Neolithic Diversities : Perspectives from a conference in Lund, Sweden

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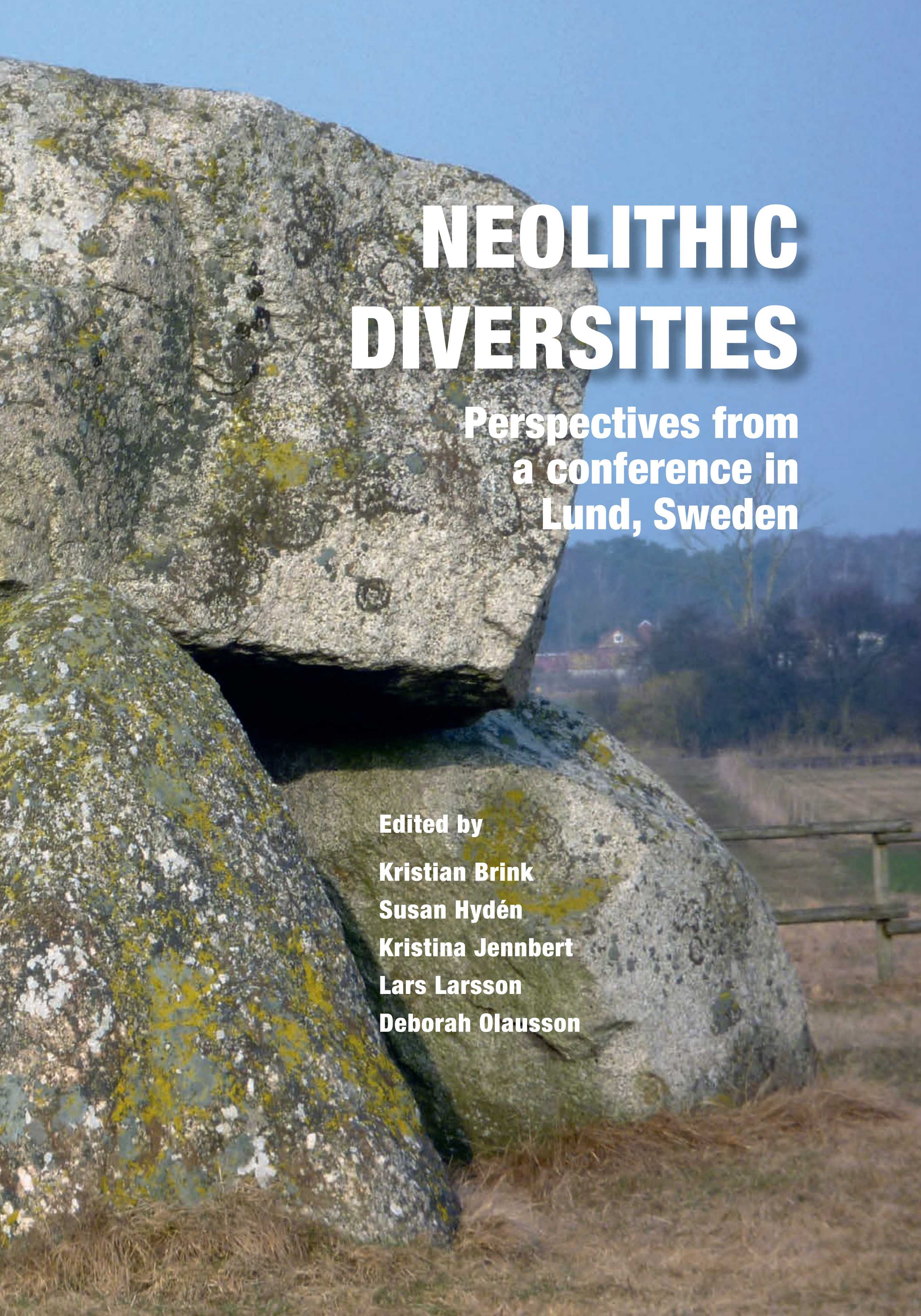

NEOLITHIC DIVERSITIES

Perspectives from a conference in Lund, Sweden

Edited by

Kristian Brink
Susan Hydén
Kristina Jennbert
Lars Larsson
Deborah Olausson

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The members of the conference "What's New in the Neolithic", May 2013. Photo by Kristina Jennbert.

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Contents

II. PERSPECTIVES ON MONUMENTS

III. PERSPECTIVES ON MATERIAL CULTURE

Preface

In the study of the distant human past, certain events and periods have come to represent decisive passages from one human state to another. From a global perspective, the characteristic feature of the last ten thousand years is that people in different parts of the world, and at different points in time, started to grow plants and domesticate animals. The rise and dissemination of agriculture were crucial factors for the continued existence of humankind on earth. The incipient agriculture is often regarded as the very beginning of human *culture*, as it has traditionally been perceived in western historiography, that is, as control over nature and the "cultivation" of intellectual abilities.

As a result of the increasing national and international interest in the northern European Neolithic (4000–2000 BC), combined with large-scale archaeological excavations which helped to nuance and modify the picture of the period, senior researchers and research students formed a Neolithic group in 2010. The Department of Archaeology and Ancient History at Lund University served as the base, but the group also included collaborators from Linnaeus University and Södertörn University, and from the Southern Contract Archaeology Division of the National Heritage Board in Lund and Sydsvensk Arkeologi in Malmö and Kristianstad.

Meetings and excursions in the following two years resulted in the holding of an international conference in Lund in May 2013 entitled "What's New in the Neolithic". Invitations to this conference were sent to two dozen prominent Neolithic scholars from northern and central Europe.

The conference was a great success, with presentations and discussions of different aspects of innovative research on the Neolithic. The members of the Neolithic group took an active part in the discussions following the presentations.

It was decided before the conference that the papers would be published. The members of the Neolithic group also had the opportunity to contribute current research to this publication.

After the conference an editorial group was set up, consisting of Dr Kristian Brink, PhD student Susan Hydén, Professor Kristina Jennbert, Professor Lars Larsson and Professor Deborah Olausson.

A grant was received from Riksbankens Jubileumsfond for the meetings and excursions of the Neolithic group 2010–2013. We would like to thank The Royal Swedish Academy of Letters, History and Antiquities and Berit Wallenbergs Stiftelse for grants which enabled us to hold the conference "What's New in the Neolithic". Grants from The Royal Swedish Academy of Letters, History and Antiquities, and Stiftelsen Elisabeth Rausings Minnesfond financed the layout and printing of this publication.

I. PERSPECTIVES ON PEOPLE, IDENTITY AND PRACTICE

Paleodemography of maritime hunter-gatherers and the quest for forager baseline demography

Torbjörn Ahlström

Abstract

Burger *et al.* (2012) used the average statistics computed from five contemporary groups of foragers, and designated this as baseline demography for the original hunter-gatherer lifeway. This average forager model (AFM) was compared to a paleodemographical analysis of two Scandinavian archaeological samples, Skateholm and Västerbjers. The salient difference between the archaeological samples and the AFM is that the latter implies a substantial juvenile mortality, reducing a cohort by 44% at the age of 15 years. The corresponding figure is 31% for Skateholm and 25% for Västerbjers. It is argued, based on the dynamics of infectious diseases, that the relatively higher mortality among the recent foragers is a function of these groups living in the vicinity of much larger populations. Thus, the baseline AFM is in fact modern, and not relevant in an archaeological context.

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Introduction

One salient feature of human evolution is the prolongation of the lifespan. Humans have experienced a significant shift in age-specific mortalities, shifting from relatively high age-specific mortalities in early life (<15 years), to relatively high age-specific mortalities in late life (>60 years). As a corollary to this, life expectancy has risen, for example, to 83.7 years among modern Swedish females (Statistics Sweden 2014). Co-varying with this shift is the transition from mortality due to infectious diseases, to mortality caused by chronic diseases, such as cancer and cardiovascular disease (Jones 1990, p. 32). For much of the time that our species has existed, however, it has existed as hunter-gatherers or foragers, a lifeway based on fishing, hunting and collecting. The contrast between the foraging lifeway and a lifeway based on a Neolithic economy may be construed as stark, but does this contrast also entail a different demography? According to a recently published paper by Burger *et al.* (2012), it does.

Burger *et al.* (2012) portray forager demography based on mortality profiles from five ethnographically observed hunter-gatherer populations collected by Gurven & Kaplan (2007). For Burger *et al.* (2012), the average statistics computed from these populations serve as a baseline for the original hunter-gatherer lifeway, thus facilitating a number of thought-provoking comparisons. According to Burger *et al.* (2012), a 30-year-old hunter-gatherer has the same probability of death as a contemporary person from Japan at 72 years. At age 15, a forager has a 1.3 percent probability of dying in the next year. Modern Swedes experience the same probabilities much later, at age 69. The difference between modern Japan and Sweden and the contemporary

Fig. 1. Map with the location of the sites mentioned in the text.

hunter-gatherers is accordingly of such a magnitude that the demography of hunter-gatherers has more in common with wild chimpanzees than modern populations.

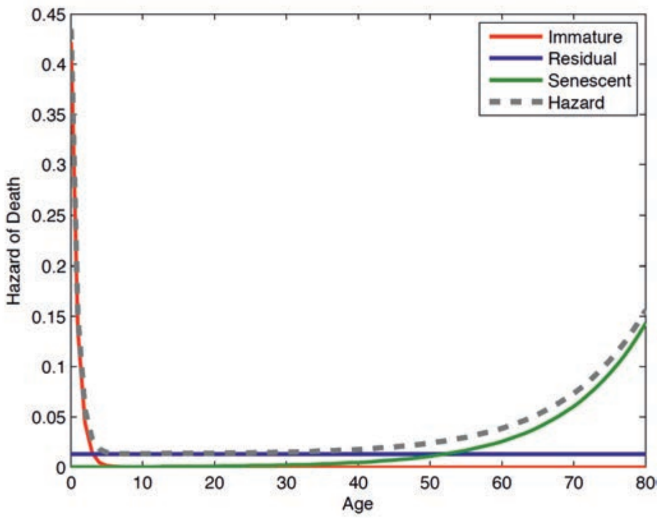
The question addressed in this paper is how well this proposed baseline fits the mortality pattern encountered in prehistoric populations. The alternative source for demographic data on hunter-gatherers is provided by skeletal remains from prehistoric cemeteries. In this paper, I present a paleodemographical analysis of two maritime hunter-gatherer populations, from the Mesolithic cemeteries at Skateholm, Scania, and the Middle Neolithic cemetery at Västerbjers, Gotland. A transition analysis (Boldsen *et al.* 2002) was used to age the skeletons. The mortality data thus generated were summarized in terms of Siler models (Siler 1979, 1983), compatible with the analysis presented by Gurven & Kaplan (2007). The results generated was compared to mortality data of nomadic Saami populations from northern Sweden (Wahlund, 1932), as well as the populations used by Gurven & Kaplan (2007). Specifically, how do these archaeologically derived populations concur with the proposed baseline for the original hunter-gatherer, or foraging, lifeway?

Material and method

Both Skateholm and Västerbjers (Fig. 1) have been published elsewhere, so the presentation of the sites will be brief. The grave fields and settlements Skateholm I and II were investigated by Lars Larsson in 1980–84. Skateholm I comprises 65 graves, and charcoal and collagen dates from four graves range between 5150 and 5200 BC (Ertebølle culture). Skateholm II is smaller with 22 graves and dated to the Late Kongemose-early Ertebølle culture, but with no radiocarbon dates on the bones (Larsson 1988, 2004). There are skeletal remains of 73 individuals from Skateholm, but the decay is advanced. In all, 34 adult individuals were so well preserved that transition analysis could be applied. To this we add 12 juveniles aged by traditional osteological methods. The total sample size from Skateholm is 46. However, this sample is likely to increase somewhat in the future as skeletons currently in museums are made available for osteological analysis in connection with refurbishments of the exhibitions.

The Västerbjers site is situated some 300 metres north of the farmstead with the same name, on a gravel-knoll protruding towards an adjacent creek, Gothemsån. The site was excavated in the thirties and forties, under the supervision of Mårten Stenberger (Stenberger 1943), with some later additions (cf. Janzon 1974). Recent dating suggests that the Västerbjers cemetery was in use 2900 to 2500 BC (Eriksson 2004). Apart from the refuse layer from a dwelling site, a grave field was unearthed. The full extent of this grave field has yet to be fully

Fig. 2. Components of the Siler model.



demarcated, but it is reasonable to believe the majority of the graves have been uncovered. The sample comprises 55 individuals, with 42 skeletons aged by transition analysis and 13 juveniles aged by traditional osteological methods. The preservation of bone at Västerbjers is better than Skateholm, due to the limestone bedrock.

In a paper that predicted the demise of paleodemography, Boquet-Appel & Masset (1982) drew attention to the way the age distribution of an archaeological (or target) population mimicked the age distribution of the reference sample. The goal might have been to capture the demography of past populations, but the result was just a reflection of the contemporary reference population. The ensuing debate revitalized the field and it has re-emerged very much aware of its biases (Hoppa & Vaupel 2002). One major development was the understanding that ageing itself necessitates that the age indications be weighted by mortality profile reflecting natural mortality, not strategies reflecting how the reference sample was collected (Wood, *et al.* 2002; cf. Ahlström & Sjögren 2009). Transition analysis (Boldsen, *et al.* 2002, cf. Milner 2010) is an ageing method that also accomplishes this. Based on nineteen characters, involving the pubic symphysis, iliac auricular surface, and suture synostosis, and a model of mortality that is derived from historic times in Denmark, transition analysis uses Bayes theorem to obtain the highest posterior point estimate of age for each skeleton. Juvenile skeletons were aged with respect to epiphyseal closure and dental development and eruption (Schaefer, Black & Scheuer 2009).

The distribution of age at death from Skateholm and Västerbjers was modelled by a Siler competing hazard model (Siler 1979, 1983; Wood *et al.* 2002). It is referred to as competing, or additive, as human mortality may be broken down into three components. The first component (immature) captures the initially high, but declining mortality associated with neonatal/infant mortality and early childhood mortality. The second component (residual) represents a constant mortality hazard across the life span. This component measures constant attrition and is age-independent. In general, this component embraces causes of death not related to growth and maturation as well as senescence, such as accidents, violence, starvation and environmental causes. The last component is the senescent component, depicting the increasing risk of death with advanced age. The components of the Siler model will be described with reference to the baseline forager model (Fig. 3).

In order to describe human mortality across the life span, we need five parameters. The first two describe the immature component, where $\alpha 1$ describes the initial neonate mortality rate, and $\beta 1$ describes the rate of mortality decline. The parameter $\alpha 2$ describes age-independent mortality (residual). Finally, the parameter $\alpha 3$ is the initial adult mortality rate, and $\beta 3$ describes the rate of mortality increase. When

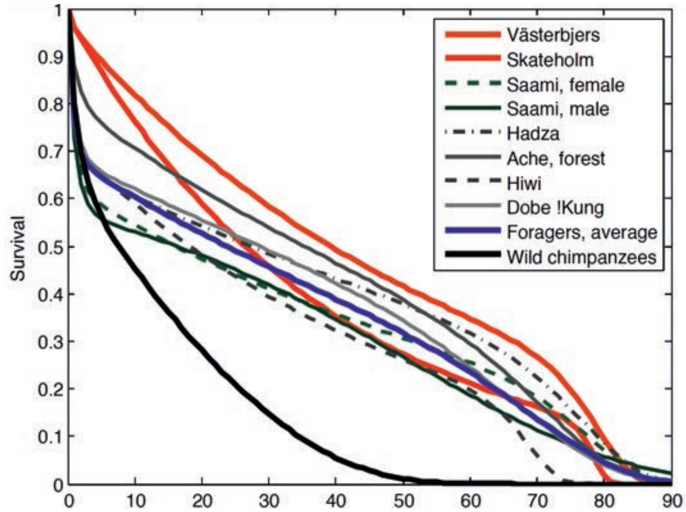


Fig. 3. Survivorship functions for Västerbjers and Skateholm (Red) and reference populations. AFM (Blue).

combined they portray the senescent mortality. Summing all three components results in the hazard function, a function that describes the risk of death at different ages. The Siler model was fitted to the Västerbjers and Skateholm data using a maximum likelihood procedure.

Results

The results of the paleodemographical analysis of Skateholm and Västerbjers are presented in Fig. 3 (survival function) and Table 1 (parameters of the Siler models). The survivorship curve depicts the number or proportion of individuals surviving at each age. It may be visualized as a number of individuals (say 100, or a cohort) that are reduced by mortality as age progresses. The survivorship curves from Skateholm and Västerbjers resemble the type II survivorship curve, characterized by mortality rates that persistently reduce the population regardless of age. There is some variability among the two archaeological groups. The mean age at death (average life expectancy at birth [e0]) is 42 years for Västerbjers and 35 years for Skateholm. The proportion surviving to age 15 is 69% for Skateholm and 76% for Västerbjers. At age 50, the corresponding figure for Skateholm is 30% for Skateholm and 42% for Västerbjers. Thus, survival is apparently somewhat higher at Västerbjers than at Skateholm.

Gurven & Kaplan (2007) collected data from five contemporary groups of foragers, namely the Dobe !Kung (Howell 2000; see also Howell 2010), Ache (Hill & Hurtado 1996), Agta (Early & Headland 1998), Hadza (Blurton Jones *et al.* 2002, see also Marlowe 2010), and Hiwi (Hill *et al.* 2007), which encompass, in all, data on 2728 individuals and 797 deaths. The Saami mortality data are based on 5101 recorded deaths (2517 females and 2584 males) among the Saami in the northern parts of Sweden, from 1791 to 1890 AD (Wahlund 1932). There is marked difference between Skateholm and Västerbjers on one hand, and the comparative populations, on the other (Fig. 3). The initial neonate mortality rate ($\alpha 1$) is considerably smaller for Skateholm and Västerbjers. In comparison with the average forager model (AFM) (Table 1, Fig. 4), the ratio of mortality risk suggests that the neonate mortality risk is seven times higher among the recent foragers compared with the archaeological examples (Västerbjers). Another marked contrast between the AFM and the archaeological populations is the magnitude of the residual ($\alpha 2$): Skateholm displays the highest age-independent mortality (0.024), comparable to that of wild chimpanzees (0.028). Following Hiwi (0.020), Västerbjers (0.017) is also associated with an age-independent mortality slightly larger than the AFM (0.013). This suggests for the archaeological populations, apart from a relatively smaller immature component, that they are associated with relatively larger resid-

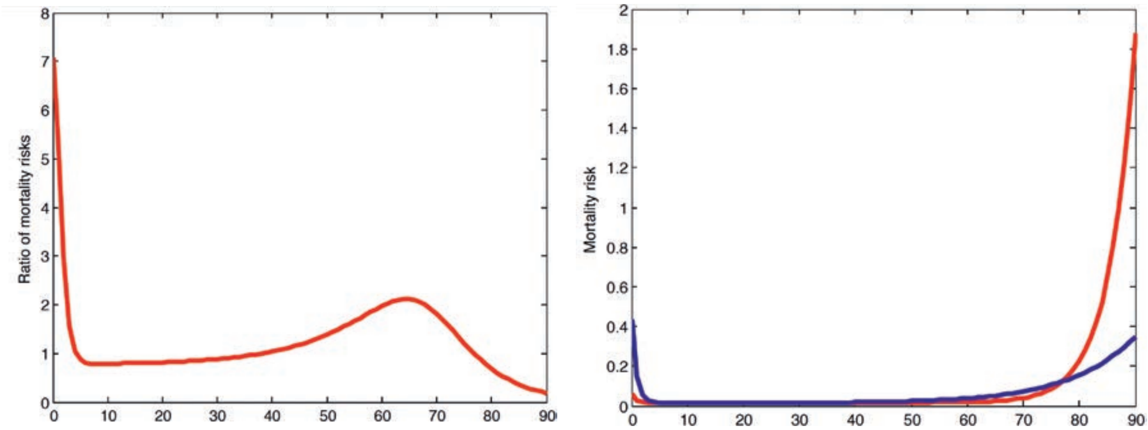


Fig. 4. Comparison between the Average Forager Model (blue) and Västerbjers (red). The differences are expressed as a ratio of mortality risks plot (left).

ual components, implying a constant attrition through the lifespan.

The last result to be communicated is an independent test of the two models with respect to another Pitted Ware culture cemetery from Gotland, namely Ajvide. This site is dated to 3100–2300 BC, and contemporary with Västerbjers (Molnar 2008). We could address this problem the other way around, by asking how the distributions of deaths would be characterized if we simulate 10,000 deaths given the two Siler models. We will specifically look into the distribution of deaths of juveniles (< 15 years) and infants (<1 year). The simulation result for the AFM suggest that 23.1% of the deaths would involve infants, and in all, 43.5% of the death assemblage would comprise individuals aged below 15 years (infants and juveniles) (Fig. 5A). The corresponding figures for the model derived from Västerbjers is 3.8% for infants and

Table 1. Siler models with parameters from a set of archaeological populations (Västerbjers and Skateholm), church records (Saami), ethnographic recordings (Hadza, Ache, Hiwi, Dobe !Kung, Agta and the average among the five populations), and wild chimpanzees (Gurven and Kaplan, 2007).

Population	**Parameters of the model**					**Mean age at death (e_0)**
	α_1	β_1	α_2	α_3	β_3	
Västerbjers	0.045	1.425	0.017	5.40E-09	0.022	42
Skateholm	0.035	4.420	0.024	3.16E-22	0.062	35
Saami, females	0.447	0.956	0.014	1.73E-06	0.142	29
Saami, males	0.449	0.799	3.625E-08	6.148E-03	0.032	28
Hadza[1]	0.351	0.895	0.011	6.70E-06	0.125	34
Ache forest[1]	0.157	0.721	0.013	4.80E-05	0.103	37
Hiwi[1]	0.458	1.390	0.020	6.32E-09	0.251	27
Dobe !Kung[1]	0.340	0.913	0.010	3.31E-04	0.077	36
Agta[1]	0.961	1.506	N/A	7.57E-03	0.040	21
Average forager[1]	0.422	1.131	0.013	1.47E-04	0.086	
Wild chimpanzee[1]	0.248	0.608	0.028	7.53E-03	0.063	13

1 = parameters from Gurven & Kaplan (2007).

