1.1), Julia Sorrell and Historic England (Figure 1.2) and Bob Brobbel (Figure 1.3), Marc Vander Linden and Volker Heyd (figure 1.4). All are thanked for their permission and kind cooperation.

This thesis is not only the product of my work over the past few years in Kiel. It is also the culmination of almost thirty years of education, standing on the shoulders of many giants who should be named here. First and foremost my family: Ton, Hanneke, Chris and Eveline Kleijne, Margriet Mak-Kalkman. No longer among us are Tiny Kleijne-Schelvis, Piet Kleijne and Koos Mak. For both my grandfathers, Piet and Koos, who respectively enjoyed fishing and had a maritime background, it would have been an adventure to visit me in Kiel I think! All are with me while I write this.

Other important people who gave me useful nudges in the right direction over the past years: Jaap Hendrikse, Wilfred Mokkum, John Wijnants (†) and Jean Roefstra.

My former colleagues at the Dutch Cultural Heritage Agency include Professor Jos Bazelmans and Jos Deeben (†) and the members of our Odyssee project team which partly inspired my research: Gary Nobles, Sandra Beckerman, Virginia Garcia Diaz, Liesbeth Theunissen, Bjørn Smit, Hans Peeters, Professor Annelou van Gijn, Tania Oudemans, Lucy Kubiak-Martens, Jørn Zeiler, Dick Brinkhuizen (†), Professor Daan Raemaekers, Roel Lauwerier, Otto Brinkkemper and Inge van der Jagt.

People trying to keep me sane, outside of all of this archaeology, by having a beer and listening to live music, focusing completely on an intense table tennis training, or providing a social presence either digital or physical, include Fiona Eckert, Ingrid Paulsen, Anne Vlieg, Bennie Douwes.

Curriculum Vitae

Jozua Petrus (Jos) Kleijne was born in Beverwijk, the Netherlands on Saturday the 19th of September in 1987. After primary education at the Bethelschool in Beverwijk he attended Ichthus College in Driehuis (Velsen) between September 1998 and August 2004, where he completed the *Gymnasium* degree.

Being fascinated by archaeology already from around the age of 7 onwards, he started studying the Bachelor of Archaeology in September 2004 at Leiden University, where he specialised in European Prehistory and followed additional courses in Computer Applications, Maritime Archaeology and Roman and Medieval Archaeology, which he finished in 2007. In September 2007 he started a 2-year Research Master programme in Prehistoric Farming Communities also at Leiden University. This programme was extended with a half-year Erasmus exchange to Sheffield (making himself familiar with the analysis of prehistoric pottery, funerary archaeology and British later prehistory). He finished his Research Master degree with a thesis about pottery production and maritime interaction networks in the Bronze Age which was nominated for the W.A. van Es prize. During his studies he collaborated on several excavation projects, including the Barrow Landscapes project in 2007 and the Stonehenge Riverside Project in 2007 and 2008 and participated in research and publishing (the *Liber Amicorum* for Professor Louwe Kooijmans). Also, he worked at the digital archive of DANS as both a student-assistant and project leader for a NWO Odyssee project, digitising and preserving literature and the data from old excavations.

Subsequently, he was employed as a Researcher for Later Prehistory at the Cultural Heritage Agency of the Netherlands (*Rijksdienst voor het Cultureel Erfgoed*) between 2010 and 2013. Here he worked as a project leader on ontologies and semantic networks, the development of beach barrier archaeology and the large NWO Odyssee project *"Unlocking the Treasure Chest of Late Neolithic North Holland"*. In 2014, with his private company of MAK Onderzoek & Advies, he undertook the first analyses of old excavation data from the Velserbroek, within the framework of writing a synthesis of Bronze Age coastal landscape habitation in Kennemerland (commissioned by the Province of North-Holland, published 2015).

In November 2014 he started his PhD research in Germany at the Christian-Albrechts University of Kiel, with the Graduate School "Human Development in Landscapes". This research, preliminarily titled *"The Beginning of Beaker"*, culminates in the thesis lying before you.

Next to his PhD research, Jos worked as a PhD representative and member of the Executive Board in 2016, and attended workshops concerned with 'Theoretical Responses to Bioarchaeological Studies and Identity Issues' at the German Archaeological Institute in Madrid and 'Radiocarbon Dating and Bayesian Chronological Analysis' at the University of Oxford and participated in excavations. Also, he presented his research at international conferences such as the 8th World Archaeological Congress in Kyoto, Japan and at the *Archéologie et Gobelets* conference in Montpellier/Arles, and he organised the subsequent *Archéologie et Gobelets* conference in Kiel.