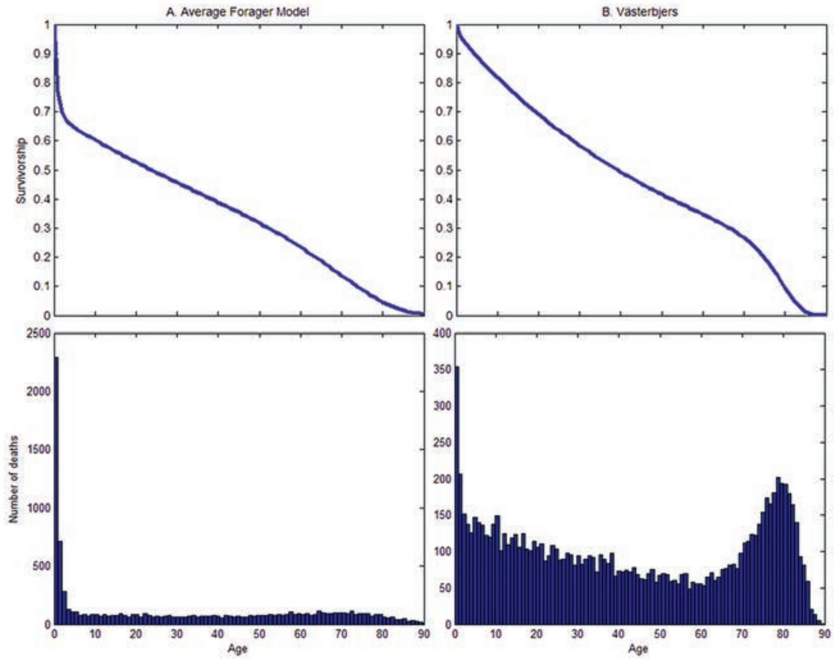


Fig. 5. Simulation of death assemblages given different models of mortality. A. Average Forager Model, B. Västerbjers.

25% for juveniles and infants (Fig. 5B). Now, we may contrast these findings with Ajvide. Molnar (2008) lists the ages of 83 skeletons, and 24 (29%) of the specimens were aged as juveniles and infants (< 15 years), and 6 (7%) as infants. Thus, the death assemblage from Ajvide fits the Siler model from Västerbjers well, but AFM does not capture the dynamics we see in the forager populations from sub-boreal Gotland, neither at Västerbjers nor at Ajvide.

Discussion

The results presented above indicate substantial differences in the archaeological record compared with the AFM as proposed by Burger *et al.* (2012). It is important to discuss the possible causes of this difference. The traditional tactic would be to highlight the under-enumeration of juveniles in the archaeological material, as well as the problems associated with the ageing of the older adults. However, the latter was effectively addressed by the development of Bayesian ageing techniques (discussed above). This is especially clear with respect to the ageing of adults in Skateholm. Compared with previous analysis of the Skateholm skeletons (Persson & Persson 1984, 1988; Alexandersen 1988), the new estimates based on transition analysis significantly increase the number of older individuals. Let us turn now to the supposed under-enumeration of juveniles, and the golden rule that 30% of a skeletal sample should comprise non-adults (Lewis 2007). Even though this is based on mortality regimes persistent in preindustrial populations (Schofield & Wrigley 1979; cf. Weiss 1973; Coale & Demeny 1983), and not relevant in this context, it has fuelled speculations regarding the missing children in archaeological death assemblages involving specialized mortuary behaviours not associated with the rest of the population. It should be acknowledged that bones from immature individuals do not survive to the same extent as bones from adults, as immature bones are not as mineralized. In acidic environments, bones from infants and children may not persist (Gordon & Buikstra 1981; Walker, Johnson & Lambert 1988). However, as the bedrock of

Gotland consists of limestone, and we do in fact identify infants and children both from Västerbjers and Ajvide, taphonomy is not critical in this context. Rather than accepting the golden rule uncritically, we should ask why we have non-adult mortality in the first place. This endeavour will eventually develop into the argument that the proposed AFM basically reflects a modern demography, and is not appropriate as a model for prehistoric foragers.

The health and survival of children represents an important characteristic of the well-being and fitness of a human population, as childhood embodies the most sensitive period of the human life history. Ahlström (2011) demonstrated with respect to historical life-tables from Sweden, that survival below the age of 20 has a substantial effect on the dynamics of human populations, which supersedes that of fertility. Causes of death among infants can be subdivided into endogenous, neonatal causes (congenital anomalies, prematurity, low birth weight, infectious diseases, and birth trauma) and exogenous, post-neonatal causes (starvation, infectious diseases, accidents, etc.) (Lewis 2007). In 2008, 68% of all deaths involving children younger than 5 years were attributed to infectious diseases (Black *et al.* 2010). Infectious diseases can be characterized as density-dependent (transmissible diseases such as measles) or frequency-dependent (sexually transmitted diseases, tetanus). Whereas the former follow a dynamical pattern, the latter are a function of the individual's exposure to risk. Transmissible diseases follow a dynamical pattern involving a pathogen, a population, and a number of susceptible individuals. Let us revisit the ethnographic populations collected by Gurven & Kaplan (2007) and illuminate the load of infections experienced by these populations. It should be emphasized that identifying the cause of death is not an easy task, especially working with ethnographic evidence.

There are two South American populations in the sample, the Ache from Paraguay and the

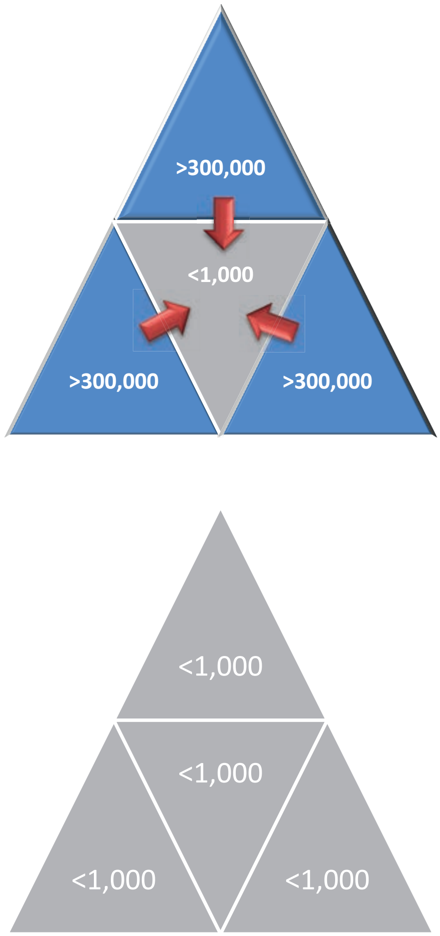


Fig. 6. Critical community size. A. Small population encircled by much larger populations and a constant reintroduction of infectious diseases. B. Sparsely populated landscape with small populations with no epidemics.

Hiwi from Columbia and Venezuela. Hill and Hurtado (1996) list cause of death for the Ache during the forest period as well as the reservation period (1978–1993). During the forest period, the data embrace 383 reported deaths, 230 (60%) of which involve juveniles (< 15 years). For the age group 0–3 years, the dominating cause of death in this sample was violence (55.7%) followed by illness (27.5%). The category of illness embraces infections sensu lato with gastrointestinal diseases (10.7%) and respiratory diseases (0.8%), among others. For the older children

(4–14 years), the causes of death are dominated by violence (73.8%), illness (15.2%) and accidents (11.1%). During the reservation period, the spectrum of cause of death changed radically. Hill and Hurtado (1996) list 106 deaths, of which 79% affected juveniles. Illness dominates (63.1%) with respiratory diseases constituting 27.4% of the cases. Gastrointestinal diseases account for 16.7%, followed by other illness (17.9%). The latter category includes malaria, tetanus, systemic infection, malnutrition and leukaemia. Hill *et al.* (2007) studied death causes among the Hiwi. Disease included infectious disease, such as respiratory infection, skin infection, microbial-caused blindness, tetanus, measles, systemic infection, diarrhoea and vomiting, gastrointestinal infections, malaria, fever and headache, general lethargy, and miscellaneous "illness". The distribution of deaths among the precontact Hiwi infants (< 1 year) is dominated by violence (38.2%), infectious disease (26.5%), and congenital infant deaths (26.5%). For the older juveniles (1–9 years), the distribution of deaths involves infectious disease (64%), accidents (15%), violence (12%) and congenital causes (9%). Following the postcontact period, infectious disease is referred to as the cause of death among 26% of the infants and 52% of the older children.

The two African populations are the Dobe !Kung in Botswana and the Hadza in Tanzania. Data on cause of death have been collected for the Dobe !Kung by Howell (1979). The Dobe area was apparently spared from epidemics that ravaged in other regions where !Kung were represented, such as a smallpox outbreak in the mid-1960s. Tuberculosis is common among the Dobe !Kung and was probably a common cause of death among adults and older juveniles. Other respiratory diseases (pneumonia, bronchitis) cannot be ruled out, however. Influenza and cold are other infections documented among them, as well as venereal diseases and parasites such as malaria and bilharzia. Howell (1979) concludes that 70–80% of the deaths among the !Kung from the Dobe region are attributed to infectious disease, far outnumbering other causes of death such as predators, violence, degenerative diseases, accidents etc. She estimates that 41% of female juveniles (0–14 years) and 43% of male juveniles will succumb to infections. Marlowe (2010, p. 150) states regarding the Hadza, that infant (< 1 year) mortality is 21%, and including the juveniles (< 15 years), the mortality rises to 46%. The high infant mortality is due to respiratory and diarrhoeal infections. At later ages children will succumb to occasional outbreaks of epidemics, such as measles. Other infections include malaria. The causes of death among the Agta from the Philippines is described by Early & Headland (1998). It is for this group we find the shortest average life expectancy at birth [e0], namely 21 years (Table 1). It should also be noted that the Agta transitioned from foragers to agriculturalists in the time span covered by the Early & Headland (1998) study. Infectious disease comprising measles, diarrhoea, pneumonia, malaria and tuberculosis constitutes 50% of the known causes of deaths. Extrapolating this to the sample of unknown deaths, it is assumed by the authors that infections may have caused 86% of the mortality among the Agtas. For all ethnographic groups discussed above, infectious disease is a significant contributory cause of death, although the effect of the specific infectious diseases cannot always be discerned.

An important concept from epidemiology is critical community size, defined as the minimum size of a closed population within which a human-to-human, non-zoonotic pathogen can persist indefinitely (Bartlett 1960). If the size of an infected population falls below this threshold, the relatively lower density of susceptible individuals will result in the extinction of the pathogen, the disease will fade out. However, if the population is living adjacent to large populations with sizes above the critical community size, the pathogen could be reintroduced. Bartlett (1960) indicated, with respect to measles, that the threshold would correspond to 250,000–300,000 individuals. For populations not larger than 1,000 to 10,000 individuals, the fade-out probability approximates unity (1) (Bolker & Grenfell 1995). As a corollary to this, small groups of foragers cannot sustain density-dependent infections whether not living adjacent to much larger populations. There are good reasons to question whether these ethnographic populations discussed above are appropriate sources for demographic data in an archaeological setting, as the load of infections experienced by these populations demonstrates that they are affected by the presence of large populations in the vicinity. As they are affected by density-dependent infectious diseases, the demography experienced is in fact, modern. The AFM fails to account for the marcroecology of infections; it does not connect to relevant population processes with respect to the geographical distributions of archaeological foragers. Whereas the ethnographic populations, albeit living in small groups, are surrounded by larger groups that may facilitate the spread of density-dependent infections (Fig. 6A), the sparsely populated landscapes in much of Holocene Europe probably did not have this capacity (Fig. 6B). Mortality due to density-dependent infectious diseases may have been lower among the juveniles.

The endeavour to portray forager demography, whether in the plural or the singular, is an important task. To accomplish this, we have to rely on the archaeological record and especially skeletons. Modern ethnographic populations are not relics of past foragers (cf. Wobst 1978), and the demography they expose may lead us astray if we aspire to research whether, for instance, the shift to a Neolithic economy had any root in an increase of well-being. The results presented here suggest that juvenile mortality has been overestimated in these small and dispersed groups in a sparsely populated environment. High juvenile mortality is intrinsically linked to high fertility, and the results can be interpreted to mean that fertility was relatively low, at least lower than the total fertility rate of 8.0 attributed to the Ache (cf. Pennington 2001). Apart from juvenile mortality, one salient feature of this research that necessitates further analysis is the strong residual component demonstrated for Skateholm. This population experiences mortality rates that persistently reduce the population regardless of age more strongly than any other of the populations.

Acknowledgement

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Neolithic depositional practices at Dösemarken – a discussion of categorization

Åsa Berggren

Abstract

Depositional practices have been regarded as a part of a Neolithic lifestyle together with farming and keeping livestock. As an ongoing discussion shows, however, it is not entirely clear how we should understand these practices. The categorization of Neolithic pits still raises questions and leaves some issues unresolved, especially as the categorization often leads to the use of dichotomies, and the material at the same time seems varied and complex. How to separate one category from the next is often unclear, and in some cases the empirical material seem to fit best somewhere in between categories. As an alternative a practice theory perspective is suggested. It allows variations of a practice to be regarded as a continuum, making it possible to avoid the use of seemingly unambiguous categories.

This paper outlines the discussion concerning depositional practices and suggests how some of the problematic issues may be solved. Pits from Dösemarken, Malmö, southern Sweden (Berggren & Brink 2012) are used as a case study.

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Concepts – structured depositions, offering pits and find rich pits

THE DEPOSITIONS IN pits during the Neolithic have received an increasing amount of attention in archaeological discussions during recent years. Some of this discussion has taken place recently within British archaeology (e.g. Garrow, Beadsmoore & Knight 2005; Anderson-Whymark & Thomas 2012; Chadwick 2012; Garrow 2012 with comments) as well as in Sweden (e.g. Sandén 2008; Rudebeck 2010, Berggren 2012; Rudebeck & Macheridis this volume).

In Great Britain the term structured deposition was suggested as a means of finding the formalized, repetitive and thus highly structured patterns of rituals (Richards & Thomas 1984, pp. 191 f.). The concept has spread within British archaeology and beyond and been used for material from various periods, as shown by Duncan Garrow in a thorough review of this concept (Garrow 2012). It is often used when mundane remains of material culture are found in pits. This situation differs from the discussion concerning ritual depositions, as this is often concerned with quite spectacular objects. However, the discussion concerning structured depositions in pits started with an explicit aim of addressing issues of "ritual or not ritual", and has led to its use also in cases of more spectacular objects.

Garrow points to the fact that the category structured deposition has become something more than initially intended. Introduced as an analytical tool to be used in discussions of possible interpretations, it has been used as an interpretation in its own right (Garrow 2012, p. 86). There is an interesting parallel in Swedish archaeology, where the concepts of "offering pit" and "find-rich pit" have seen a similar development (Berggren 2012). Starting as a discussion of whether pits with large amounts of material remains should be interpreted as waste or ceremonial deposits (e.g. Stålbom 1997), some find-rich pits were categorized as offering pits by Stålbom (1997), a category previously reserved for pits with more spectacular objects. This was a shift in the use of this category. Pits with very fragmented material remains were starting to be interpreted as offering pits also in other regions, as their assemblages were similar to those in other pits categorized as offering pits, where e.g. intact vessels or large parts of vessels had been deposited (e.g. Touminen & Koch 2007). The meaning assigned to the term offering pit has thus shifted in Swedish archaeology during the last decade. From having signified pits with specially arranged materials such as intact pots and other artefacts, the term "offering pit" now also includes pits with rich assemblages of fragmented materials.

In an attempt to discuss the function of pits with large amounts of material using examples from the Malmö region in southwestern Scania, the concept of Early Neolithic find-rich pits (in Swedish *fyndrika TN-gropar*) was suggested in a paper from Lund University (Eriksson *et al.* 2000). The concept has been increasingly used during the past decade, at least in the Malmö area. To turn this concept into a functional analytical tool, different definitions of find-rich pits have been used. In the original paper it was defined as a pit with finds of a total weight of between 0.5 and 1.0 kg or more, consisting of flint and/or pottery, not excluding other materials (Eriksson *et al.* 2000, p. 4). In another study, the definition was at least one kilogram of material (Gidlöf 2009, p. 94), and in yet another study a find-rich pit was defined as containing more than 50% of the average find material of flint tools, animal bones and pottery from the studied site (Rudebeck 2010, p. 162).

I believe this concept grew in popularity as there was a need for an analytical tool in the efforts to understand these material patterns. However, the use of the term "find-rich pit" has also been unclear at times and has been used in the same way as the concept of structured depositions as described by Garrow. First introduced as an analytical tool, it too has been used as an interpretation in itself.

Problematic dichotomies

The discussion concerning pit depositions has partly been concerned with the question whether the depositions were ritual or not, in many respects echoing the discussion concerning wetland depositions (Berggren 2010). Traditionally, deposits of anything odd or spectacular have been interpreted as ritual and deposits of less spectacular materials have been categorized as mundane. This has been regarded as unsatisfactory, as the ritual interpretation was habitually used to explain what was perceived as inexplicable in utilitarian terms (Richards & Thomas 1984, p. 189; Brück 1999; Bradley 2003; 2005; Chadwick 2012, pp. 294 f.). It seems the complex material will not easily be placed in binary categories such as dichotomies, and a question such as "ritual or not ritual?" can perhaps be phrased differently.

The use of dichotomies, such as the separation of a ritual sphere from a domestic sphere in society, ritual sites from domestic sites, and ritual acts from domestic acts, has been increasingly criticized (e.g. Brück 1999). This is connected to the concept of ritual and how it is defined. Many definitions of the concept of ritual aim to separate ritual from non-ritual phenomena, even though they fail to do just this (Bell 1992, pp. 69 f.). The use the concept of ritual in archaeology is a product of modern rationalism, resulting in a view of ritual as irrational. However, ritual may be regarded as rational by the participants, which means that what is regarded rational action has to be reconsidered. We cannot assume a distinction between ritual and rationality in prehistoric society (Brück 1999).

Additionally, this division has often been connected to a division between sacred and profane phenomena, connecting the ritual to the sacred. Ritual has thus most often been seen as belonging to a religious sphere, which means that other rituals, e.g. social rituals, are left out of the discussion (Berggren 2010, pp. 89 f.). Ritual has hence been seen as disconnected from profane and rational behaviour.

Garrow suggests a distinction between odd deposits and material culture patterning, describing depositions of a more spectacular kind and less spectacular depositions respectively. Garrow stresses that these categories are not to be regarded as distinct, but rather two ends of a continuous spectrum (Garrow 2012, p. 94). Garrow is unsatisfied with an imbalance between ritual and everyday interpretations of structured depositions, as he believes there has been an unjustified focus on ritual in what he calls a hyperinterpretative turn. Interpretations of odd deposits as meaningful and ritually deposited are used as arguments to interpret material culture patterning as meaningful and ritual as well. Instead Garrow points to the possibility that not all material culture patterning may have been meaningful or symbolic; in fact, some of it may just have happened (Garrow 2012).

Garrow's idea of a spectrum from odd deposits to material culture patterning is in line with other calls for a view of acts in a continuum (Bell 1992; Berggren & Nilsson Stutz 2010; Chadwick 2012).

However, it is difficult to embrace the idea of a continuum, and easy to fall into thinking with dichotomies. What Garrow introduces as extremes of a continuum is used – by Garrow – as an absolute dichotomy (Thomas 2012, p. 124). This is problematic as the distinction and separation make it difficult to understand how these phenomena may have been unseparated in the eyes of a prehistoric person. We have to be able to think that this distinction was not made, without thinking that everything in prehistory was permeated by ritual. Ritual acts may be seen as a part of domestic life, not separated from it (Bradley 2003; 2005). Instead of asking what is ritual and not ritual, a possibility of ritualization of different degrees may be discussed. In cases it may even be difficult to distinguish between what was ritual and what wasn't. But perhaps this may not have to be problematic, if the focus is shifted to the social significance of the acts (Berggren & Nilsson Stutz 2010).

A practice theory perspective on depositions

As shown above, the use of dichotomies has implicitly connected ritual to irrationality. However, there is nothing to suggest that ritual behaviour is irrational. On the contrary, a ritual is often experienced as "the right thing to do" in certain situations, as is discussed in a practice theory (Bourdieu 1977; Bell 1992). Various solutions to the problematic dichotomies and the separation of the ritual and mundane practices have been suggested, ranging from avoiding the concept of ritual altogether (Brüch 1999; Fontijn 2012) to a view of depositional practices as a continuum from ceremonial to routine acts (Bell 1997; Nilsson Stutz 2003; Berggren 2010; Berggren & Nilsson Stutz 2010; Chadwick 2012; Thomas 2012). This approach to practice is made possible by a practice theory perspective. It allows us to regard acts in a continuum of degrees of formalization, which may let us avoid either/or questions, avoid regarding ritual as irrational and give us more flexible analytical tools.

According to practice theory, practice generates meaning. This is in opposition to a view of practice as representing or expressing a meaning that is predefined, a priori to the act. Instead the meaning is seen as created and defined in the act, and may vary according to situation and context. This means that the meaning of one type of act can vary. Most importantly, the meaning that is defined in practice consists of relations between phenomena, it is not the phenomena themselves that are defined by the acts (Bourdieu 1977, p. 120). The relations consist of structures that become embodied in the participants but also objectified in the material components connected to the act. The key to understanding practice lies in these relations created by the act.

Practice theory is closely connected to the concept of materiality and the study of relations between things, or the order of things (Miller 2005, pp. 6 f.). According to Bourdieu the order of things is given a homology or a counterpart in other orders in society that are thus given a material base. The material culture may thus be regarded as a network of corresponding orders, that is, the base for everything in society (Bourdieu 1977, p. 143; Miller 2005, pp. 6 f.; Tilley 2006, p. 65).

A practice theory perspective offers us tools to discuss the relation between acts of individuals as well as the relations between these individuals and the social structure of their society. This way it is possible to discuss the significance of these acts in society, regardless of how the acts are categorized.

Any act may be ritualized, through a strategy of differentiation (Bell 1992). However, identifying these strategies archaeologically may be difficult. An act may be performed in the same way on different occasions, but only when, for example, a special word is uttered is it differentiated and ritualized. This means that the material remains of the acts, ritualized and non-ritualized, may be identical. Thus we have to consider that ritualized acts are not materially distinct from other acts. Ritualized acts may be found anywhere in a continuum of acts of different degrees of formalization, from very formalized ceremonies to more casual, more temporal, less formal acts (Bell 1997, p. 138). It may thus be concluded that rituals may have different degrees of formalism and other acts may have the same degree of formalism. However, rituals are more common near the more formal end of the continuum (Rappaport 1999, pp. 34 f.).

This conclusion may be illuminated by a discussion about translation and ambiguity. Bourdieu was well aware of the discrepancy between the unambiguous concepts of science within anthropology and the ambiguous way informants may use to express themselves (Bourdieu 1977, p. 108). This is one of his reasons for developing a practice theory. A similar point is made on behalf of archaeology, as it aims at unambiguous interpretations, when social reality is often characterized by ambiguity and uncertainty. Instead of cleaning our data from ambiguity, it has been suggested that we should strive for concepts that emphasize this ambiguity (Gero 2007). There is a problem of translation between different cultures, and it

Table I. Some characteristics of the three pits from Dösemarken.

pit	size	depth	fill	worked stone	pottery (incl. clay discs)	burnt clay	bone	worked flint	date
12461	2.22 × 1.53 m	0.26 m	1 homo-geneous	220 g	2220 g	–	114 g	1909 g	ENI (based on pottery)
2777	1.60 × 1.25 m & 0.60 × 0.70 m	0.30 m & 0.03 m	1 layer in each pit	7 611 g	2714 g	263 g	1035 g	4252 g	ENII/MNAI (based on pottery)
28411	0.7 × 0.7m	0.30 m	5 layers	–	69 g	–	–	1969 g	MNA (3270–2930 BC cal. 1 σ)

Fig. 1. Stones at the northern edge of pit A12461. Photo: Anna-Clara Johannisson.

may be difficult to find the right concepts. It may even be impossible to find translations of concepts or phenomena across culture borders, as "even the most modest attempts at description are surely in some sense translations across conceptual schemes" (Keane 2008, p. 112). In other words, subtle meanings and nuances get lost in translation. Our categories are rather blunt tools, but we may try to make them more flexible and open to these nuances. To regard acts in a continuum of degrees of formalization instead of using separate categories may be a fruitful solution. This way the categories, both as analytical tools and as interpretations, are not strictly delimited, but rather flexible.