Jos continues to hold an interest in prehistoric archaeology, focusing in his research on diverse aspects of studying innovations, reconstructing prehistoric subsistence economies, the analysis of material culture and landscape archaeology.

Tabular Curriculum Vitae

Personal information

Name:	Jozua Petrus Kleijne (Jos)
Date of birth:	19-09-1987
Place of birth:	Beverwijk, The Netherlands
Nationality:	Dutch

Education

09/2007 – 01/2010:	*Research Master* degree in Archaeology at Leiden University (NL).
09/2007 – 02/2008:	*Erasmus* scholarship at Sheffield University (UK).
09/2004 – 08/2007:	*Bachelor* degree in Archaeology at Leiden University (NL).
09/1998 – 06/2004:	*Gymnasium* degree at Ichthus College Driehuis, Velsen (NL).
09/1991 – 08/1998:	Elementary education at Bethelschool, Beverwijk (NL).

Professional experience

08/2018 –ongoing:	Postdoctoral researcher at Collaborative Research Centre 1266 ‘Scales of Transformation’, Christian-Albrechts Universität zu Kiel (GER).
11/2014 – 07/2018:	PhD candidate at Graduate School Human Development in Landscapes, Christian-Albrechts Universität zu Kiel (GER).
02/2014 – ongoing:	Self-employed researcher (MAK Onderzoek & Advies).
02/2013 – ongoing:	Volunteer at network organisation for Metal Ages research in the Netherlands (organising annual conference and proceedings and maintaining social media).
02/2016 – 04/2017:	PhD representative and member of the Executive Board of the CAU Graduate School Human Development in Landscapes.
02/2016 – 03/2016:	Guest researcher at the Faculty of Archaeology, Leiden University.
09/2010 – 09/2013:	Researcher for Later Prehistory of the Holocene Netherlands at Cultural Heritage Agency of the Netherlands (RCE).
01/2010 – 01/2012:	Member of monuments committee Municipality of Beverwijk (voluntarily, archaeology specialist).
09/2009 – 09/2010:	Project leader at DANS (Data Archiving and Networked Services).

11/2014:	Member of University Visitation Committee for the RMA Archaeology Leiden University
10/2009:	Member of University Accreditation Committee for the RMA Archaeology Leiden University at NVAO

Excavation experience

2005: Oegstgeest Rijnfront, the Netherlands (river area, Early Medieval harbour)
2005: Oss Horzak, the Netherlands (Pleistocene sand, Iron Age/Roman settlement)
2006: Oss Horzak, the Netherlands (Pleistocene sand, Iron Age/Roman settlement)
2007: Apeldoorn Echoput, the Netherlands (Early Iron Age barrow landscape)
2007: Stonehenge Riverside Project, Great-Britain (Stonehenge monumental landscape)
2008: Stonehenge Riverside Project, Great-Britain (Stonehenge monumental landscape)
2011: Haarlem Liewegje, the Netherlands (coring campaign, Neolithic habitation coastal dunes)
2012: Rijckholt, the Netherlands (Middle Neolithic flint mine shafts)
2017: Riņņukalns, Latvia (Middle Neolithic shell midden)
2018: Riņņukalns, Latvia (Middle Neolithic shell midden)

EMBRACING BELL BEAKER

Adopting new ideas and objects across Europe during the later 3rd millennium BC (c. 2600-2000 BC)

This book deals with the question how communities across Europe during the later 3rd millennium BC adopt and transform the Bell Beaker phenomenon differently. By looking at these processes of change from the perspective of settlements and settlement material culture, an interpretation is given to the development of this phenomenon that is alternative to the currently prevailing migration models.

Instead, the author uses social theories on the spread of innovations, the development and functioning of communication networks and the social technologies involved in the production of material culture in his arguments. For the first time, settlements from various regions of Europe are studied at the same level and compared using modern research methods such as aoristic frequency distributions, the Bayesian modelling of radiocarbon dates and network analyses. Temporal and spatial variability in the regional processes that lead to the adoption (and rejection!) of Bell Beaker innovations are described in detail. The regional variability in communication between settlements, and the exchange of ideas and objects and mobility of people are combined with sociological network theories on the spread and adoption of novel ideas. Regional differences in the production of pottery are reviewed by both quantitative and qualitative methods.

Finally, a Bell Beaker network is described in which various processes of innovation adoption and subsequent re-invention, developing communication networks and different forms of mobility take part.

CRC 1266
SCALES OF TRANSFORMATION

Sidestone Press
ISBN: 978-90-8890-755-5
9 789088 907555 >