Depositional practices at Dösemarken; three examples

Three pits dated to the Early and Middle Neolithic from Dösemarken (Berggren & Brink 2012) are chosen as a case study (see Table I). They represent depositional practices of different degrees of formalization. This limited amount of pits is a small sample. The discussion is meant to be of more general interest, rather than an exhaustive interpretation of depositional practices at Dösemarken.

Large, oblong pit (A12461)

The homogeneous fill indicates that the pit was filled rather quickly, but in several stages. Pottery and stones were a part of this infilling. They were not carefully placed, some were deposited with the soil, some deposited between instances of backfilling. Some pottery and stones landed in clusters. Some stones rolled to the edges (Fig. 1), perhaps as soil had built up a pile in the middle of the pit.

One stone had probably been used in crushing some organic material prior to the deposition in the pit. The other stones showed no signs of use, but were of similar size and form. The sherds of pottery in the pit represented at least 14 different vessels of different sizes. They were probably used in cooking, consumption and perhaps storage of foods. The clay disc may have been used for the preservation of heat (Stilborg 2002). The flint implements consisted of remains of all parts of production of blade-like flakes. Some flakes were given a jagged edge, and a use-wear analysis shows that they were used for processing vegetable fibres, perhaps in the production of rope or thread. Some flakes without retouch were used in the same way, others were used to work on wood. A flake with polished surface shows that an axe was used as raw material for producing other tools. The bones scattered in the fill were both burnt and unburnt and a few fragments were identified as coming from cattle and pig. They show that meat was cooked and probably also consumed in the area (Berggren & Brink 2012, p. 45).

Many of the objects in the pit can be connected to the preparation and consumption of food, but different crafts are represented as well. Some of the stones and pottery were deposited separately from the soil. The lack of careful arrangements indicates that the formalization of the deposition of stones and pottery was low.

The objects are of types that may be found at a settlement, but the nearest contemporary known remains are located about 250 metres away. Digging and filling this pit may have been a solitary event, away from the houses of the settlement. Perhaps this was an isolated workplace of some kind, where food was consumed as well. Some of the material may have been lying in the soil that was used to backfill the pit, indicating that the workplace was used frequently. If anything, this deposition would represent what Garrow calls material culture patterning. The lack of formalization suggests the acts were not differentiated and thus not ritualized. However, depositing fragmented material in a pit may have been understood as the correct way to act. The depositions in the pit were perhaps a part of organizing or cleaning the workplace. A large-scale example of organizing a temporary living space by depositing material remains in pits without special arrangements can be seen at the nearby site of Almhov (Rudebeck & Macheridis this volume).

Two pits with arrangements of stone, bone and pottery (A2777)

Two pits, dug one after the other in close connection, were located on a settlement, about 30 metres from a contemporary longhouse. Different character of the fills suggests that the pits were filled in on two separate occasions. At the bottom of the shallow pits, stones, animal bones and pottery were carefully arranged. In the larger pit stones were placed in a rather sparse formation, creating two semicircles. Two of the stones were grinding stones. Between the stones and in the middle of the semicircles, large sherds of funnel beakers and two animal skulls were placed: a pair of cattle horns with a piece of the skull attached and a half-sectioned cranium of a pig. In the eye socket of the pig a small, red stone was found (Fig. 2). The stones, pottery sherds and the two skulls were partly resting on each other and must have been placed together in a sequence, on one occasion, as one arrangement. Outside the circle of stones, two lower legs of cattle were positioned next to each other, one foreleg and one hind leg. They must have had remaining soft tissue when they were positioned in the pit. In the smaller pit, one intact clay disc and parts of an incomplete disc were found on the bottom.

The deposition of the objects may have been performed by one person or a small group (Fig. 3). The arrangement may have been laid out as a display to be viewed, before the pits were backfilled.

The order of this arrangement may have taken its structure from another arena in society, as a material homology. To understand this

Fig. 2. The pig cranium in pit A2777, with red stone in eye socket. Photo: Ulf Sandén.

homology, it may be helpful to look at what happened to the objects prior to deposition.

Before the deposition, the objects were used in various functions. The majority of the stones were burnt and two were clearly worked. They had probably been used in polishing and grinding tasks, possibly polishing of flint objects and grinding some form of plant. They were both parts of fragmented quern stones. The animal bones consist of the parts of the animals that have less meat, such as the skulls and the lower legs. They are not likely remains of meals, but rather bones from slaughter. One of the two lower legs of cattle was scorched by fire, which in other cases may be a sign of cooking. However, this leg was probably burnt in other circumstances before the deposition. The pottery and clay discs that were used in the arrangement were fragmented before the deposition. This may have taken place just before the deposition as the pieces were large; one side of a funnel beaker and a large part of a clay disc. Another clay disc was intact when deposited.

Fig. 3. A reconstruction of the deposition in A2777. Illustration: Krister Kàm Tayanin.

Most of the objects were probably found nearby, at the settlement. Many of the objects were used in the processing, preparation and consumption of food. The vessels may have been used at the house and the burnt stones may have been collected in hearths in the house or nearby. The two worked stones show that quern stones had been fragmented after use. One of the fragments was burnt and must have been in contact with fire before deposition in the pit.

The bones from slaughter were collected at a slaughter place, perhaps on the perimeter of the settlement and not directly at the house like the rest of the objects. This means that the arranged objects could be found in the area, but not all in the same place. Before deposition they had to be selected and collected.

After the objects were arranged at the bottom of the pits, the pits were backfilled with soil that contained many finds. The plentiful flint material scattered in the soil consisted of remains of simple production of flakes and blade-like flakes. The whole chain of production is represented in the material. Mostly the local flint from the till was used, but other flint materials and polished flint objects were also used as cores in some cases. A use-wear analysis of a small portion of the flakes show that retouched as well as unmodified flakes were used for processing wood, hide/meat, bone/horn and plants. A small proportion of the flint was burnt.

The pottery sherds represented at least 13 vessels of different sizes and functions, e.g. funnel beakers and hanging vessels. A study of the fragmentation of the pottery shows that it was probably deposited as rather large sherds. Some vessels were represented by several sherds, e.g. a funnel beaker with a wavy decoration of two-ply cord. Pieces of burnt clay of clay packings were also found scattered in the soil, probably remains of ovens or clay-coated hearths (Berggren & Brink 2012, p. 52).

The material scattered in the soil indicates activities that were carried out at the settlement, such as cooking and consumption of food, processing, crafts, storage and burning fires. As the pits were located on the settlement, the soil can be expected to contain much debris from activities of the people living there. The majority of the objects in the fill of the pits were probably already in the soil when it was used to backfill the pits, as a material culture patterning taking its structure from the organization of the settlement. However, the unusually large sherds may have been picked up and deposited separately with the soil. They were not arranged, and the degree of formalization in the deposition of these sherds was low. They were a part of a depositional practice, but not necessarily a part of a formalized and perhaps ritualized activity. However, the objects at the bottom of the pits were arranged according to some structure in a more formalized fashion and are found on the odd-deposit end of Garrow's continuum. In fact, the acts of depositing them may have been differentiated by creating new relations, and thus ritualized.

Many of the objects in A2777 were connected to food preparation and consumption. However, the animal bones arranged at the bottom were not remains of meals. Instead they were collected directly from the slaughter area. Perhaps the deposition was performed to handle the relation to the individual animals that were just killed? The red stone in the eye socket of the pig may have made it easier to regard him or her as an individual.

Small pit with arrangement of flints (A28411)

Five layers of fill that contained different amounts of finds indicate that the pit was filled on five occasions. Many flint implements, some pieces of clay discs, a few pottery sherds and pieces of burnt clay were mixed in with the soil and deposited with it. The flint dominated this material while other materials that are usually frequent in Neolithic pits were missing (animal bones), or scarce (pottery).

Fig. 4. Flint implements and clay disc parts arranged in pit A28411. Note the two pieces of clay disc on the left, almost the colour of the soil. Photo: Ulf Sandén.

Some time may have lapsed between the occasions of filling the pit, and after the third one some objects were placed at the bottom of the pit, on top of the third layer of soil. The objects were clearly arranged in a certain order (Fig. 4). Some flint flakes from axe production were placed on top of each other in a pile and a sherd of a clay disc was placed on top of them. Another clay disc was broken into two pieces that were placed near each other, and a scraper used to process hide was placed between them, and a blade struck from a polished axe was placed next to them. Above this two more layers of soil, containing scattered flint objects, represent two more infilling events.

The objects are not representative of everything that may have been found on a settlement, but seem rather selected. The choice and layout of the carefully arranged objects on top of the third layer seem to follow a structure, perhaps a material homology. It would be placed close to the odd-deposit end of the continuum as proposed by Garrow.

Analysis of the flint supports the impression of a selected material. It originates mostly from production of square flint axes and some from the production of blades (Berggren & Brink 2012, p. 47). A smaller amount originates from so-called household production of flakes, which usually is the most common flint material found in Neolithic pits (Knarrström 2000). The analysis shows that flint tools were produced and used somewhere in the area. Some scrapers and retouched flakes had been used in the processing of meat and perhaps hide (Berggren & Brink 2012, p. 47). Only unretouched flakes had been in contact with fire, in contrast to the other flint implements such as the axe production remains, the blades, retouched flakes, polished flakes and tools such as scrapers. It seems that the use of flint may have been spatially organized, and only household production happened near fires. Production of e.g. axes took place where there was no contact with fires. The flint implements may have had different connotations, not only as they were products of different manufacture, but also as they were collected at different places in and around the settlement.

The clay discs were broken before the deposition, one of them perhaps just prior to deposition, or at least not very long before, as the pieces were kept together until they were arranged in the pit. It has been suggested that clay discs were used to preserve heat (Stilborg 2002). They were often heated repeatedly and it seems they are closely connected to fire and heat. The clay discs in this pit are no exception. It is not known whether the pieces were heated during the deposition, but it is possible, and they may thus have brought heat to the pit. The clay discs were closely arranged with the flint. As two pieces of a disc were placed on both sides of a scraper and one piece of clay disc was placed on top of flakes, it seems that the discs enveloped or covered the flint in heat. Perhaps this was bringing flint production and fire together, phenomena that were spatially kept apart at the settlement. The objects had to be collected in different areas, perhaps by people who normally did not perform tasks together, creating a relation between them.

The objects that were mixed in with the soil were dominated by flint, but not representative of any random flint scatter on the ground. Instead they consisted of the same selected stages of axe production and blade production as those found in the flint material arranged with the clay discs. It is possible that the flint mixed with the soil was equally selected, but it is also possible that certain stages of flint production took place near the pit. When the pit was filled with soil from the ground around the pit, the flint on the ground followed the soil into the pit. Certain stages of flint production may have taken place away from the settlement, in this case about 100 metres from a contemporary house. It is thus possible that the objects in the soil can be a result of a material culture patterning, without any degree of formalization. It is rather a result of how the activities were organized outside the settlement. However, the deposition of the flint and clay discs was formalized and may also have been ritualized, creating relations between tasks or people performing tasks not normally in close proximity.

Conclusion

It seems possible to locate the depositions in the three pits at various places along a continuum of different degrees of formalization. The carefully arranged objects in the double pit A2777 and A28411 with flints are both examples of what may be regarded as formalized depositions, following certain structures. They are close to the odd-deposit end of the continuum, using Garrow's concepts.

The stones and pottery in the isolated pit A12461 and some of the large pottery sherds in the double pit A2777 seem to have been part of a less formalized depositional practice, and should be placed closer to the other end of the continuum. They may still be a part of a socially significant practice, such as cleaning and organizing a workplace.

The majority of the objects scattered in the fills of these pits may have accompanied the soil used for backfill, not following any depositional practice in themselves, but indicating spatial structures of activities in and around the settlement. They are at the material culture patterning end of the continuum. However, the backfilling may have been regarded as one part of a sequence of formalized acts when the arranged objects were covered with soil, making them a part of the same practice. How the objects in this soil were treated, though, was not a part of the formalization.

This means that the objects occur in the pits may have found their way into the pits in different circumstances and for different reasons. Even though one pit may constitute one context, the finds and the acts that took place there should not automatically be regarded as homogeneous.

Both more and less formalized acts seem to have taken place at the pits that may have been parts of depositional practices which created relations between the objects as well as the persons involved. These relations may have been a part of the social structure created and recreated by various practices in this society. The depositional practices may have been performed to handle relations resulting from a spatial organization of the settlement. The structure was embodied in the persons performing the depositions and also objectified in the pit and the deposited material. This may be seen in the pit with flint objects, A28411, where different tasks performed in different areas seem to be connected to each other, and in the double pit A2777 where relations may have been created between individual animals and the participants.

According to practice theory and the ritualization concept, all acts may be ritualized, but a high degree of formalization is a common differentiation strategy. It is possible that in this case too, the more formalized depositions may have been a part of ritualized activities. Other differentiation strategies of these depositional acts may have been the arrangement of objects that were normally not connected, such as remains of certain flint production and fire, or handling slaughter remains as if they were still individual animals. Also, the fact that the objects were placed and arranged under ground may have differentiated them from others. The acts of depositing stones and pottery in the isolated pit A12461 and the large pottery sherds in A2777 were not likely ritualized, even though they were a part of a socially significant depositional practice and were a part of organizing space.

Some of the acts of deposition discussed here may have, and some may not have, been ritualized by the person performing them. It is not possible to place these acts in unambiguous categories such as ritual or non-ritual. However, by placing the acts at different points along a continuum of different degrees of formalization, it is possible to discuss interpretations of social significance, also of less formalized acts – regardless of categorization. It is also possible to discuss the creation of various significant relations. This is in my view a more flexible approach to acts and practice than dichotomies such as ritual/non-ritual.

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New insights into early farming practice and diet from stable isotope analysis of crop assemblages

Amy Bogaard

Abstract

Stable isotope analysis of charred cereal grain and pulse seed material can shed new light on both the nature of farming practice and the dietary importance of crops. Measurement of $\delta^{13}C$ and $\delta^{15}N$ values in well preserved crop remains provides complementary perspectives on growing conditions, with implications for water status and manuring, respectively. Particularly when measured across many bulk samples, and informed by ecological analysis of weed assemblages associated with crop material, stable isotope analysis of crop remains offers a direct means of assessing key dimensions of agricultural intensity. Moreover, $\delta^{13}C$ and $\delta^{15}N$ values of plant remains provide much needed constraints on the estimation of the dietary role of farmed produce in the human diet. These applications are illustrated through examples from different parts of Europe.

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Introduction

Archaeologists continue to debate the nature and dietary contribution of Neolithic farming, and the ways in which its form and significance may have varied across Europe (e.g., Whittle 2003; Colledge & Conolly 2007; Hedges *et al*. 2013). One central issue is the "value" of arable land: to what extent did Neolithic farmers make investments of labour and/or nutrients that increased the suitability of certain plots for crop growing and enhanced the likelihood of ownership claims over them? This question has fundamental implications for broader issues of property, inheritance and social status (e.g., Bentley *et al*. 2012; Bowles & Choi 2013). Previous work on arable weed assemblages from central European sites suggests that growing conditions tended to be highly productive and disturbed (Bogaard 2004). Soil disturbance plausibly reflects tillage and weeding activities, rather than "natural" soil disturbance in floodplain habitats (Sherratt 1980), for two reasons. First, crops were often autumn-sown and so would be damaged by spring flooding (Bogaard 2004). Secondly, geomorphological work on the formation of floodplain sediments through later prehistory suggests that Neolithic floodplains were poorly suited to cultivation (Bogaard 2012, p. 27); instead, these habitats were probably important for livestock grazing (Kreuz 2008; Knipper 2012). The role of farmers in maintaining high soil *productivity*, however, is ambiguous. Circumstantial evidence suggests that an anthropogenic component through middening and manuring is likely – farming spread in tandem with livestock keeping, for example, and herding appears to have been generally a small-scale and local activity (e.g., Halstead 1996; Schibler & Jacomet 1999; Bartosiewicz 2005) – but weed ecology *per se* does not reveal its significance.

A second key issue is the dietary contribution of crops to Neolithic diets. Intensive management of arable plots need not imply

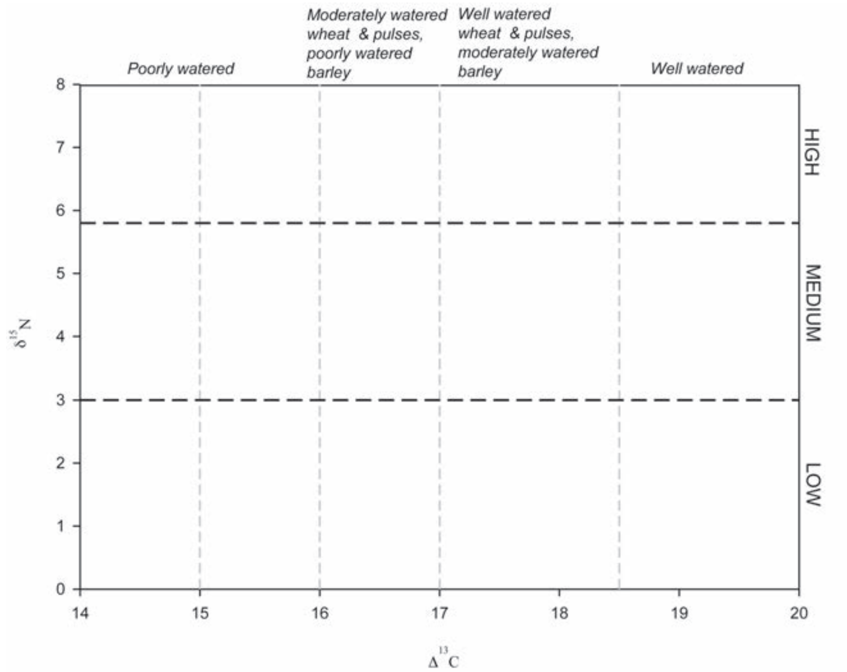

Fig. 1. Summary of inferences on crop water status (using $\Delta^{13}C$ values) and manuring (using $\delta^{15}N$ values) based on modern agricultural experiments (Fraser *et al.* 2011; Bogaard *et al.* 2013, Fig. 1; Wallace *et al.* 2013, Fig. 5). Dashed horizontal lines represent thresholds of low (i.e., residual from previous land use history only), medium (10–15 t/ha) and high (35 t/ha) manuring rates in cereals.

that crops played a staple role; "gardens" could be maintained for aesthetic reasons, and to provide special foods rather than core components of the diet (e.g., Ingold 1996; Leach 1997). The only methodological approach that can make a direct assessment of the dietary importance of specific foods is palaeodietary analysis through stable isotope measurements of human skeletal collagen and of potential food sources (Tauber 1981; Schoeninger *et al.* 1983). Until recently, however, this approach has tended to exclude direct measurements in archaeobotanical material due to lack of preservation and/or concerns over contamination (e.g., Hedges & Reynard 2007). For a combination of reasons to be explored further below, interpretation of stable C and N isotope ratios in human and faunal collagen has likely underestimated the potential importance of crops in Neolithic diets.

Stable isotope analysis of charred cereal grain and pulse seed material can shed new light on both the nature of farming practice and the dietary importance of crops. In this paper I discuss case studies ranging from southeastern to northwest Europe in order to explore and illustrate the potential and limitations of crop stable isotope analysis as a source of evidence for early farming practice and diet.

Archaeobotanical stable isotope analysis

Hastorf and DeNiro (1985; DeNiro & Hastorf 1985) conducted pioneering work on stable C and N isotope analysis of archaeobotanical materials, and highlighted the potential contribution of this approach for differentiating (morphologically unidentifiable) residues of C3 versus C4 plants, or N-fixing legumes versus cereals. Another early study, by Marino and DeNiro (1987), highlighted the potential of stable C, O and H isotopes in food plants for palaeoclimatological investigations. Araus and colleagues (e.g., Araus *et al.* 1997; Ferrio *et al.* 2005) have investigated stable carbon isotope analysis as a method of inferring crop water status, with a particular focus on arid regions of western Asia and Iberia. Analysis of crop stable nitrogen isotope ratios offers a means of inferring soil nitrogen composition and, in an arable context, the practice of manuring (e.g., Bogaard *et al.* 2007; Fraser *et al.* 2011). Volatization of ^{14}N in ammonia enriches soil nitrates in ^{15}N as well as plants taking up those nitrates; the effect on plant $\delta^{15}N$ increases with manuring rate. Isotopic study of present-day cereals and pulses grown under a range of experimental and "traditional" farming regimes from the UK to the eastern Mediterranean (Fraser *et al.* 2011; Wallace *et al.* 2013) has demonstrated the usefulness of stable C and N isotope compositions for assessing whether soil productivity was manipulated through water management and/or manuring, respectively (Fig. 1).

A complementary strand of work has assessed the extent to which the original stable C and N isotope values in cereal grains and pulse seeds are retrievable despite charring and burial (e.g., Kanstrup *et al.* 2012; Fraser *et al.* 2013; Styring *et al.* 2013). The upshot of work to date is that $\delta^{15}N$ values in cereal grains and pulse seeds tend to be increased by charring, but that these increases are modest and predictable, and can be taken into account. Fraser *et al.* (2013) suggest that 1‰ be subtracted from $\delta^{15}N$ values in charred cereal grain and pulse seed to make (generous) allowance for the biasing effect of charring on nitrogen isotope composition, and this adjustment has been applied to all of the data presented in this paper. $\delta^{13}C$ values appear to be less affected by charring, and neither isotope appears to be biased by burial or appropriate laboratory pre-treatment protocols. (Since this paper was written two papers have been published that further refine understanding of charring effects (Nitsch *et al.* 2015) and pre-treatment options (Vaiglova *et al.* 2014b)).

Crop stable isotope analysis thus appears to provide a useful method for assessing specific aspects of land use, and for constraining palaeodietary interpretation (Fraser *et al.* 2013; Vaiglova *et al.* 2014a). In relation to land use and crop husbandry, this potential complements inferences afforded through weed ecological analysis: weed ecological characteristics relating to general soil productivity are often the best correlates of manuring *and* irrigation (e.g., Charles *et al.* 1997, 2003; Jones *et al.* 2000), and stable isotope determinations of crops provide an independent means of identifying these specific contributions to growing conditions. Moreover, stable C and N isotope analysis is conducted *directly* on crop remains, and can be used to compare the growing conditions of different crops, or crop deposits, whether or not associated weed data are available. On the other hand, weed data provide useful ecological constraints on the interpretation of stable isotope data, indicate levels of soil disturbance, pH etc. that are not directly accessible through isotopic analysis and can identify subtle ecological differences that may not be apparent from isotope data. Ideally, therefore, crop growing conditions would be reconstructed through a combination of weed ecological and stable isotope approaches, in order to exploit their complementary strengths.

In terms of Neolithic diets, the contribution of crops cannot be inferred from the frequency of crop remains *per se*, but becomes accessible if stable carbon and nitrogen isotope analysis of well preserved archaeobotanical remains is integrated with that of faunal and human collagen (Fraser *et al.* 2013). In the absence of actual

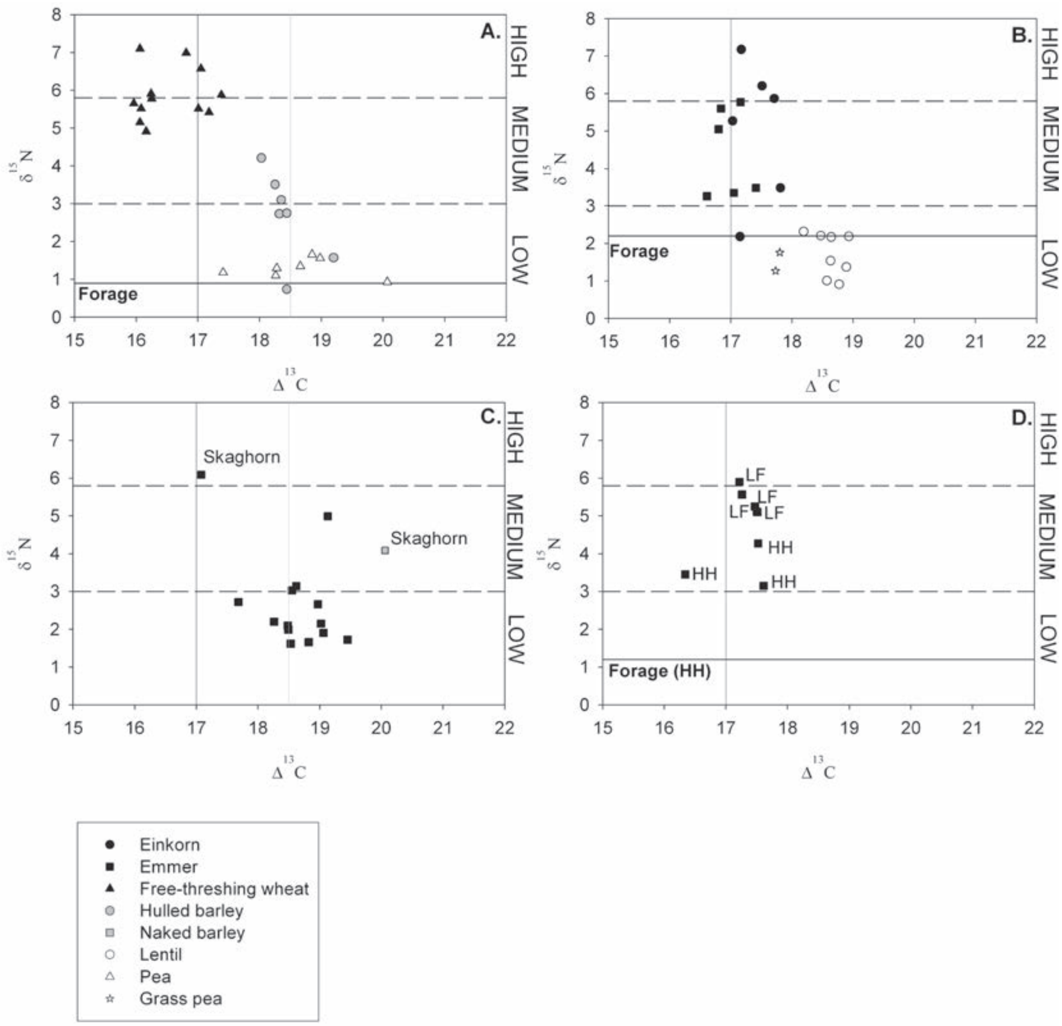

Fig. 2. $\Delta^{13}C$ and $\delta^{15}N$ values of cereal (and pulse) crops at six Neolithic sites: (A) Koufovouno, Greece; (B) Slatina, Bulgaria; (C) Sarup and Skaghorn, Denmark; (D) Hambledon Hill and Lismore Fields, UK. Horizontal lines ("Forage") in 2A, 2B and 2D represent estimates of large herbivore forage $\delta^{15}N$ values (by subtracting 4‰ from the mean value for herbivore bone collagen to account for trophic shift). Dashed horizontal lines represent thresholds of low, medium, and high manuring rates inferred from modern experiments (see Fig. 1). Black vertical line represents well-watered wheat and pulse threshold; grey vertical line represents well watered barley threshold (see Fig. 1).

crop $\delta^{13}C$ and $\delta^{15}N$ values, previous studies have made assumptions about the isotopic values of plant foods that tend to minimize their apparent protein contribution: either generalized modern plant values are used (e.g. an average $\delta^{15}N$ value of 3‰ for non-N fixing plants), or plant $\delta^{15}N$ values are inferred from herbivore bone collagen values by subtracting plant-diet to collagen fractionation values (Hedges & Reynard 2007). Neither approach takes account of variation in plant $\delta^{15}N$ among habitats, including the "manuring effect", or of substantial differences in isotope ratios between different plant parts, cereal grain being more enriched in ^{15}N than "chaff" components (Bogaard *et al.* 2007; Fraser *et al.* 2011). Given the likelihood that humans were the primary consumers of cereal grain, both manuring *and* compositional differences among plant parts would tend to elevate the $\delta^{15}N$ values of plant foods consumed by humans above those of animal forage (Fraser *et al.* 2013). On the other hand, dung evidence demonstrates that livestock consumed a range of plants and plant parts from a variety of habitats (e.g., Kühn & Hadorn 2004), and estimated herbivore forage $\delta^{15}N$ values provide an indication of local unmanured vegetation baselines.

Implications for land use

Bogaard *et al.* (2013) reported the results of a large-scale programme of stable C and N isotope determinations on 124 bulk samples of well preserved archaeobotanical cereal grains and pulse seeds from 13 Neolithic sites across Europe, from the UK to southern Greece. Along with reference values derived from agricultural experiments (Fig. 1), estimates of herbivore forage $\delta^{15}N$ values were derived from collagen analysis of associated fauna to provide local vegetation baselines. Stable carbon isotope ratios are expressed as carbon discrimination ($\Delta^{13}C$) values, which take into account changes in $\delta^{13}C$ of source CO_2 through time (e.g., Ferrio *et al.* 2005).

Fig. 2 illustrates results from a selection of sites, two in southeast Europe and four in the northwest: Koufovouno in Laconia, southern Greece (*c.* 5800–5000 cal. BC) (Vaiglova *et al.* 2014a), Slatina near Sofia, western Bulgaria (*c.* 5900–5500 cal. BC) (Marinova 2006), Sarup and Skaghorn, Denmark (*c.* 3900–3400 cal. BC) (Andersen 1997), Hambledon Hill, Dorset, UK (*c.* 3700–3300 cal. BC) (Mercer & Healey 2008) and Lismore Fields, Derbyshire, UK (*c.* 3810–3600 cal. BC) (Jones 2000). An initial observation is that each site is to an extent unique: thus, at Koufovouno in southern Greece (Fig. 2a), high $\delta^{15}N$ values are associated with wheat versus barley, while at Slatina, western Bulgaria (Fig. 2b), groups of cereals with relatively high and low $\delta^{15}N$ values occur within the *same* crop type (the hulled wheats, einkorn and emmer). Nevertheless, both sites reflect a similar range of cereal $\delta^{15}N$ values, and a tendency for (nitrogen-fixing) pulses to be better watered than the cereals (i.e. irrigated or grown on more humid soils), as well as manured (given enrichment in ^{15}N above atmospheric nitrogen, 0‰ – Fraser *et al.* 2011). Emmer samples from the TRB enclosure site of Sarup on the island of Fyn, Denmark, dating to the later 4th millennium BC, present a strikingly different distribution of values (Fig. 2c): stable carbon isotope values are markedly higher, reflecting the wetter climate, but $\delta^{15}N$ values are almost all within the range expected for cereals with little to no manuring. It is perhaps important here that Sarup is a ceremonial enclosure site rather than a settlement; tantalizingly, a pair of cereal samples from the nearby TRB settlement site of Skaghorn returned $\delta^{15}N$ values higher than all but one (outlier) sample from Sarup (Fig. 2c). While the low number of samples from Skaghorn limits the reliability of this observation, a similar contrast in cereal $\delta^{15}N$ values, and hence potentially in manuring levels, is observed between emmer wheat samples from the Stepleton enclosure at Hambledon Hill, Dorset (n=3) and the burned structures at Lismore Fields, Derbyshire (n=5), though sample numbers remain low (Fig. 2d). Geology may also be relevant to the Hambledon values: previous stable isotope work on chalkland sites suggests that they are associated with relatively low $\delta^{15}N$ values (Stevens *et al.* 2013).

The broad implication of these results is that early farmers used manuring and (where limiting) watering to enhance arable productivity to varying degrees, depending on local circumstances and crops. People cultivated arable land with variable histories and degrees of "investment" through manuring. Crops deposited at

Table 1. Linear-mixing model parameters and outputs used for estimating the percentage of animal protein of total dietary protein in human diets at Vaihingen (modified from Fraser *et al.* 2013: Table 5) and Hambledon Hill. Grey shading = not applicable to Hambledon Hill due to lack of pulses.

Model inputs for $\delta^{15}N$ values	Human dietary model scenarios					
	A. Standard model	B. Cereal consumer	C. Mixed cereal/pulse consumer	D. Standard model (+5‰)	E. Cereal consumer (+5‰)	F. Mixed cereal(/pulse) consumer (+5‰)
Vaihingen an der Enz						
Human collagen	9.1‰	9.1‰	9.1‰	9.1‰	9.1‰	9.1‰
Herbivore collagen	6.7‰	6.7‰	6.7‰	6.7‰	6.7‰	6.7‰
inferred herbivore forage	2.7‰	na	na	2.7‰	na	na
Vaihingen cereal crops	na	4.5‰	3.7‰	na	4.5‰	3.7‰
Vaihingen pulse crops	na	na		na	na	
$\Delta_{plant\text{-}herbivore}$	4‰	na	na	4‰	na	na
$\Delta_{diet\text{-}human}$	4‰	4‰	4‰	5‰	5‰	5‰
estimated % animal protein	~60%	~29%	~46%	~35%	~0%	~13%
Hambledon Hill						
Human collagen	9.2‰	9.2‰		9.2‰	9.2‰	
Herbivore collagen	5.2‰	5.2‰		5.2‰	5.2‰	
inferred herbivore forage	1.2‰	na		1.2‰	na	
Hambledon cereal crops	na	3.6‰		na	3.6‰	
$\Delta_{plant\text{-}herbivore}$	4‰	na		4‰	na	
$\Delta_{diet\text{-}human}$	4‰	4‰		5‰	5‰	
estimated % animal protein	~100%	~100%		~77%	~40%	

Sarup and Hambledon Hill could represent relatively non-intensive forms of production situated near the enclosures themselves – and hence lacking potential middening/manuring from substantial year-round human and livestock populations – or from outfield areas near settlement sites elsewhere.

Evidence for variable rates/histories of manuring at these sites are consistent with the available weed ecological data and other bioarchaeological datasets. Relatively rich weed assemblages from Bulgarian Neolithic sites including Slatina (Marinova 2006) suggest long lived cultivation plots: few woodland taxa but many of disturbed habitats imply plots established for 5–10 years at least (cf. Bogaard 2002, 2004). Bulgarian assemblages present the mixture of "garden crop weeds" and "cereal weeds" characteristic of small-scale and intensive cultivation (cf. Jones *et al.* 1999). Sheep/goat dung and associated mineralized plant remains (Marinova 2006) imply herding near settlements, compatible with small-scale animal husbandry and manuring. At Sarup, where the crop isotope data suggest little to no manuring, weeds associated with cereals reflect sandy soils of low productivity (e.g. thyme-leaved sandwort, *Arenaria serpyllifolia* – Andersen 1997, p. 62).

Implications for diet

When combined with stable C and N isotope analysis of associated fauna and humans, crop isotope measurements can refine palaeodietary interpretation. Fraser *et al.* (2013) reconstructed the palaeodietary setting of LBK Vaihingen an der Enz, southwest Germany (later sixth millennium cal. BC) using $\delta^{13}C$ and $\delta^{15}N$ values of human and faunal bone collagen and of charred plant remains from cereal crops (emmer and einkorn wheat) and pulses (lentil and pea). Simple linear mixing models for Vaihingen that take account of the *actual* crop $\delta^{15}N$ values measured all point to higher consumption of plant-derived protein (~50–70%) than the standard model estimate (~40%), which assumes that human plant food $\delta^{15}N$ is the same as that of animal forage (Table 1A-C) (Fraser *et al.* 2013). Estimates of plant-derived protein are higher still if greater trophic offsets of 5+‰ are used (cf. O'Connell *et al.* 2012) rather than 4‰ as the mid-point of the conventional 3–5‰ range (Table 1D-F). Interestingly, given a higher trophic offset of 5+‰, the Vaihingen cereal value would be slightly too high to account for the average human $\delta^{15}N$ value, suggesting that (manured) pulses played a significant role alongside cereals (cf. Bogaard 2012, p. 92, Table 5.5). In sum, direct measurement of crop stable isotope ratios at Vaihingen builds a strong case for their staple role in the diet.

The implications of crop $\delta^{15}N$ values for human diets can also be assessed at Hambledon Hill, Dorset (*c.* 3700–3300 cal. BC) (Mercer & Healey 2008), where a small number of emmer wheat samples yielded an average $\delta^{15}N$ value of 3.6‰ (n=3) (Fig. 2d). It should be emphasized that this is essentially a heuristic exercise: the few grain samples from Hambledon Hill – a place of periodic aggregation rather than a residential site – are unlikely to represent the average year-round isotope values of plant foods consumed by the people represented in the skeletal assemblage. The $\delta^{15}N$ value of emmer wheat at Hambledon is higher than the forage value inferred from herbivore collagen data (1.2‰, assuming a plant-herbivore offset of 4‰) (Richards 2000, 2008; pers. comm.; Bogaard *et al.* 2013, Table 2). Nevertheless, given an average human $\delta^{15}N$ value of 9.2‰ (n=45 (sub)adults) and a faunal average (excluding dogs and indeterminate specimens) of 5.1‰ (pigs on average 4.8‰, n=9; herbivores on average 5.2‰, n=35 cattle, red deer and sheep/ovicaprid – Richards 2000, 2008, pers. comm.), consumption of animal protein by people at Hambledon Hill would remain ~100% (Table 1B). Adopting a higher diet-collagen offset in δ^{15}N of 5+‰ as recently suggested on the basis of isotopic data from humans fed on controlled diets (O'Connell *et al.* 2012), the standard "human plant food = herbivore forage" assumption would indicate an animal protein contribution of ~77% (Table 1D). If the Hambledon grain δ^{15}N value of 3.6‰ were used to estimate that of human plant food, the animal protein contribution would become much lower (~40%), though still appreciably higher than that inferred using the same assumptions at Vaihingen (~0%) (Table 1E).

Clearly, *both* higher human-diet trophic offsets *and* enrichment of human plant food in ^{15}N over herbivore forage lead to greater estimates of plant-derived protein in the human diet. Though there are too many unknowns to hazard specific estimates, it is striking that animal protein contributions at Hambledon Hill appear higher than at Vaihingen. Such a contrast may reflect a broad trend towards higher animal protein consumption in northern Europe as protein-rich pulse crops were abandoned and other sources of protein (including milk) became more important (cf. Halstead 1989; Salque *et al.* 2013); recent work in Britain (Colledge *et al.* 2005) and Ireland (McClatchie *et al.* 2014) appears to confirm that pulse crops were lacking altogether from Neolithic crop spectra in these regions.

Conclusions

A new ecological understanding of early farming niches and diets is accessible through stable isotope analysis of archaeobotanical crop assemblages. As an approach to land use, it is complemented by ecological analysis of arable weed assemblages, while dietary insights require integration with stable isotope analysis of associated faunal and human remains. The results to date are thinly scattered across Europe – more intensive regional studies are needed to develop an understanding of local sequences (cf. Kanstrup *et al.* 2014) – but the intra- and inter-site patterning observed suggests diversity as well as common tendencies in Neolithic farming practice.

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Growth and decline?

Population dynamics of Funnel Beaker societies in the 4th millennium BC

Martin Hinz

Abstract

This article tries to combine different indicators of a decline in settlement activities between 3400 and 3100 cal. BC that was first visible in the analysis of summed calibrated ^{14}C dates. While until now such analyses were seldom associated with independent data, here the results are enriched with palaeobotanical and cultural developments in the distribution area of Funnel Beakers. A climatic trigger for the observed decline seems to be the most likely explanation. But this need not necessarily result in a monocausal and oversimplistic explanation. Such an interpretation has to take into account local, not global, climatic signals, and has to take place considering the complex nature of the interplay of natural and cultural systems. Given a certain magnitude of climatic change, only a society that is vulnerable will react on an external shock with a collapse.

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Introduction

IN RECENT YEARS, increasingly more studies have succeeded in showing demographic trends in prehistory with the tool of summed calibrated date probability distributions (SCDPD) and were able to make them plausible. The method itself, introduced by Rick (1987), is not without controversy. Williams (2012) gives a current overview of the discussion and also lists conditions under which such an analysis can be taken seriously. Considering these conditions, we (Hinz *et al.* 2012) were able to show by using SCDPD that, after the introduction of agricultural practices around 4100 cal. BC in northern central Europe and south Scandinavia (distribution area of the TRB), a phase of growth and stabilization took place, as commonly expected. This phase was followed by a sharp decline of settlement activity deduced from the SCDPD, starting at approximately 3400 cal. BC. A considerable rebound is not visible before 3100 cal. BC. Recently, Shennan *et al.* (2013) were able to verify that this trend is not only true for the distribution area of the TRB but is also visible in France and the British Isles.

Multiproxy and multicausal explanations

What is lacking in our study from 2012, in that of the Shennan working group as well as in most other attempts to identify demographic developments using SCDPD, is the consideration of and associations with other proxies. Of interest are, of course, such proxies that mirror the intensity of human impact on the environment as well as those that give information about the cultural development of those human societies whose demographic trends are to be traced, interpreted and explained. Without such a multiproxy approach, it is hard or even impossible to obtain a holistic, historical picture of the human past. Moreover, in the absence of alternatives, this could lead to an explanation of demographic change either as an effect of demography itself (demographic pressure) or as a passive reaction (often monocausal) determined by external environmental conditions, mostly prominently from climate shifts. A focus on climatic explanations may result from recent discussions about climate change. Another reason for such explanations could be that palaeoclimatic data is among the few sources that is continuously available over longer periods of (pre-)history and is therefore especially attractive as a basis for interpretations.

Thus, it was the aim of this investigation to incorporate additional indicators of the intensity of human activities and their impact on the environment as proxies for the level of the population that was the cause of these impacts. In addition, we try to synchronize cultural characteristics and dynamics with the demographic trends indicated by the SCDPD in order to achieve a better understanding of causal relationships: Are the changes caused by an external event, an internal development, or are they a combination of both?

In the past, large-scale and coordinated migratory movements were often used as explanatory models for demographic changes, especially when crises seem to be indicated by the archaeological material. Such interpretations become fashionable again with the availability of aDNA analysis. This cannot and should not be our model. An "invasion" of "foreign people" is not an option for explaining the crisis which we assume to have occurred between 3400 cal. BC and 3100 cal. BC. This is already obvious from the fact that the development we have identified takes place in the middle of the Funnel Beaker Complex and is therefore completely void of anything warranting ethnic interpretation.

Ethnic interpretations and climatic determinism in the search for monocausal explanations ignore the complex nature of human societies. It is this complexity that gives societies the ability to resist singular influences through culture (in the form of traditions) and cultural techniques. But it is the same complexity that makes them vulnerable to a combination of influences that, in isolation, would not cause any crisis. That is not to say that climate or environment do not have any influence on human societies. Such a statement would ignore many counterexamples in human history. But the environment only represents the framework in which humans organize their lives and survival. The environmental conditions can be used more or less efficiently. This results in the fact that it is always culture that mediates between the environment and the well-being of individuals. Thus, an interpretation framework is necessary that complies with the characteristics of human societies as specific systems as well as with those of environmental systems.

System breakdown?

In our study, we observed a repetitive pattern in the SCDPD: a drop in the second half of the 4th millennium BC, more specifically between 3400 cal. BC and 3100 cal. BC (Fig. 1). A pinpointed accuracy in dating the event cannot, of course, be achieved due to the standard deviation of the dates themselves and the blurring which results from the sum calibration. With this method, only a timeframe can be determined during which the triggering event took place. The pattern was visible in the areas around the Danish Isles (northern Germany, Jutland, Scania, western Sweden), while the Isles themselves apparently underwent a different development. The fact that this signal was observable in different regions verifies that it is not an effect of different scientific traditions (including ^{14}C samples or not). It also can be excluded that it is the effect of the calibration curve, as it can be shown that there is no significant influence of this curve on a sum calibration of sufficient sample size (Hinz & Müller in prep.). Because our reasoning is based upon ^{14}C dates from

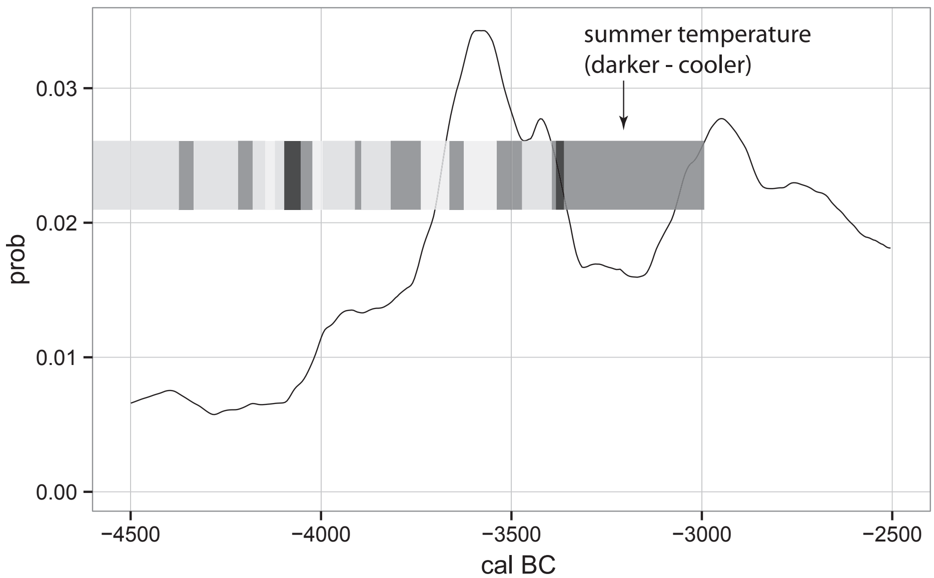

Fig. 1. SCDPD of the [14]C dates of settlements from Northern Germany, Jutland, Scania, Western Sweden (n=1060). The grey band results from a sedimentological analysis (Dreibrodt *et al.* 2012), darker colours indicate cooler summer temperatures.

settlements, the cause of the drop in the SCDPD is most likely a demographic change. The use of settlements has two further important advantages: The settlements of the north European Neolithic have a comparable detection probability during the period in consideration. Counting settlements per time period is a standard tool for an estimation of demographic change. We use essentially the same method by pooling the data per settlement. Still there may be issues with this proxy. In some areas, especially in the Danish Isles, but also in Jutland, concentration of settlement activity at large single sites can be observed. Another problem could be that e.g. for southwest parts of Scania it is possible that the preferred settlements locations shifted to the coast (Larsson 1984), which could bias the picture. But as the changes in settlement patterns differ from region to region still due to the wide spread of the observed developments, we think that it cannot be explained by any of these possibilities in toto.

Surprisingly, similar decreases in settlement activities are observable during the same timeframe in different regions of Europe. Also based on SCDPD, Shennan *et al.* (2013) were able to show this on a supra-regional level. In the aggregated chart (Shennan *et al.* 2013, p. 3, fig. 2), the drop in the second half of the 4th millennium is obvious. In the regionalized chart (Shennan *et al.* 2013, p. 4, fig. 3), the respective drops are also visible in the areas focused on in our paper. That Shennan *et al.* (2013) could not certify significance in their test for these areas is probably a result of the insufficient sample size. Our study was able to use a higher number of samples for the relevant regions. In their interpretation, the authors reject a climatic cause since no (global) climatic proxy correlates with the SCDPD (cf. Shennan *et al.* 2013, p. 6, table 2). We will come back to the suitability of global (ice core) proxies for such a purpose.

This strengthens the assumption that we are dealing with a large-scale phenomenon in case of the possible crisis between 3400 cal. BC and 3100 cal. BC. As one additional study based on ^{14}C, the paper by Stevens & Fuller (2012) should be mentioned. With reference to cereal dates, they observe a contemporaneous drop. Although they used the same method (SCDPD), due to their specific and very different sample selection it is still interesting that the investigation arrived at the same results. Here, the drop is also especially visible on the British "mainland", while the surrounding Isles show different trends (Stevens & Fuller 2012, p. 716 fig. 5). Their interpretation maintains a total abandonment of cereal cultivation and a turn towards pure pastoralism (2012, pp. 718f.). Whether this statement is correct for Great Britain or not, it does not fit our working area where cereals are also present after 3400 cal. BC (e.g. Kirleis *et al.* 2012).

The empirical background of all studies mentioned so far was SCDPD. Thus, it could still be supposed that the observed trend could be considered a consequence of the methodology and represent an artificial rather than a real signal. But indications of a phase with decreased settlement activity and an associated demographic development can also be deduced from other indicators. Such a phase is also inferable from the dendro dates from the alpine area and its periphery. Schlichtherle (2011, p. 156) presented an overview that combines the Swiss dendro dates with those from the Bodensee and Upper Swabia. A period of lower settlement activity is also observable in this data. Here, the phase seems to begin approximately 100 years earlier than the estimations based on the ^{14}C data. A possible explanation could be the uncertainty of the radiocarbon data, but maybe the same process that caused the drop in the SCDPD of northern central Europe had a different impact within the alpine environment. It is synchronous with the Piora II cold phase (it lasted approximately from 3650–3200 BC (Schlichtherle 2011, pp. 157–160).

This provides us with first indications concerning the possible trigger of the phenomenon we observed. Climate is for sure the first suspect if we have to explain a pan-European shift. But, as indicated above, Shennan *et al.* (2013, p. 4) could not find a correlation between global climate proxies and the SCDPD. Before we discuss this contradiction, we will call attention to a last indication of a critical situation.

In their analysis of mtDNA of prehistoric populations, Brandt *et al.* (2013) observed a development, among others, that could matter in our model: their B2 event is characterized by an increase of the haplogroups U that are commonly associated with pre-Neolithic hunter/gatherer communities. This event dates between 3400 cal. BC and 3100 cal. BC. Although this observation fits very well with a general crisis in this timeframe, it must be kept in mind that the database for this interpretation consists of only 17 successfully sampled individuals.

Global and local climatic proxies

As already mentioned, climate is a tempting explanation for such a large-scale phenomenon. But it is always a risky choice. Archaeological as well as climatological investigations deal with temporal uncertainties. This makes it difficult to decide whether two events are actually correlated. Additionally, correlation itself is, of course, not sufficient verification of a causal relationship. And moreover, climatic processes are highly complex developments in a chaotic system. Global processes can result in very different local climate and weather conditions. If a cooling is observable in arctic ice cores, it does not necessarily mean that a cooling also takes place in central or northern Europe. Conversely, today's global warming could result, for example, in a cooling phase in Europe (Petoukhov & Semenov 2010). If this is true, then regional changes could also take place without leaving a trace in the global record or the ice core data. To establish causality between climatic changes and demographic developments, it is therefore

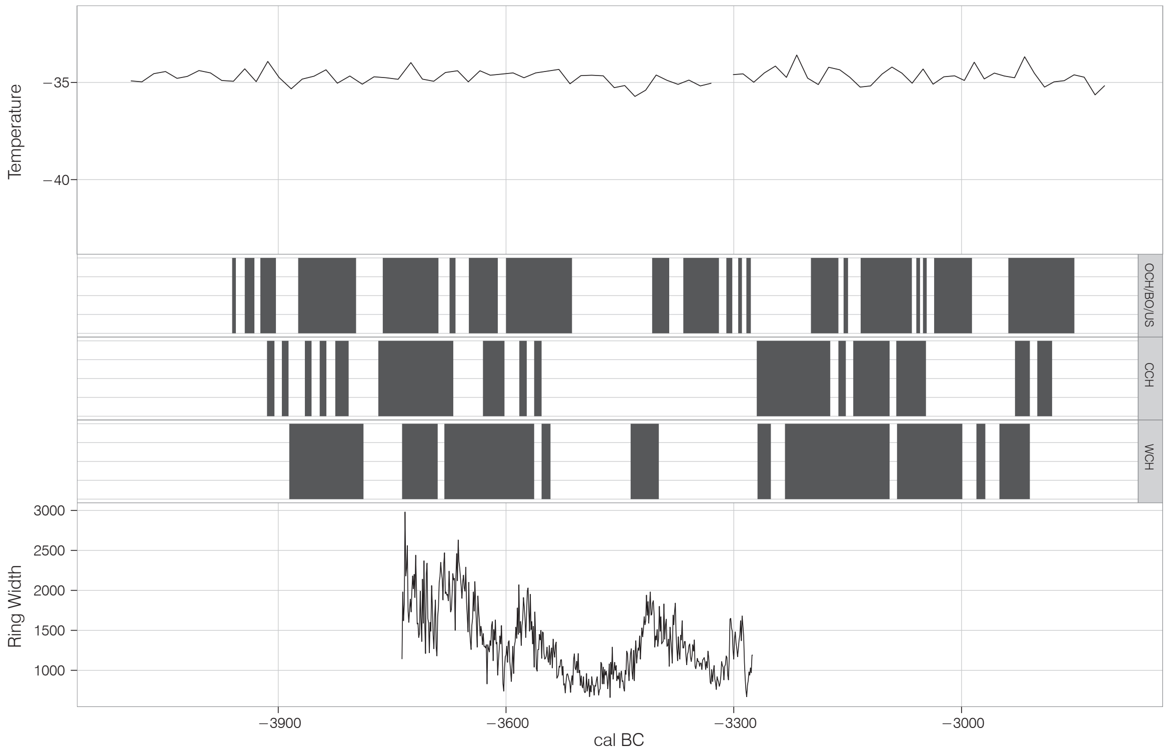

Fig. 2. Availability of dendro dates from Switzerland, the Bodensee and Upper Swabia (after Schlichtherle 2011) compared with d18o from the GISP2 ice core (above) and a local dendro master curve from the Bodensee region.

a prerequisite to obtain a local signal. This is connected with two non-trivial tasks: defining what is local and procuring good proxies for this local signal.

Tree ring master curves would certainly represent an optimal local climatic signal. With them not only a real local proxy would be obtained but also the signals themselves would indeed represent favourable or unfavourable conditions for plant growth. This is the value that archaeologists usually like to deduce from climate proxies (admitting that the physiology of trees differs from those of crops). Unfortunately, such curves are hard to obtain, at least for our working area. With one example from the Bodensee region, it is possible to show the value of such an approach.

As already mentioned, the decreased settlement intensity in the circumalpine area can be related to the Piora II cold phase. If we consult the temperature curve extrapolated from the GISP 2 ice core for this period, it is rather inconspicuous (Fig. 2): no one would discern a cooling event from that data. In contrast, a tree ring master curve for the Bodensee region (data Billamboz n.d.) shows a very interesting correlation during the observed settlement gap.

As no such data is available for the north, we must turn to a different proxy. Within the framework of the DFG priority programme SPP 1400 "Early Monumentality and Social Differentiation", sedimentological analyses were conducted at Lake Belau and Poggensee, which are both also known for their importance as pollen archives for northern Germany. In these analyses using microalgae (Dreibrodt *et al.* 2012),

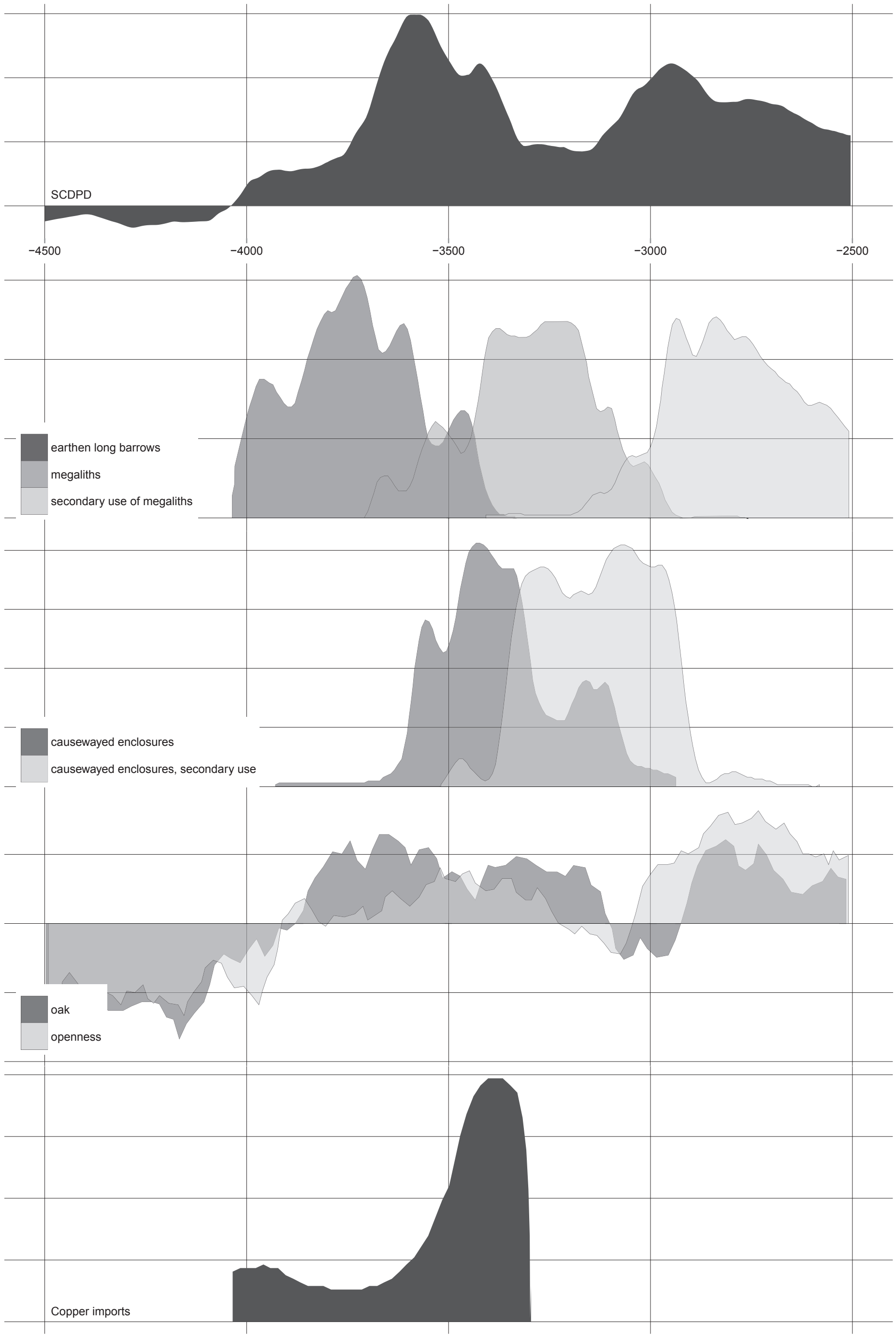

Fig. 3. Combining the available proxies. From top to bottom: SCDPD of the ^{14}C dates of settlements from Northern Germany, Jutland, Scania, Western Sweden (n=1060); frequency of monumental burials (Müller 2011, 18); frequency of causewayed enclosures (Müller 2011, 18); openness of the landscape according to an NMDS and the abundance of mixed oak forest taxa (Feeser *et al.* 2012, 181 fig. 13); Copper imports (Müller 2011, 18).

"sprunghaft abnehmende Sommertemperaturen" (sharply decreasing summer temperatures, Dreibrodt *et al.* 2012, p. 155) around 3300 cal. BC could be detected that initiated a longer phase of colder summers (Fig. 1). This phase of local climate is in good correlation with the decreased number of settlement dates. Surely it would be oversimplified to think that the colder summers would be the direct and only cause for the decrease in settlement intensity. Similar cold phases are also detectable (Dreibrodt *et al.* 2012, p. 154, fig. 7) that do not correlate with relevant archaeological events.

Adding additional traces

Beyond indications of the demographic change itself and the possible causes, proxies for the possible effects of the change in population – in the form of changes in human impact – are also available. Most common for this purpose is the pollen record. In eastern Schleswig-Holstein, there are four intensively investigated lakes (Großer Segeberger See, Poggensee, Lake Seefeld and Lake Belau) that offer a good temporal resolution. Using a combination of these archives, it becomes possible to estimate which effects are due to local conditions and which rather represent general trends. Feeser *et al.* (2012) carried out partial recoring of those lakes and revised the AMS chronology with the help of Bayesian models. One result indicated a change in the climatic situation between 3350 cal. BC and 3100 cal. BC (based on corroded pollen grains, the *Alnus/Corylus* ratio and measurements of loss on ignition; Feeser *et al.* 2012, p. 184 and p. 180, fig. 12). But more important with respect to human impact is a measurement of land openness that was computed using Non-metric Multidimensional Scaling (NMDS). This index is not only based on *Plantago lanceolata* – the common indicator of open land – but also incorporates multiple species and their ratios, and additionally correlates the different lakes as an example of a regional signal (Feeser *et al.* 2012, p. 181 fig. 13). The according curve shows that after an increase in land openness after 4100 cal. BC, a decrease is visible around 3300 cal. BC (Fig. 3). The openness indicators decline while woodland recovers, as shown by the curve for mixed oak forest taxa, but with a lag of approximately 200 years. This seems to be a good verification for the interpretation that the SCDPD really indicates a decrease of settlement activity, as the human impact on the environment decreases accordingly.

Now we can start to combine the SCDPD with the development of other cultural features, as compiled by Müller (2011, p. 18) (Fig. 3). During the time of the potential crisis, the dating rate of the construction of causewayed enclosures decreased. Instead, more indications of their secondary use are recorded. The construction of megalithic graves started before the possible crisis, but it reaches its maximum at approximately 3400 cal. BC. The intensity of construction is steady until 3150 cal. BC. This plateau extends over nearly the whole span of the possible crisis. It is also of special interest that shortly after the drop in the SCDPD around 3300, copper imports into the distribution area of the TRB cease.

While causewayed enclosures were not constructed in the same quantity from 3400 cal. BC to 3100 cal. BC (as is also true for the British Isles, personal communication Roger J. Mercer), the already known idea of monumental megalithic graves gains influence and importance. It is possible to interpret this as a stronger focus on the ancestors as anchors and stabilization factors in a changing world. Traditional rituals were maintained and probably stabilized the world view of the societies of the Funnel Beaker times. Simultaneously, we have indications that an exchange network collapsed: copper imports ceased, which were linked to prestige objects that probably had previously stabilized societies. Copper either lost its importance, or it could not be maintained because of changed conditions.

Conclusions

In sum: Beginning with the TRB at approx. 4100 cal. BC, a significant increase in the SCDPD is visible. It can be expected that this mirrors the increase in population that follows the introduction of agricultural practices. Around the same time, the introduction of cereal cultivation is likely. Although this had not already involved large-scale clearings, indications of such processes are nevertheless visible in open land indicators (increases) as well as in the mixed oak taxa (decreases).

After a short while, the introduction of earthen long barrows took place as the earliest monumental burials in our working area. Subsequently, according to the pollen data, woodland was cleared to a substantial degree during the course of the 38th century BC. This may be connected to the introduction of the ard (Sørensen & Karg 2012). Until this point in time, we are faced with a society that is searching and establishing its traditions and strategies in view of a changed cultural and economic base. With earthen long barrows (monuments) and large-scale open land (dominating agriculture), elements are now present which constitute the TRB society. The advent of these elements marks the beginning of the growth phase of this society (r phase) that is again connected with a rise in population (according to the SCDPD). This is accompanied by a narrowing of the available strategies for action, because a certain spectrum of the given strategies had proven to be successful (Kirleis & Fischer 2014).

Increasing rigidity and tension within the society probably needed balancing mechanisms. This could be the interpretation of the fact that collective ritual activities, such as the construction of megalithic collective burials and causewayed enclosures, became more important. Also an increase in the import of copper may hint in the same direction. At the same time during the 36th century BC, a stabilization of landscape openness can be observed. In conclusion, the society seems to have entered a conservation phase (K phase) at this stage in time and the increasing rigidity and decreasing diversity of options led to inner tensions that made the whole social system more vulnerable to external shocks.

Such an external shock could have occurred during the 34th century BC. A climatic change resulted in a breakdown in the economic and probably also in the social sector of a society that had lost its resilience (Ω phase). This crisis is indicated by the SCDPD, if we take it as a population indicator, as well as by the decrease of human impact on the landscape. What remained stable was ritual behaviour, whereas imports of copper also ceased. Then, after a phase of higher diversity (α phase), a rise in land openness as well as in the SCDPD can be noted anew. Again, we observe a society that establishes new traditions and strategies and finally shifts to the Single Grave/Corded Ware society (new r phase). How this transformation took place must still be integrated into this framework of interpretation.

In light of the described investigation, it becomes clear that it is only possible to merge individual developments into a full picture and an historical interpretation by combining different indicators and proxies. In the case of the crisis during the second half of the 4th millennium BC, neither internal developments nor external factors and influences were singular causes. It rather seems likely that societal development itself formed the basis for a situation in which an external shock could influence the society to such as extent. It is also clear that we are confronted with very different phases and practices in the social complex that achieves certain coherence as the TRB through the ceramics used. For a characterization of this society, the respective internal and external conditions as well as the historical situation must be considered. Only then is it possible to interpret such a complex phenomenon as the northern central European Neolithic.

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The cultural encounters of neolithization processes

A discussion of different ways to understand plurality

Anders Högberg

Abstract

Recent years' development in archaeometry has led to the writing of new narratives about Neolithization processes all over the world. Different forms of DNA and isotope analyses have attained importance as study material for interpretations of people's patterns of movement and interaction. Often, however, the results of these studies are presented in the framework of a non-problematized and non-theoretical interpretation of cultural encounters. This text proceeds from modern plurality studies. Five models for understanding cultural encounters are discussed. The idea is that ways of thinking about present-day cultural encounters can inspire critical thinking about prehistoric cultural encounters.

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Recent years' development in archaeometry has led to the writing of new narratives about Neolithization processes all over the world (Balter 2012). Different forms of DNA analysis and isotope analysis have attained importance as study material for interpretations of people's patterns of movement and interaction. Many of these studies have made crucial contributions to reinterpretations of prehistoric encounters between groups of people. It is easy to imagine how the future development of this research will serve as a foundation for investigations of complex prehistoric migration processes (Prescott 2013).

Yet, while refined scientific methods have given archaeology access to new source material, many studies show weakly constructed chains of interpretation. Studies presenting, for example, pioneering results of genomic DNA analysis (Malmström *et al.* 2009; Skoglund *et al.* 2012) incorporate these results in the framework of a non-problematized and non-theoretical interpretation of cultural encounters. To put it simple, the explanations of the way people met during the Stone Age and how they interacted and perceived each other are not supported by the empirical evidence presented in the analyses (Fredengren 2014). The reason is that, although the studies are rooted in solid methodological research concerning complicated analyses which yield new data not previously available to archaeology (Prescott 2013), the data are presented in a framework that lacks a proper knowledge of the diversity of expressions that can result from people's cultural and social encounters and interactions (for the diversity of cultural encounters see, for example, Barnard 2011; Van Reybrouck 2012).

This is a problem. Human interaction in the past is explained in a way that is insufficient in relation to the knowledge about interaction that is available in the human sciences. Phenomena such as migration, cultural belonging, cultural encounters, and change over a long time from one (material) cultural expression to another are used as social and economic explanatory frameworks, even though the studies have not analysed these frameworks (for example, Sørensen & Karg 2013). This result in a simplistic picture of how cultural encounters between people took place in the Stone Age and also implicitly how they can take place in our own times and in the future (for a discussion see Cassel 2011).

But how can one understand cultural encounters? This text uses modern plurality studies to give perspective to these questions. The idea is that ways of thinking about present-day cultural encounters can inspire critical thinking about prehistoric cultural encounters in general and Neolithization processes in particular.

Ways of thinking about how present-day societies organize cultural encounters

In a major study of how heritage is used in our times, Ashworth *et al.* (2007) have investigated ways in which cultural plurality can be expressed. They highlight five models: the heritage in assimilation model, the heritage in melting pot model, the heritage in core+ model, the heritage in pillar model, and the heritage in salad bowl/rainbow/mosaic model (Ashworth *et al.* 2007, pp. 69 ff.). In their study the models are used as templates to describe different ways of handling issues of cultural heritage and diversity, and as a starting point for systematizing and describing examples of the use of cultural heritage taken from different parts of the world. In this text I proceed from these models in order to clarify the many ways in which cultural encounters can be understood. I would stress that the aim is solely to arouse ideas about the complexity of cultural encounters, not to provide models for the interpretation of prehistoric cultural encounters.

The assimilation model

The model describes a society that accepts only one set of shared values, social norms, and practices. This set of shared values is the core through which conceptions of the world are defined. This is done on an essentialist basis, often associated with origin myths or ideas about a national character arising from blood and soil. Those who are not a part of the core must either adapt to it or be excluded from it.

The function of cultural heritage in this model is as a tool for assimilating aliens so that they are admitted to the core, or else marginalizing or excluding the aliens who are unwilling or unable to become a part of the core. This exclusion simultaneously confirms those who are already included, strengthening their internal cohesion. They bear a cultural heritage of traditions and norms which are considered to have a value that is given by origin. Cultural heritage thus has an educational effect, with a socializing role of both including and excluding. The use of cultural heritage is a constant process of assimilation whereby likeness is confirmed inwards and difference is manifested outwards. This process is given the impression of being eternal and primordial, usually with a mythical beginning and no end. The majority of the European nation states are typical examples of this use of cultural heritage; other examples are the way regionalism or the EU make use of cultural heritage.

The melting pot model

This model describes societies as melting pots where people of different origins are mixed into something shared and new. There is no core here to which everyone is supposed to relate. Instead everyone will blend together and thus create new common values, social norms, and practices around which to unite.

The function of cultural heritage in this model is identity construction, where all those involved are expected to lay aside their previous cultural heritage and instead identify with the new one, often a new place and new values. Everyone who agrees to this is included. The process in the use of cultural heritage is transient in that, once everyone has undergone the transformation in the melting pot, the process is over. Processes then often begin when a core of shared premises is formed and other ways of handling cultural heritage and diversity take over to clarify processes of inclusion and exclusion. European immigrants to the USA are a typical example from history of this use of cultural heritage.

The core+ model

This model describes societies where there is a harmonious core culture or a dominant cultural heritage and the cultural heritages of a number of so-called minorities have been added to this. The value of the core culture is usually represented by a substantial majority with historical or political dominance and is viewed as such by the minorities. Both the majority culture and the minority cultures accept this situation and define themselves on the basis of it.

The function of cultural heritage in this model is multifaceted, but it usually contains some form of strengthening inclusion inwards in both the majority and the minority cultures. This is done through a combination of inward activities and outward exclusion. In this way the instrumental role of cultural heritage inside each group resembles the assimilation model, with the difference that it does not serve to assimilate but to separate. The use of cultural heritage is a constant process whereby likeness is confirmed inwards and unlikeness is manifested outwards. A typical example of this model is the minority policy in Sweden.

The pillar model

This model views society as consisting of a number of independent and separate units not linked to each other in any way. Together each unit supports the structure (for example a state) to which they all belong. The consistent idea, however, is that the distinctions should be maintained between each cultural unit.

The role of cultural heritage in this model is multifaceted. Each group handles its cultural heritage on its own terms to maintain the culture inwards and to mark a clear exclusion of others. The use of cultural heritage is a never-ending process whereby likeness is confirmed inwards and difference is manifested outwards. Typical examples of this model are countries where the population is divided into Catholic and Protestant.

The salad bowl/rainbow/mosaic model

This model views society as a framework where disparities in the form of different cultures, ethnicities, and identities act together and create a whole without this being at the expense of anyone else. The necessary foundation is an understanding that society consists of complex sets of similarities and differences and that the instrumental role of cultural heritage is to assist in this. The salad bowl metaphor illustrates different ingredients that have been mixed to give a specific and unique salad in which each ingredient still retains its character. The mosaic metaphor similarly emphasizes that each piece is unique in character but together the pieces in a mosaic make up a pattern. The rainbow metaphor emphasizes different colours that give a regular pattern in which each colour is distinct but at the transition to the next colour there is a gradual merger with no distinct boundary. In these metaphors the bowl, the mosaic pattern, and the rainbow stand for the society while the salad ingredients, the mosaic pieces, and all the colours of the rainbow are individuals or groups of people represented through cultures, ethnicities, and identities.

The role of cultural heritage in this model is multifaceted. It can be inclusive in that everyone is invited to contribute to the cultural heritage. The focus is on openness by making everyone's cultural heritage visible and available. The role of cultural heritage can be excluding in that each separate group in this model, through its use of cultural heritage, approaches the way that cultural heritage is used in the assimilation model. The process comprised in this model is a constant confirmation of differences, along with an endeavour to include everyone in the community. However, empirical examples show that the model is usually a vision or a utopia, while the reality is often that the use of cultural heritage develops into variants of other models. A typical example is South Africa's post-apartheid vision of a "rainbow nation".

Discussion

The five models presented above are borrowed from Ashworth *et al.* (2007) and primarily related to the field of heritage studies. I have here used them to show the radically different ways in which cultural encounters can be organized and understood. The past in the form of cultural heritage is activated in diverse ways in order to create a future which looks different in different societies depending on how people think they ought to live together. An understanding of encounters and interactions based on, say, the assimilation model differs radically from one based on a salad bowl/rainbow/mosaic model.

Cultural encounters are an important issue in archaeology (Petersson & Skoglund 2008). They are also a burning issue in contemporary politics (Breslin 2010). Archaeometry studies which claim to investigate and interpret how people in the past moved, interacted, and competed, but which do not actually analyse the interaction itself, risk creating a muddled understanding of cultural encounters in the distant past. This muddled understanding risks affecting our understanding of cultural encounters today. It is therefore important to discuss different ways of thinking about cultural encounters in relation to archaeological interpretations of prehistoric encounters.

Translated into the interpretation of Neolithization processes, the assimilation model is by far the most common in recent years' presented archaeometry studies (Skoglund *et al.* 2012). Prehistoric groups are regarded as cultural units where expressions of materiality concern identity and ethnicity. Material culture is used to create archaeologically demarcated cultures and these are then perceived as being distinct and separate. Terms such as Ertebølle culture, Funnel Beaker culture (TRB), and Pitted Ware culture (GRK) are well known as both well-deconstructed and well-constructed examples. Translated into a discussion of the time when Ertebølle culture gave way to Funnel Beaker culture, for instance, this usually concerns how one dominant cultural expression took over after another or what actually happened when the former was transformed into the latter in an assimilation process.

But what would happen if questions about the transition between Ertebølle and Funnel Beaker cultures were formulated on the basis of other models (see Jennbert 2011 for the start of a discussion of this kind)? Is it possible to investigate this time in terms of a melting pot model or a salad/rainbow/mosaic model? Or was it perhaps a time that could be described as dominated by a pillar model, where differences were contained within one and the same shared space? Or an initial encounter according to the salad bowl/rainbow/mosaic model that have resulted over a few generations in a society that can be described in terms of a melting pot or a core+ model?

Recent years have seen the publication of detailed studies of cultural encounters on the island of Öland in the Middle Neolithic (see for example Papmehl-Dufay 2006; Fornander 2011). Analyses of what people ate and how they moved show that different groups – hunter-gatherers and farmers – lived separately. People buried in the Pitted Ware cemetery at Köpingsvik in central Öland and those buried in the megalithic monuments at Resmo in southern Öland show quite distinct life stories according to archaeometrical analyses (Fornander 2011). This is despite the fact that the places are not separated by more than a short day's travel on foot or by boat. Do we perhaps have an example here of a pillar model where people lived culturally separate but with shared structures, that is to say, with the geographical area of Öland and its coast as their common everyday reality? Was it perhaps the case that some parts of social life were shared even though the expressions manifested in material culture and dietary intake were kept separate? Did this change over time? Would an understanding of cultural encounters in terms of a core+ or pillar model lead to more profound interpretations of this?

Studies of ancient migration often focus on distribution patterns and migration. In a well-informed comment on the latest findings about Neolithization processes within archaeometry, Michael Balter discusses the potential of the studies for continued investigations of questions which have been with archaeology for a long time (Balter 2012, p. 400):

> But many questions remain: Did farmers themselves migrate throughout Europe, or just the ideas and techniques of farming? What routes did farmers and farming take as they replaced the hunter-gatherer societies already present? Did farming advance in one solid wave, or sometimes leapfrog its way past the resident hunter-gatherers?

These are all vital questions to be asked. But they are not sufficient. Migration and interaction consist of so much more than just ideas and techniques moving with or without people along routes, replacing something existing with something new. Migration and interaction are constituted by people meeting each other. And when people meet, things get complicated. Established ways of understanding the world are challenged by new thinking. How this is dealt with differs radically from group to group, from society to society. As Gísli Pálsson has stated, simple reductionist gene talk is not enough to understand this: "The big challenge for anthropology now is to realign the biological and the social on new terms in a nonreductionist fashion" (Pálsson 2012, p. S194).

The ambition in this text has been to exemplify the complexity of cultural encounters. With theoretical models taken from ways of thinking about how present-day pluralistic societies can be understood in different ways, the aim has been to inspire deeper thinking about prehistoric encounters. By pondering on the ways in which cultural encounters can take place, I hope it may be easier to understand possibilities and limitations in the questions, methods, and interpretations that archaeology presents, based on the often amazing data about Neolithization processes that archaeometry is publishing at an increasing rate.

Translation by Alan Crozier

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Creolization processes in the later south Scandinavian Neolithic

An approach to cultural heterogeneity

Rune Iversen

Abstract

This paper approaches the cultural heterogeneity of the later South Scandinavian Neolithic. South Scandinavia experienced a very uneven development in the course of the 3rd millennium BC, with a variety of archaeologically defined cultures. This situation has resulted in the application of a "culture-centred" approach by which individual "cultures" have been thoroughly analysed but without the achievement of a coherent understanding of the cultural heterogeneity of the period. This paper questions the application of dogmatic cultural labelling and proposes the use of creolization theory to explain the blurred cultural situation that followed the Funnel Beaker era in eastern Denmark and lasted until the onset of the Late Neolithic when a new period of incipient cultural homogeneity began.

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Introduction

IN SOUTH SCANDINAVIA the beginning of the Neolithic is defined by the presence of domesticated crops and the occurrence of the Funnel Beaker culture around 4000 BC, which remained the sole archaeological culture throughout the 4th millennium BC in the region. From around 3000 BC we see significant changes in the material culture, including new types of pottery, battle-axes, arrowheads, changed settlement patterns, subsistence economic practices and burial customs. These changes are generally related to the appearance of new Middle Neolithic "cultures" including the Pitted Ware culture, the Swedish-Norwegian Battle-Axe culture and the Single Grave culture covering a Jutland variant and an east Danish variant.

The term Single Grave culture was introduced by Sophus Müller in 1913 in order to describe a certain type of burials on the Jutland Peninsula consisting of low burial mounds with stratified single graves holding stone battle-axes and cord-decorated beakers (Müller 1898; 1913). Some 20 years later, Carl Johan Becker analysed the contemporary and multifaceted assemblage of finds recovered from eastern Denmark and introduced the term "the Single Grave culture of the Danish Islands" (Becker 1936).

The abundance of archaeological cultures defined within the later part of the south Scandinavian Neolithic has to a wide extent resulted in a "culture-centred" approach. Thus, research has mainly been focused on individual cultures and associated aspects such as culture-specific burial customs, settlement patterns etc. I do not consider such an approach mistaken, but standing alone it appears inadequate if one wishes to explain the cultural heterogeneity of the later Neolithic period, as is the purpose of this paper.

Cultural heterogeneity in the 3rd millennium BC

As indicated by some recent ^{14}C dates (e.g. Andersen 2008, p. 39; Skousen 2008, pp. 207 ff.), the late Funnel Beaker culture coexisted with the Pitted Ware culture, the Jutland Single Grave culture and the Swedish-Norwegian Battle-Axe culture on a regional level for a couple of hundred years during the early 3rd millennium BC. The late Funnel Beaker culture was the dominant material culture group at the beginning of the millennium, with features like Store Valby pottery and thick-butted A-axes spread across Denmark. However, viewed from a pottery-based perspective, one could ask if the Store Valby phase should be regarded as a part of the Funnel Beaker complex at all.

The plain bucket-shaped vessels, the thick and coarsely tempered ware and the scarce and simple ornamentation clearly distinguish the Store Valby pottery from the earlier and far more elegant and elaborate Funnel Beaker styles. Artistically we are facing a degeneration phase, which in my view mirrors a general transformation of the late Funnel Beaker societies that includes a gradual incorporation of various new material elements. The occurrence of the Store Valby pottery is in itself an indication of this development as it shares some bucket-shaped vessel types with the western Globular Amphora group (cf. Davidsen 1978, p. 174 f.).

The downgrading of the visual and stylistic aspects of pottery was not unique to early 3rd millennium BC southern Scandinavia and northern Germany but can also be found in many other later Neolithic styles, such as Horgen (Switzerland) and Seine-Oise-Marne (northern France/southern Belgium) pottery (Whittle 1996, p. 283).

Even though the Store Valby style covered most parts of present-day Denmark, we see a clear disintegration of the Funnel Beaker culture from around or a little before 3000 BC. One example is the appearance of the stone packing graves in northern and western Jutland, c. 3100–2800 BC. The stone packing graves show similarities to both the wagon burials of the Yamnaya culture of the Pontic-Caspian steppes and the cattle burials of the Baden and Globular Amphora complexes, including the Złota group of southern Poland (Whittle 1996, p. 136, pp. 211 ff.; Johannsen & Laursen 2010).

The disintegration of the Funnel Beaker culture can furthermore be seen in the differentiation of pottery styles such as the north Jutland Ferslev style, the Bundsø/Lindø style of the Danish Islands, the Karlsfält/Stävie group in Scania and the Vasagård and Grødby styles on Bornholm. However, the most far-reaching trend within the late Funnel Beaker pottery is the development of the south Scandinavian Pitted Ware tradition (M. Larsson 2006; Iversen 2010).

Material culture changes did not only show in the form of new pottery styles but also in the occurrence of tanged Pitted Ware arrowheads and in the shaping of flint axes. Thick-butted flint axes appeared from the onset of the 3rd millennium BC and can be divided into two chronologically overlapping types (A and B) (Nielsen 1979). Whereas A-axes are spread throughout southern Scandinavia and are related to Funnel Beaker contexts, B-axes are concentrated in Scania and eastern Denmark where they occur on late Funnel Beaker and Pitted Ware sites, sometimes together with A-axes. Besides, B-axes are affiliated with the technically poorer thick-butted flint axe of the Single Grave culture.

There is no doubt that the B-axes derive from the A-axes and that these represent a further development of the chronological earlier thin-butted axes. Thus, the thick-butted flint axes are clearly rooted in the Funnel Beaker flint tradition. The development of B-axes must be related to the disintegrated late Funnel Beaker

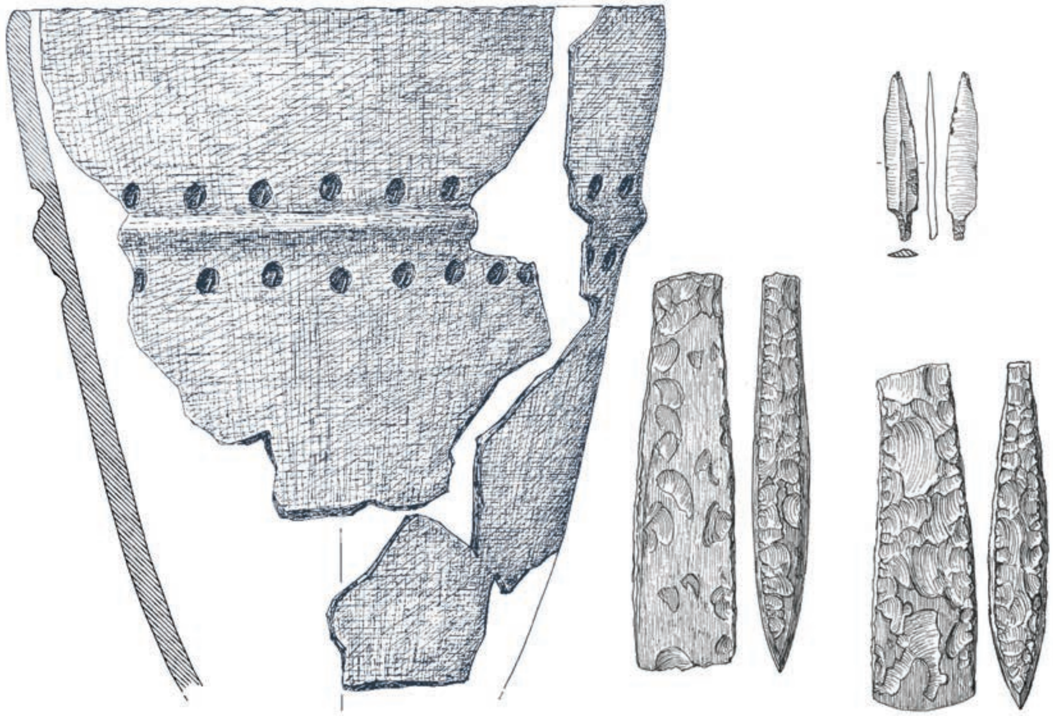

Fig. 1. Material culture of the early 3rd millennium BC. Store Valby vessel, tanged arrowhead and thick-butted flint axes. After Ebbesen 1975, figs. 234, 245; Davidsen 1978, pl. 62. Drawing by H. Ørsnes.

milieu that appeared in eastern Denmark and Scania during the early 3rd millennium BC (Fig. 1).

In addition to the artefact types discussed above, a few scattered finds of early Single Grave type battle-axes occurred in east Denmark (Zealand and adjacent islands) as Single Grave communities started to appear on the Jutland Peninsula from around 2850 BC (Glob 1945, figs. 1–16). Some of the Single Grave beakers found in east Denmark might be contemporary with the late Funnel Beaker milieu. Besides, a restricted number of vessels from the Globular Amphora and Elbe-Havel cultures are known from southeastern Denmark. Even though these different elements can be explained as single imports, the result of direct exchange in the form of gifts, migration of individuals or exogamic relations, they introduce ideas and mindsets different from those of the Funnel Beaker culture and are thus parts of an increasing disintegration of the Funnel Beaker world.

The general impression of the archaeological record in eastern Denmark in the early 3rd millennium BC is a mixture of different cultural elements brought together within the context of the late Funnel Beaker culture.

The shaping of new cultural identities and the choice of terminology

A very rich vocabulary exists when it comes to the description of the fusion of cultural traits including: *hybridization*, *syncretism*, *ethnogenesis*, *acculturation*, *assimilation*, *creolization* etc. Most of this terminology takes its point of departure in the description of the European colonialism in the Americas and the creation of

African-American/African-Caribbean societies in the 18th and 19th century AD.

Acculturation, assimilation and creolization are among the terms that have been applied in archaeological research (e.g. Okun 1989; L. Larsson 1998; Webster 2001; Bergstøl 2004). I think it is worth considering some of the slight differences associated with the two main terms: acculturation and creolization. At some point there is a tendency within cultural anthropology to use the term acculturation to describe asymmetric power relations in which one society is dominant in proportion to another. Such a superior-subordinate relationship often leads to the assimilation/absorption of the subordinate culture into the dominant one. Thus, acculturation often leads to assimilation (Ember & Ember 2011, pp. 29 ff.). I do not find that such asymmetric power relations are consistent with the actual situation we face at the onset of the 3rd millennium BC and I will therefore leave the acculturation/assimilation terminology out of account.

Creolization, on the other hand, is a linguistic term that describes the blending of two or more languages into a new language. Creolization also has a hint of the above-mentioned asymmetrical power relations as it initially was used to described the emergence of European and African mixed languages resulting from the import of African slaves by the European colonial powers. However, the concept of creolization has a historical dimension to it that I think is highly applicable when we wish to describe and explain the fusion of cultural traits into new and mixed cultural expressions.

Creole languages often emerge from some kind of pidgin, which is the initial blend of two or more parent languages. Whereas creoles are defined by being natural languages having their own native speakers, a rich vocabulary and developed grammar, pidgin is a rudimentary language that is often limited to certain functions or domains. All pidgin speakers will also have a native language of their own but as pidgin is learnt by new generations as a primary language is becomes a creole (Baptista 2005, p. 34).

The disintegration of the Funnel Beaker culture

I think that the concepts of pidginization and creolization offer very useful frames for understanding the cultural situation in east Denmark during the early 3rd millennium BC. Creolization theory provides us with an approach by which we can capture the cultural substance behind an otherwise culturally blurred archaeological record. Creole languages are diversified and shaped through non-homogeneous processes involving a range of complex mechanisms that are dependent on factors such as the identity of the interacting agents. Similarly, cultural creolization is not a unified process resulting in a single creolized blend (a new normative culture) but rather in a series of interacting subcultures (Ferguson 1992, pp. xli ff.; Webster 2001, p. 218; Baptista 2005, p. 39). Thus, from around 3000 BC onwards a series of new material culture trends were obtained by the indigenous Funnel Beaker culture in a process I will describe as cultural pidginization, which in the course of time resulted in creole communities.

The palisade enclosures of the early 3rd millennium BC probably played an important role as social arenas and facilitators of this cultural transformation process. The palisades, in my opinion, can best be explained as products of the Funnel Beaker tradition of constructing large ritual gathering sites (cf. the earlier causewayed enclosures). Traces of early Battle-Axe and Pitted Ware material culture found in connection with the palisades show how people obtained new material elements within an overall Funnel Beaker cultural and ritual framework materialized in the palisade enclosures. Thus, the incorporation of new cultural elements was not done uncritically as it had to be legitimized in accordance with old norms and traditions. A somewhat similar scenario is also visible at the Alvastra Pile Dwelling in Östergötland, Middle Sweden, where Pitted Ware material culture and lifestyle was adopted within a ritual and constructional Funnel Beaker setting (cf. M. Larsson 2007; Lagerås 2008; Brink 2009, pp. 324 ff.; Browall 2011, pp. 412 ff.).

Likewise, the megalithic tombs might have worked as transformers of culturally alien objects. People placed Pitted Ware tanged arrowheads, Single Grave beakers and battle-axes in the megalithic tombs and by doing so they introduced new material forms within a well established setting continuing and accentuating Funnel Beaker customs. My view is that the Funnel Beaker worldview, ritual traditions, burial customs and social organization continued relatively unaltered and functioned as a cultural basis during most of the 3rd millennium BC. On this foundation new material elements were obtained, creating a series of interacting subcultures characterized by e.g. different pottery styles and subsistence economic strategies.

On the basis of the material and cultural diversification that took place during the early 3rd millennium BC, I conceive the late Funnel Beaker milieu as an expression of an incipient creolization process or what we can term cultural pidginization. This is first and foremost seen in the development of various late Funnel Beaker pottery styles (including the "degenerate" Store Valby style), the B-axe complex and the incorporation of Pitted Ware tanged arrowheads (types A–C) (see Fig. 1). These material elements were influenced by, or related to, various cultural groups (Globular Amphora, Funnel Beaker, Pitted Ware) forming what I conceive as a new rudimentary material "language". It is from this culturally pidginized milieu that new creole communities emerged as the Funnel Beaker complex finally ceased and Corded Ware/Single Grave influences became predominant in east Denmark.

After the Funnel Beakers

From around 2600 BC Corded Ware objects appeared in east Denmark in larger numbers than hitherto seen. What we see is neither the adoption of the material culture of the Jutland Single Grave culture nor that of the Swedish Battle-Axe culture but rather a mix of the two combined with few Pitted Ware elements and continued underlying Funnel Beaker traditions.

The material culture that characterizes the final Middle Neolithic, c. 2600–2350 BC, in east Denmark is primarily thick-butted flint adzes, late tanged arrowheads (type D) and a relatively limited number of Corded Ware beakers and Single Grave type stone battle-axes. The curved beakers and late battle-axes found in eastern Denmark can be compared to those of eastern Schleswig-Holstein and Mecklenburg-Vorpommern rather than those of the Jutland Single Grave core area of west-central Jutland or Battle-Axe culture Sweden. It is noteworthy that no straight-walled beakers, which otherwise account for more than half of the Single Grave funerary pottery on the Jutland Peninsula, have been found in east Denmark. Likewise, no Swedish Battle-Axe vessels are known from Denmark, showing that a separate pottery tradition was created in east Denmark strictly demarcating the area from the Jutland Single Grave culture and the Battle-Axe culture.

Furthermore, we see no significant increase in the number of battle-axes in east Denmark, as was the case within the Jutland Single Grave area. In east Denmark, the battle-axes are mainly recorded as stray finds but they also occur in wetlands and in megalithic tombs. This find situation is very unlike that of the Jutland Peninsula where battle-axes were part of the grave goods in more than 1100 single graves (Hübner 2005, p. 605).

What we see is the selective adoption, transformation and use of new material elements in accordance with underlying Funnel Beaker norms. If we apply the linguistic concepts of creolization to the situation in east Denmark then the "grammar" (rules of usage, or in cultural creolization the way material things are made, used and perceived) remained principally Funnel Beaker culture whereas the "lexicon" (words, or the artefacts) appears to be Single Grave culture (cf. Ferguson 1992, p. xlii). However, the Funnel Beaker "grammar", or norms as I will prefer to call it, did not only affect the way artefacts were use but also to a high degree burial customs and deposition practices.

Burial customs are influenced by a range of cultural norms, political strategies and beliefs and are associated with various funerary rituals and sometimes elaborate architecture (Pearson 2003). When it comes to burial customs too, the final Middle Neolithic societies in east Denmark differentiated themselves from the rest of south Scandinavia. Compared with more than 1500 recorded burial sites on the Jutland Peninsula holding close to 2400 single graves, the handful of east Danish sites with single graves seems almost negligible (Iversen 2013).

Instead of adopting the Single Grave burial custom, people of east Denmark preferred the old megalithic tombs, which indicates a great deal of consistency concerning mortuary practice and ritual behaviour. This consistency is significant as the way people choose to bury their dead is closely associated with cultural practices, heritage and religious beliefs. Rituals tend to be rather conservative, preserving ways of doing things, which is particularly true for funerary rites and mortuary practices, even though rapid changes can occur (Pearson 2003, p. 195). Thus, the active continuation, or change, of burial practice must be regarded as a weighty indicator of the cultural affiliation and self-understanding of a given social group.

The consistency seen in the burial practice is also visible in the ritual norms that governed the deposition practice. Flint axes/adzes continued to be deposited throughout the Middle Neolithic in east Denmark, showing that the ritual norms of the late Funnel Beaker culture were continued.

The creolization of south Scandinavia

A continued low frequency of stone battle-axes, an almost total rejection of the individual Single Grave burial custom, continued flint axe/adze depositions and reuse of megalithic tombs clearly show the continuation of old Funnel Beaker norms throughout the late Middle Neolithic. Not only was the "Funnel Beaker way" actively upheld by the reuse of megalithic tombs, it probably also constituted the underlying socio-structural backbone of the final Middle Neolithic societies of east Denmark. The old Funnel Beaker norms governed the adoption and rejection of material culture elements including types of objects, the restricted use of battle-axes, mortuary and depositional practices and contact networks.

The reason why east Denmark so conservatively upheld the Funnel Beaker norms must be found in the area's old position as "megalithic heartland", which reached back to the early 4th millennium BC when dolmens and passage graves were constructed in very large numbers. As the Funnel Beaker culture ceased and new Corded Ware customs gained a foothold in northern Europe, material elements were adopted and transformed through a cultural creolization process creating what has otherwise been termed "the Single Grave culture of the Danish Islands" (cf. Becker 1936). However, with a limited number of battle-axes and the lack of single graves, one can hardly talk about a Single Grave culture in east Denmark

(Iversen forthcoming). This reasoning brings us to the question of what to call this cultural expression otherwise known as the Single Grave culture of the Danish Islands.

My view on this question is that nothing much is gained by just adding another cultural label to the rich collection of Middle Neolithic cultures. Instead of "inventing" a new culture, I think that we should see this cultural expression as the result of the creolization process described above. This process took place in east Denmark and neighbouring areas and was caused by the combination of strong local identities rooted in the regional position as megalithic Funnel Beaker heartland and new Single Grave culture influences. The creolization process was made possible by an increasing disintegration (cultural pidginization) of the late Funnel Beaker culture during the early 3rd millennium BC shown by the emergence of the Store Valby pottery and associated late local Funnel Beaker styles and Pitted Ware elements (see Fig. 1).

A somewhat similar creolization process to that described for east Denmark can also be found in other parts of south Scandinavia. Local communities in eastern Jutland, on Funen, in northeastern Schleswig-Holstein and northern Mecklenburg-Vorpommern saw much of the same development. However, these areas were more influenced by the overall Corded Ware complex, or the Single Grave culture of e.g. westcentral Jutland, than east Denmark.

The creolized communities that evolved in east Denmark from c. 2600 BC were in a wider sense affiliated with, or at least influenced by, the overall Corded Ware complex but they used the new material culture trends in accordance with old Funnel Beaker traditions. In the old Pitted Ware areas of northeastern Denmark, elements from the Pitted Ware complex and lifestyle were continued.

This scenario presents a culturally blurred and complex picture and challenges the prevalent rigid view of prehistoric cultures as closed self-sustained units, each occupying its time period and geographical area. With the application of creolization theory is has been possible to put forward an interpretation of an archaeological material and a period that has been poorly understood and appeared fragmentary and associated with cultural decline.

At the end of the culturally diversified Middle Neolithic, new Late Neolithic material and cultural trends came to influence south Scandinavia, and in the long term created a new and far more homogeneous cultural expression known from the Early Bronze Age.

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Cultural identity?

The Middle Neolithic Pitted Ware complex in southern Scandinavia

Kristina Jennbert

Abstract

The aim of this short article is to question the archaeological classification of the Neolithic archaeological cultures, and to raise questions about how to understand the fragmentary material culture in terms of social agency and cultural expression. The settlement of Jonstorp in southern Sweden as a case of the south Scandinavian Pitted Ware complex presents theoretical and methodological implications for the study of economic systems in emerging complex societies. We have problems understanding the time in question. The problems might be in the archaeological material and our classifications, in our methods and our ability to understand the past. However, the narrative of the Neolithization and the introduction of animal breeding and cereal production in southern Scandinavia describes a chaotic period with the construction of monuments and enclosures, technological innovations and colonizing the landscape. Does the material culture at the Pitted Ware sites reflect encounters between regional cultural identities? Can we talk about clashing cultural identities in altered regional economic systems in Scania, southern Scandinavia and in the rest of Europe? My contribution to the debate involves anthropological theories of economic systems, sociological theories of cultural representation, conflict and identity, and above all a critical perspective on archaeological classification.

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Introduction

CAN WE UNDERSTAND what happened during the Neolithic? Can we ask questions about cultural identities? Can we talk about clashing cultural identities in altered regional economic systems in Scania, southern Scandinavia and the rest of Europe? Did people meet peacefully or did they end up in violent conflict? The aim of this short article is to question the archaeological classification of the Neolithic archaeological cultures, and to raise questions about how to understand the fragmentary material culture in terms of social agency and as cultural expression.

There is no doubt that we have to work with a very fragmented material record, as the amount of material that has perished is voluminous. We work with oral cultures, today silent. Perhaps our questions are too naïve, and too ambitious for us to find answers? Of course, the actual source material gives us limitations.

Nevertheless, in the following I will discuss the Pitted Ware complex in the Kullen area in northwestern Scania and draw some conclusions about researching the Neolithic. One tempting question is whether the material culture at the Pitted Ware sites reflects a regional cultural identity. The settlement Jonstorp in southern Sweden as a case of the south Scandinavian Pitted Ware complex will present theoretical and methodological implications for the study of economic systems in emerging complex societies.

The archaeological classification

Our shortcomings might also lie in our classifications, in our methods and our ability to

Fig. 1. The location of Kullaberg in northwestern Scania, south Sweden. Illustration: Maria Wihlborg 2013.

understand the past. But it is a deontological responsibility to scrutinize our terminology, and the tyranny of our classifications, and to realize that the past as modern constructions reflects mentality and values in our own time.

A debate has taken place over many decades about the classification of archaeological material related to the Middle Neolithic (MN): the Funnel Beaker culture (farming), the Battle Axe culture (herding), and the Pitted Ware culture (hunter gathering) (e.g. Becker 1954; Malmer 1962). The material culture in the Scandinavian Middle Neolithic (MNA), at the transition between MNA I and MNA V, has been interpreted as belonging to developments within the Funnel Beaker culture (Edenmo *et al.* 1997, p. 144; Iversen 2010, 2014). The Battle Axe culture follows in MNB. The Pitted Ware is interpreted as a cultural expression in its own right, which chronologically overlaps the division between MNA and MNB (Malmer 2002; Jennbert 2007, 2014), but also as a part of the Funnel Beaker culture (Edenmo *et al.* 1997). Thus, different interpretations have evolved about the MN archaeological complexes and subsistence strategies.

The Kullen area and Pitted Ware sites in eastern middle Sweden

A quick look at the distribution of the Pitted Ware sites in the Kullen area shows quite another geographical setting than the Funnel Beaker sites and Battle Axe sites further south in western Scania. In the Kullen area a large number of Late Mesolithic Ertebølle and Middle Neolithic Pitted Ware sites are situated on the southern shores of Skälderviken. This region in southern Sweden was a post-glacial island during the Neolithic, isolated from the mainland by a wide strait between the present-day Höganäs and Jonstorp (Fig. 1). The archaeological sites of the Neolithic period have mainly been registered by surface collection, and by a few excavations near Kullaberg. Sites of different ages very often share the same location, according to results from the restricted excavations and the survey collections (Lidén 1938, 1940; Althin 1954; Malmer 1969, 2002, p. 122; Jennbert 2007, 2014).

The formation of the Pitted Ware complex is closely connected to coastal areas in southern Scania as in eastern Middle Sweden (e.g. Carlsson 1998, p. 49; Gill 2003). The Pitted Ware culture seems to occur around the Baltic Sea, and in eastern middle Sweden already in Early Neolithic (EN I and EN II), and consists of a fairly well defined material culture (Åkerlund 1996; Stenbäck 2003; Larsson 2006; Papmehl-Dufay 2006). However, the concept of Pitted Ware culture is complicated to use in western Scandinavia, and often connected to the Funnel Beaker tradition (Larsson & Olsson 1997; Strinnholm 2001; Iversen 2014).

The Neolithic Pitted Ware sites in Scania are mostly located on the seashore, mainly on the northwestern coast (Lidén 1938; Malmer 1969; Jennbert 2007), the northeastern coast (Wyszomirska 1986) and the southeastern coast (Strömberg 1988). Sites are also found in the central part of the province, along the shores of the large lake Ringsjön (Althin 1954, p. 82).

With the island location in the Kullen area, and with the main activities taking place on the beaches, the Jonstorp sites undoubtedly characterize a maritime economic system. The sea opens up the potential for navigation, colonization, and trade. The sea should be understood as allowing movement and connections rather than a barrier for dividing social space. The location must surely have influenced emerging cultural identities.

Economic systems

Early in archaeological research, the distinction between the Neolithic archaeological groups traditionally was explained by economic factors, defined in terms of either agrarian or foraging economic systems. The polarity between the different systems of subsistence goes back to the earliest Scandinavian archaeologists (e.g. Nilsson 1838–1843; Becker 1954; Malmer 1962). However, it is too simplistic to argue, as in the ongoing debate, that different material complexes represent different subsistence systems.

The categorization of "farmers" versus "hunter-gatherers" inhibits rather than increases an understanding of social agency in the Neolithic. Unfortunately, the twentieth-century categories and the archaeological chronological system have created narrow categorizations that generate more problems than constructive ideas in finding answers about social agency and cultural identities. In contrast, anthropological and sociological research on economic systems that consider social agency expand the analytical concepts. If the understanding of subsistence strategies is supplemented with concepts such as production, consumption and distribution of goods and services, (e.g. Sahlins 1972; Woodburn 1980, 1982; Godelier 1986; 2010; Pryor 2005), new interpretations may be formulated.

The Neolithic was a period of major transformation of the landscape. The landscape ecology, with the different ecological niches, allowed for all kinds of economic routines, including farming, fishing, herding, hunting and the use of resources such as flint, clay and perishable material. The Jonstorp sites give us some clues about economy, but a restrictive emphasis on subsistence strategies does not consider all aspects of the economic system on the shores.

Economic exploitation incorporates both agency and structure, and these factors must guide our interpretations of the sites. Did people visit the sites in order to get supplies for growing terrestrial plants, or just to slaughter the catch of seals? Or were social factors involved? At the Jonstorp sites the archaeological evidence gives some hints as to the economic exploitation of the landscape and seascape. Fishing and seal hunting, cultivation of wheat and emmer, gathering of wild plants and anthropogenic indicators of plant and animal tissues, bones, urine, faeces and ashes were found in the culture layers.

The sites in the Kullen area were not isolated and separated from the mainland. The archaeological material does not exhibit remoteness, rather connectivity, integration and contact with the mainland (Lidén 1938; Carle 1986; Malmer 1969, 2002; Jennbert 2007, 2014). In conclusion, the Pitted Ware complex on the shore at Jonstorp, and in other coastal areas in Scandinavia, reflects a maritime economic system with knowledge of seafaring and skilled handicraft. Judging by the character of the material culture, the people were also in interaction, whether peaceful or violent, with people in the adjacent monumental landscape.

Cultural representation and identity

What about the cultural representation and identity expressed by the material culture found on the Jonstorp sites? Are pottery, flint and stone tools, the maritime economic system, and seashores associated with a special cultural identity? It is not just subsistence strategies that should be understood but also the meaning of the material culture. Nowadays, material culture is understood as a conscious expression challenging and remodelling social roles. Material culture can be understood as a set of things with meanings in a set of practices between members of a society (Hall 2013, p. XVIII).

Material culture is not a passive reflection of social reality, but an active component for people to define themselves in relation to others. Materiality in itself is as much an active social force as an expression of skill in handicraft and technology. As materiality can signal either identity and ownership, knowledge and quality, but also the behaviour, characteristics, and appearance of individuals, so material culture are to be understood as a social force and vital in the construction of cultural identity (Jones 1997; Boivin 2008; Olsen 2010; Hodder 2012).

In his research Maurice Godelier shows that neither kinship relations nor economic relations are sufficient to forge a new society. Instead he argues that political-religious relations weld together kin groups into a society with the authority of a territory, its inhabitants, and its resources (Godelier 2010). The artefacts could in that case function as cultural representations in political services.

Neolithic pottery and tools could be examples of this. A compilation of typologically classified Neolithic tools in Scania and their association with contextual placement in the different Neolithic complexes develops the issues further (Table 1). The find associations support the idea that objects circulated during the Neolithic, and closed social groups did not exist. At the Jonstorp sites the following patterns can be observed:

- Associations with Funnel Beaker contexts: Pit-ornamented vessel, clay-disc, thick-butted flint A/B- axe, thin-bladed axe, double-edge axe
- Associations with Battle Axe contexts: Thin-bladed axe, thick-butted flint-axe with concave cutting edge, thick-bladed flint axes
- Cylindrical blade cores, and tanged blade arrowhead at Jonstorp are associated with the middle Neolithic; arrowheads A-C with MNA, type D with Battle Axe

Table 1. Associations of a selection of artefacts and contexts in Middle Neolithic Scania related to Funnel Beaker, Pitted Ware with special presence at Jonstorp sites and Battle Axe contexts (Carlie 1986; Strömberg 1988; Karsten 1994; Malmer 2002). EN (Early Neolithic), MN (Middle Neolithic).

Artefact – relative dating	**Funnel Beaker context**	**Pitted Ware context**	**Battle Axe context**
Funnel Beaker beaker (EN–MNA)	Dwelling, megalith		
Funnel Beaker, big pit-decorated storage vessel (MNA IV–V)	Dwelling, enclosure, wetland		
Pit-ornamented vessel (MNA)	Dwelling, enclosure, wetland	Dwelling, Jonstorp	
Clay disc (EN, MNA)	Dwelling	Dwelling, Jonstorp	
Thin-butted flint axe (EN, MNA I–II)	Dwelling, wetland, earth grave		
Thick-butted flint A-axe (MNA III–V)	Dwelling, single find, wetland	Dwelling, Jonstorp	
Thick-butted flint B-axe (MNB)		Dwelling, Jonstorp	Single find, wetland
Pointed-butted flint axe with concave cutting edge (MNA IV–V)	Dwelling, single find, wetland		
Thin-bladed axe (MNA IV–V, MNB)	Dwelling, single find, wetland	Dwelling, Jonstorp	Earth grave
Narrow chisel (EN–MNA, MNB)	Dwelling, grave		Earth grave
Thick-butted flint-axe with concave cutting edge (MNB)		Dwelling, Jonstorp	Single find, wetland
Thick-bladed adzes (MNB)			Earth grave
Thick-bladed flint axes (MNB)		Dwelling, Jonstorp	Earth grave
Polygonal battle axe (EN)	Dwelling, megalith, Single find		
Stone mace head (EN)	Single find		
Double-edge axe (EN: MNA)	Dwelling, megalith	Dwelling, Jonstorp	
Flint halberd (EN, MN)	Dwelling, hoard		
Flat copper axe (EN, MN)	Single find, wetland		Single find, wetland
Battle axe (MNB)			Single find, wetland, earth graves
Cylindrical blade cores (MN)	Dwelling	Dwelling, Jonstorp	
Tanged blade arrowhead (MNA, MNB)	Dwelling, megalith, enclosure	Dwelling, Jonstorp	Dwelling

Hypothetically, the Pitted Ware complex in Jonstorp signals another kind of materiality than the contemporary or slightly older Funnel Beaker complex, and the later Battle Axe complex. A blending of different things or qualities characterizes the material culture on the island. However, the dating of the Jonstorp sites is problematic, as the Ua series ^{14}C datings of food crusts were affected by freshwater reservoir effects. The remaining ^{14}C datings point to a time sequence between 2,900 and 2,600 cal. BC (Fig. 2), e.g. between MNA and MNB (Müller 2010). Of course, it is impossible to say anything about contemporaneity in the material culture. Judging by the stratigraphy of the excavated units (Jennbert 2014), however,

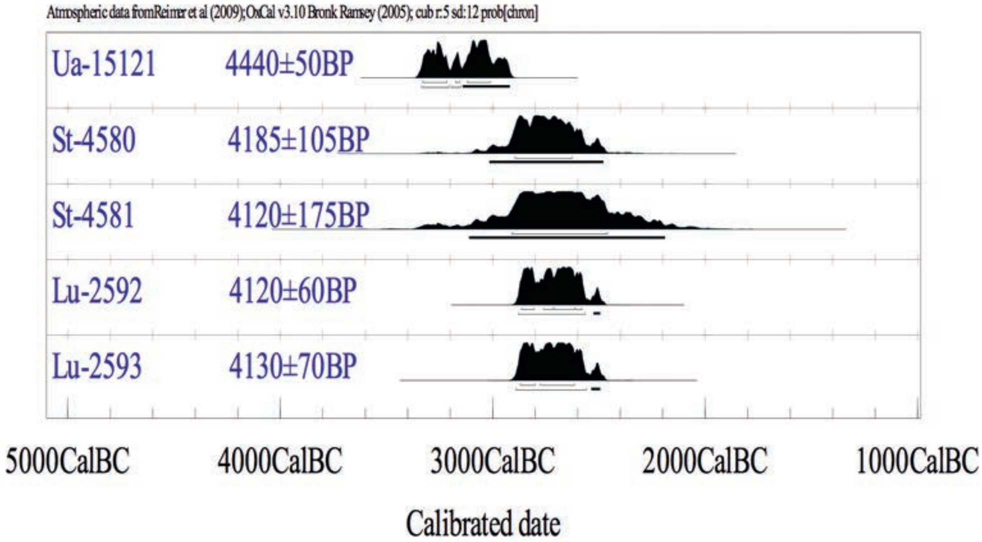

Fig. 2. Calibrated ^{14}C datings from Jonstorp M2 and M3 sites.

we can assume that several of the objects could have been used during one generation or two.

So, can we talk about artefacts as cultural representations and identity at the Pitted Ware sites at Jonstorp? We may suppose that the maritime economic system was a delayed return system. In a delayed return system binding commitments and dependencies between people are vital (Woodburn 1982). The finds indicate activities such as reuse of polished flint axes (Leffler 2013), as well as pottery craft, flint and stone manufacture. Without local flint access, the flint axes were certainly a desirable raw material, for example, for tanged arrowheads, whose function could have been either as tools for catching seal, or a weapon against other people (Jennbert 2014).

Work axes in the Pitted Ware are characterized by the same set of flint axes as in the Funnel Beaker and the Battle Axe complexes (Carlie 1986; Malmer 2002, p. 81). Although there are similarities in material expressions in the middle Neolithic complexes, my interpretation of the material culture and the setting of the Jonstorp sites leans towards a blended creolization. One possibility for understanding the blending of material culture is to consider social movements, and the encounter of the southern Funnel Beaker complexes in combination with the Swedish eastern Pitted Ware complexes.

Therefore, I choose to classify the Jonstorp archaeological material as Pitted Ware, because of the character of the material culture, especially the pottery, the economic system, and the landscape settings. Thus, the Jonstorp sites express a certain regional cultural identity. Following the complexity of the Jonstorp site, I understand other Pitted Ware sites with the same complexities in western and southern Scandinavia as being expressions of blended creolization. The phenomena of blending might be the consequence of social agency, even conflicts as clubs, mace-heads, polished stone-axes are found on the Jonstorp site as on other Neolithic sites.

Social conflicts

The traditional archaeological classification of different Neolithic archaeological cultural groups makes it more difficult to understand social agency and cultural expression. The scientific need to sort and classify in unmixed finds is understandable, but it has limited the scope for understanding dynamic social encountering. Of course, social encountering has all kinds of dynamics. To simplify in this short article, social agency might include peaceful interaction as well as violent conflicts.

Certainly, there were commitments in the encountering between people in different parts of the province, but in what ways? It seems as if the warrior ideal was a growing social category during the Neolithic, probably already during the Mesolithic. Artefacts such as clubs, daggers of bone and antler, and arrowheads, the burials, and the body traumas show the presence of war and violence during the Neolithic (Sarauw 2007; Ahlström & Molnar 2012; Schulting & Fibiger 2012). Likewise, weapons of flint, stone, and antler were in use, found on dwellings, in graves, and deposited as single finds and in hoards on dry land or in wetlands. It looks as if social practices included competition between different social groups.

In addition, several Funnel Beaker places were constructed by building megaliths and enclosures (Larsson 1982; Andersson 2004; Brink 2009; Müller 2011). In Scania the river valleys inland from the coastal regions contained megaliths, enclosures, and settlement sites (Strömberg 1980). The Pitted Ware sites are not located in the river valleys, but associated with the coasts, and the shores of Ringsjön, although there is a certain discrepancy in the geographical use of Scania; the most important point is that the boundary between the Funnel Beaker complex and the Pitted Ware is far from sharp (Strömberg 1988, p. 78; Malmer 2002, p. 49).

My assumption is that the different social groups during the Neolithic were involved in specific spatial routines and traditions. My previous hypothesis was that the access to the ecological mosaic with its physical and mental resources was negotiable through the social agreements (Jennbert 2014). As I continue trying to understand what these different archaeological groups stand for in terms of cultural representation, conflict, and social identity, it seems obvious that there were multiple circumstances indicating growing social conflicts and clashing cultural identities in the late MNA.

Conclusion

When social aspects are integrated into the system of archaeological classification, the understanding of the fragmentary material culture is broadened and extended. The Neolithic archaeological cultures emerge as complex social units, not as isolated units of self-nourishing and evolving social units. Understanding the fragmentary material culture in terms of social agency and cultural expression raises new questions.

The settlement Jonstorp as a case of the south Scandinavian Pitted Ware complex serve as a suitable candidate to explore theoretical and methodological implications for the study of economic systems in emerging complex societies. The Pitted Ware sites were situated in a maritime non-monumental landscape along the coasts. The Funnel Beaker and the Battle Axe sites were located along river valleys with the construction of megaliths, cemeteries and enclosures. Even if there were similarities in the material cultures, differences, especially in pottery ornamentation, also indicate diverse social units and identities. The dissimilarity in the landscape use and geographical settings of south Scandinavian Neolithic assemblages indicates different economic systems and social identities. Probably, In the emerging social complexity, several Neolithic regional lifestyles were represented in the landscape. As a result, the encountering between groups of people led to competition between groups of people.

In conclusion, we still have insufficient classification of the Neolithic archaeological assemblages. The analytical complexities in the interaction between material culture, economic system, landscape setting, geographical location and cultural identities need to be extended. The narrative of the Neolithization and the introduction of animal breeding and cereal production in southern Scandinavia describes a chaotic period with the construction of monuments and enclosures, technological innovations and colonizing the landscape. Regarding multiple landscape use and consideration of its benefits, the maritime landscape increase the horizon of understanding. The seashore and wetland areas can be understood as ecological niches on the margins. But the agency of the fish and the seals in the seas, like the wild and domesticated animals on land, is as crucial for social activities and cultural identities, as are the potential pathways out to the maritime landscape.

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Agency, creolization and the transformation of tradition in the constitution of the earliest Neolithic in southern Scandinavia

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Abstract

During the last 20 years a lot of work has focussed on the agricultural transition and the origins of the Neolithic in southern Scandinavia at a broad, inter-regional, rather than regional scale. Consequently, there is broad agreement today that the dispersal of farming into Europe involved both the resident hunting and gathering communities and exogenous farming groups. We also know that for the more widespread adoption of farming, the role of contact between foragers and farmers was very important. But what motivated the transition to farming at a local and regional level? And what processes enabled the transition, and the coeval development of a new cultural tradition to occur? It is my belief that causes and motivations operating at the regional level may well have been different from more general and diffuse conditions operating at broader geographical scales.

In this article I will chiefly concentrate on the development of the earliest TRB, the Oxie group, and try to comprehend at a regional scale the transition from hunting-gathering to farming in south Scandinavia. An important feature is the application of the theory of structuration and agency as a way of elucidating the course of this transition.

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A change is gonna come: Neolithization in south Scandinavia – an introduction

One of the most frequently discussed issues in Scandinavian archaeology is Neolithization and what caused it. I will focus on what followed: the regionalization and the local groups with a focus on the earliest ones, the Oxie, Svenstorp and Mossby groups.

When Carl Johan Becker in 1947 presented his three eponymous groups A, B and C he saw them as chronologically separated and as a result of migration. When new archaeological results started to emerge during the 1970s and 1980s, other possibilities were discussed, and in both Denmark and Sweden new chronologies were launched, resulting in regional groups with names taken from important sites like Oxie, Volling, Svenstorp and so forth (M. Larsson 1984; Madsen & Petersen 1984).

It was also obvious that the Oxie and Svenstorp groups, to some degree at least, were contemporaneous (M. Larsson 1984). The radiocarbon datings of these two groups were placed between 3950 and 3700 BC (M. Larsson 2007; Rudebeck 2010, p. 210). During the 1990s there was some discussion regarding the oldest of these groups: Oxie. The present author has suggested that on purely typological grounds the Oxie group ought to be the oldest (M. Larsson 2007). Several new radiocarbon dates from Almhov in Malmö and elsewhere correspond well with the ones mentioned above, 3950–3700 BC (Rudebeck 2010, p. 210). It is obvious to my mind that that the Oxie group is the oldest, and the homogeneity of its accompanying material culture over a large area of south Scandinavia might be taken as evidence for a rapid change and transformation along old contact routes.

Previously uninhabited inland areas like the inner part of Scania were settled by Neolithic communities, as indicated by the distribution of pointed-butted flint axes. If we look at the distribution of these axes it is clear that the majority of these axes have been found in the western part of Scania (Jennbert 1984; Sørensen & Karg 2012). The distribution of the pointed-butted axes illustrate a rather dense inland habitation during the Early Neolithic. They seem to concentrate in regions with light, easily worked arable soils. Based on typological characteristics, pointed-butted axes were divided into three distinct types. The majority are stray finds. Their typology and placement within the Early Neolithic I period is supported by several radiocarbon dates from settlement contexts. The dates supports the typology originally proposed by P.O. Nielsen (1977). Large and systematic production and distribution of these axes is revealed by numerous concentrations of pointed-butted axes close to the flint mines at Stevns, in Eastern Zealand, and Södra Sallerup on the outskirts of Malmö. The pointed-butted flint axes are typical of the Oxie group. There is nevertheless some scant evidence for pointed-butted axes in the Svenstorp group but not in either the Volling or the Mossby group (Madsen & Petersen 1984; M. Larsson 1984; 1992).

As noted by Magnus Andersson (2003, p. 161) in his work in western Scania, there are few if any traces of Mesolithic habitation at the Early Neolithic inland settlements. Several of the earliest Neolithic settlements also had a distinct location in the landscape. They were situated on ridges or small hills in the undulating landscape. This is especially true for the sites with large numbers of pits like Svenstorp and Månasken in southwest Scania (M. Larsson 1984, 1985). The pits are often layered, meaning that they were actually recut and reused. Large amounts of flints debris are found in the pits, but also obviously unused implements such as flake axes, flake scrapers and in some cases even complete axes and vessels (M. Larsson 1984).

As has long been recognized, there is a close resemblance between the flint industry of the late Ertebølle culture and the early TRB culture. The flake axes, for example, are similar. Although the flake axes in the TRB culture are smaller and somewhat cruder in appearance, the affinity is still close. Other implements that appear in the earliest TRB are, for example, transverse arrowheads. These are also very similar in shape and technique to the ones found on Ertebølle sites.

What does all this have to do with the Oxie group? To try and explain this we have to go back to the Ertebølle culture once more. Already in the 1980s Peter Vang Pedersen demonstrated that it was possible to see regional groups in the late Ertebølle on Zealand. These were distinguished by specific items in their material culture.

It is at this point that structuration theory can be effective: At a regional and community level individual and collective motivations – reasons and justifications for doing things – must have been formulated into strategies by people who had a certain level of knowledge about their social and natural environment – "knowledgeable social actors". The outcomes of such strategies must have been contingent on and validated by structural principles and dialectical social relationships within which such a community operated.

We can look at some important issues in the debate using the above statements:

(a) Settlement shift. Abandonment of earlier Ertebølle permanent settlements (and their burial sites) and their replacement by single homesteads. for example, Mossby and Dagstorp. In this there was also an element of deliberate social agency aiming at transformation of the Ertebølle structural code, i.e. structural principles = houses. Changes in subsistence altered the structural conditions under which the new subsistence could operate. New settlement areas were coming into use.

(b) The lithic industry. Changes through agency and routine practice can be also detected in the flint work. We can here detect influences from both Neolithic groups in continental Europe as well as regional Mesolithic traditions. This implies the following: (1) continuation of routine practice in the manufacture of stone tools, (2) selective adoption of Neolithic elements in tool types such as polished axes and sickle blades, but also stone tools such as battle axes.

(c) Pottery. The same process of retention of routines and institution of change applies to ceramics: TRB vessels resemble in shape and form pottery like Rössen but above all Michelsberg pottery, but motifs are different, and somehow similar to those of the decorated Ertebølle pottery. People retained an earlier Neolithic form and shape for practical reasons, but allowed the imposition of a new symbolic code – a hunter-gatherer one – through a deliberate act of enculturation, through agency. Unlike shape or form, decoration became an emblematic statement by hunter-gatherers turned farmers, who by this symbolic shift adopted the Neolithic ceramics as a part of their cultural identity.

If we scrutinize the above statements, from where did people get the incentive to change their way of life? We have the late hunter-gatherers, of course, but what else? Recently Lasse Sørensen has argued that the different material culture which occurs in southern Scandinavia, that is, the TRB, at the beginning of the 4th millennium BC indicates migrating farmers from central Europe expanding into this area. The new material culture consists of pointed-butted axes, jade axes, battle axes, short-necked funnel beakers, clay discs and copper (Sørensen 2013). In this we might see more influences from the Michelsberg and Baalberg cultures area than previously believed.

If we go along with this notion we can, for example, mention that Rowley-Conwy (2011) has suggested that pioneering farmers expanded to the north by leapfrog movement that would suggest sporadic immigration.

What Sørensen, and Rowley Conwy, propose is a cultural dualism with migrating farmers moving inland and hunter-gatherers still living at the coast. This is how we might explain the early TRB sites with the large number of pits. This was a part of the intentional transformation of the landscape that begins with the Neolithic. The linear way of building during this period has often been interpreted as a link between the Linearbandkeramik long-houses and the long barrows (cf. Hodder 1990; Bradley 1998). The oval Funnel Beaker houses should probably be seen in the light of this discussion. If we accept this notion we might also see the rounded houses/huts as a lingering Mesolithic trait. Richard Bradley has recently (1998) stated that a Mesolithic world view probably existed and we might turn this argument around and state that a Neolithic world view also existed of course. In this oval or trapezoid structures were preferred.

Another way of documenting a cultural dualism is by performing DNA analysis. The burial site of Ostorf in northern Germany was originally interpreted as a hunter-gatherer enclave surrounded by agrarian societies, because the individuals had a high intake of aquatic resources (Lübke *et al.* 2009 pp.130 ff.; Schulting 2011 p. 21). However, three burials contained Palaeolithic/Mesolithic haplogroups U5 and U5a, while four other burials contained Neolithic haplogroups J, K and T2e (Bramanti *et* *al*. 2009, p. 139). The individuals at Ostorf illustrate a rare example of hunter-gatherers and possible farmers, who may have integrated with each other.

In this context a study by Skoglund *et al.* (2012), in which the DNA of early farmers (TRB) from Gökhem passage grave at Falbygden were compared to individuals belonging to the Pitted Ware Culture (PWC) found that individuals from the two contexts show starkly different genetic signatures, with the Neolithic hunter-gatherers being outside the variation of modern-day humans but most closely related to populations from the Baltic area today, whereas Neolithic farming individuals were most closely related to people from places like the Netherlands and France, but Greece and Sardinia as well (Skoglund *et al*. 2012).

This might indicate that the farmers in Falbygden belonged to a primarily northwest European farming tradition. These results suggest that migration from southern Europe catalysed the spread of agriculture and that admixture in the wake of this expansion eventually shaped the genomic landscape of modern-day Europe. This is of course interesting regarding the Michelsberg culture that is strong in these areas.

How then could we understand this development?

Single cultural traits in the form of an artefact category are in fact a material resource that may have been drawn into a variety of strategies. You could say, in the words of John Barrett (1988, p.8), that "The material world acts as a storage of cultural resources".

The term "creolization" might be useful in this context. It refers to a process whereby men and women actively blend together elements of different cultures to create a new culture. Creolization is perceived as a more active process and one that involves, by definition, a give and take between peoples of diverse cultural traditions (Cohen & Toninato 2011, pp. 1 ff.). This is what might have happened after a couple of centuries; the incoming farmers blended with the hunter-gatherers living in the coastal areas. The outcome of this is probably the movement from the inland down to the coastal areas. At this time in history we also see the development of dolmens, sometimes incorporated into the older long barrows. In this way a whole new TRB developed with a more stable settlement structure, long-houses and a more developed agricultural economy.

Possibly this also represents a shift from kinship-based to household-based societies (Levi-Strauss 1982, p. 174), where the house constitutes a "corporate body holding an estate that reproduces itself through the transmission of its name, goods, and titles" (Hodder & Cessford 2004). Humans were entangled in social relations, but it is also important to stress the connection between people and place. As Ian Hodder (2012)recently said, "the focus has changed from how things make society possible to the thing itself and its multiple connections". This means that society and material culture are co-entangled.

Conclusions

What I have tried to show in the above is how complex the situation has become. We cannot say any more that there is no evidence for migration of people during the period of Neolithization around 4000 BC. The evidence is of course still scanty and in the case of Falbygden hard to really grasp. Closer collaboration between scientists working with DNA and archaeologists would be recommended. If we bring into the equation the material culture associated with the earliest TRB then the evidence for cultural dualism is strong. To understand the development between c. 4000–3700 BC a term like creolization might be useful to understand how men and women actively blend together elements of different cultures to create a new culture might be a way in trying to understand the development at this point.

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Animal husbandry and social identities during the Neolithic in southern Sweden

Ola Magnell

Abstract

Animal husbandry and social identities in Scania, south Scandinavia, during the Neolithic have been studied based on the frequency of animal bones (NISP). Cattle were the most important livestock to the humans on the Funnel Beaker sites. Differences in the amount of wild game indicate regional differences in subsistence and identities between southwest and northwest Scania. A change in animal husbandry is evident during the Middle Neolithic B with a larger diversification. Pitted Ware sites are characteristic, with a high frequency of wild game and an almost complete absence of cattle and sheep. During the Late Neolithic the importance of sheep seems to increase. To what extent Neolithic pigs represent wild boar or domestic pigs is also discussed.

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Introduction

WHAT WAS NEW in the Neolithic? The big news of the Neolithic was livestock along with agriculture, which resulted in a different way of life, causing social and cultural change. There were of course several other changes in the Neolithic in south Scandinavia, with the building of monuments, polished flint axes and new forms of ceramics, but the factor that enabled and pushed these changes can be traced to the significance of livestock and agriculture. Animal husbandry and agriculture resulted in demand to control land. Animals also became property possessed by specific persons and groups of people, unlike hunted game during the Mesolithic, and a kind of wealth causing social change (Russell 1998; Marciniak 2005, pp. 43 f.). The livestock and agriculture most likely also enabled population growth and a more sedentary lifestyle, but were also the forces that resulted in a change of the landscape, which became more open and altered by humans (Price & Gebauer 1993, pp. 107 ff.; Regnell & Sjögren 2006). The significance of cattle, sheep and pigs is fundamental for understanding the Neolithic. Most zooarchaeological studies of the Neolithic in south Scandinavia, however, have been site-specific and more synthesis of the animal husbandry is needed. Following a study of animal husbandry during the Neolithic published in 1995, a few studies have dealt with different regions, such as Västergötland and Mälardalen (Ahlfont *et al.* 1995; Sjögren 2003, pp. 128 ff.; Bäckström 2007; Hallgren 2008, pp. 123 ff.). Studies based on analysis of isotopes have also resulted in new evidence of the movement of Neolithic livestock (Sjögren & Price 2013). During the last 15 years several excavations and analyses of faunal remains from Scania, the southernmost region in Sweden, have made it possible to study animal husbandry in more detail. This study aims at describing the development of animal husbandry and the importance of hunting, based on the abundance of different livestock and wild animals in faunal remains from Neolithic sites. Further, the study aims at considering regional

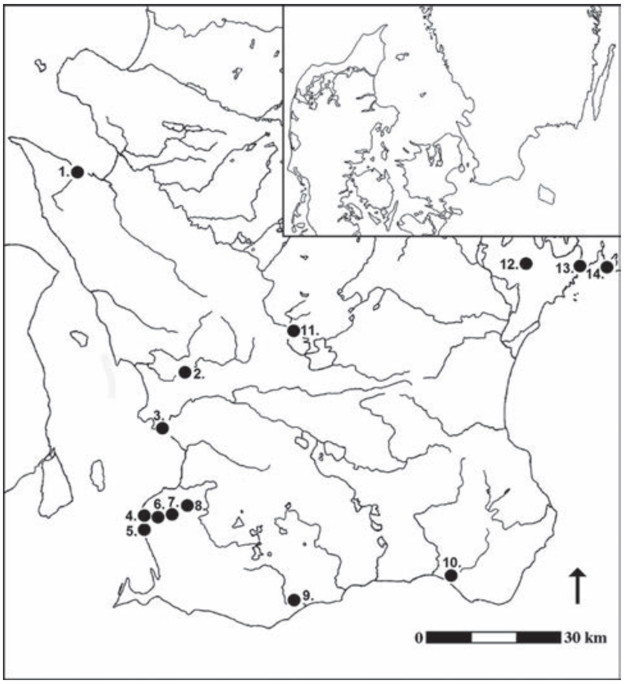

Fig. 1. Map of Southern Sweden and sites used in the study. 1. Jonstorp, 2. Saxtorp SU 9, 3. Löddesborg, 4. Skjutbanorna 1A, 5. Bunkeflostrand 15:1, 6. Almhov, Hylliestation, Hylliepalissaden, Elinelund 2A & 2B, Lindängelund 4, 7. Hindby kärr, Lockarp 7B, 8. Ängdala flint mines, Södra Sallerup 15H, 9. Rävgrav, 10. Bredasten, 11. Sjöholmen, 12. Hunneberget, 13. Nymölla III, Nymölla I, 14. Siretorp.

and cultural differences in relation to animal husbandry and hunting.

Material and methods

The study is based on 20 samples from 18 Neolithic sites and four Late Mesolithic sites in Scania and western Blekinge in southern Sweden (Fig. 1, Table I). The quantification of different species of livestock and wild game has been based on bone samples with a number of identified specimens (NISP) over 85. Sample size varies from 85 to 2735 NISP with a median of 298 (Table I).

The small sample sizes of some of the sites are problematic, and it can be discussed to what extent the quantification of faunal assemblages with NISP about 100 is representative. The preservation of bones and the taphonomy of faunal remains also differ a great deal between different sites. Certain samples have well-preserved bones, while others mainly consist of burned bones and teeth. This may also have affected the abundance of different species and resulted in bias towards animals with larger robust bones, such as cattle. The sites are also of different character; some are settlements where the bones mainly were found in pits, while on other sites the bones mainly originate from cultural layers. Two sites are palisaded enclosures and three are ritual depositions in wetlands. Because the archaeological contexts, taphonomic conditions and sample sizes differ between the sites it would be expected that the frequency of animals is affected by these factors to some extent. It is thus important to focus on the general trends rather than single sites with divergent composition of fauna.

Faunal remains from different chronological phases of the Almhov and Hunneberget sites have been divided into different samples. The dating of faunal assemblages is based on radiocarbon dating and the median of ^{14}C datings is used as an approximation of the dating of the sites.

Hunting and the frequency of wild game are based on bones from mammals. In the quanti-

Table I. NISP of livestock and mammalian wild game from Neolithic and Late Mesolithic sites in Scania and Blekinge ordered according to dating. The column "Pigs" includes both wild boar and domestic pigs. Note that dogs and antlers of cervids are not included in the table. Based on the following references: Bredasten (Magnell 2006), Nymölla III (Wyszomirska 1988), Skjutbanorna 1A (Jonsson, E. 2005), Löddesborg (Jennbert 1984; Hallström 1984), Ängdala flint mines (Rudebeck 1994; Nilsson 1991; Hadevik 2009), Almhov (Vretemark 2001; Jonsson, L. 2005; Hadevik 2009), Saxtorp SU 9 (Nilsson & Nilsson 2001), Hunneberget (Magnell 2007; Andersson 2007), Rävgrav (Larsson 1990; Andersson 2013), Hindby kärr (Nilsson 2007; Hadevik 2009), Elinelund 2A & 2B (Sarnäs & Nord Paulsson 2001), Lindängelund (Boethius 2009), Nymölla I (Edenmo *et al.* 1997; Mannermaa & von Moscinsky 2001), Södra Sallerup 15H (Nilsson 2006; Hadevik 2009), Sjöholmen (upper layer) (unpublished data), Siretorp (Dahr 1939, Edenmo *et al.* 1997), Hylliepalissaden (Jonsson 2003; Brink & Hydén 2006), Hylliestation (Vretemark 2003; Brink & Hydén 2006), Lockarp 7B (Eliasson & Kishonti 2003), Jonstorp (Edenmo *et al.* 1997; Olson 1998), Bunkeflostrand 15:1 (Magnell 2008; Brink *et al.* 2009).

	Cattle	Sheep/goat	Pigs	Wild game	total
Bredasten			1334	870	2204
Nymölla III	1		31	136	168
Skjutbanorna 1A	11		5	54	70
Löddesborg	7		44	197	248
Ängdala flint mines	50	24	24		98
Almhov – EN I	178	39	154	56	427
Saxtorp SU9	246	90	78	11	425
Hunneberget – EN	85	36	50	61	232
Rävgrav	933	504	1209	89	2735
Almhov – EN II–MNA	51	6	13	15	85
Hindby kärr	184	47	144	9	384
Elinelund 2B	314	14	59	4	391
Hunneberget -. MNA	142	69	74	63	348
Lindängelund 4	383	74	254	3	714
Nymölla I	73	11	744	848	1676
Södra Sallerup 15H	371	43	52	1	467
Sjöholmen (upper layer)	3		21	103	127
Siretorp	73	15	81	1219	1388
Hylliepalissaden	84	104	166	31	385
Hylliestation	39	7	41	2	89
Lockarp 7B	30	17	43	1	91
Jonstorp	4		24	118	146
Bunkeflostrand	20	108	12	70	210
Elinelund 2A	78	48	5	5	136

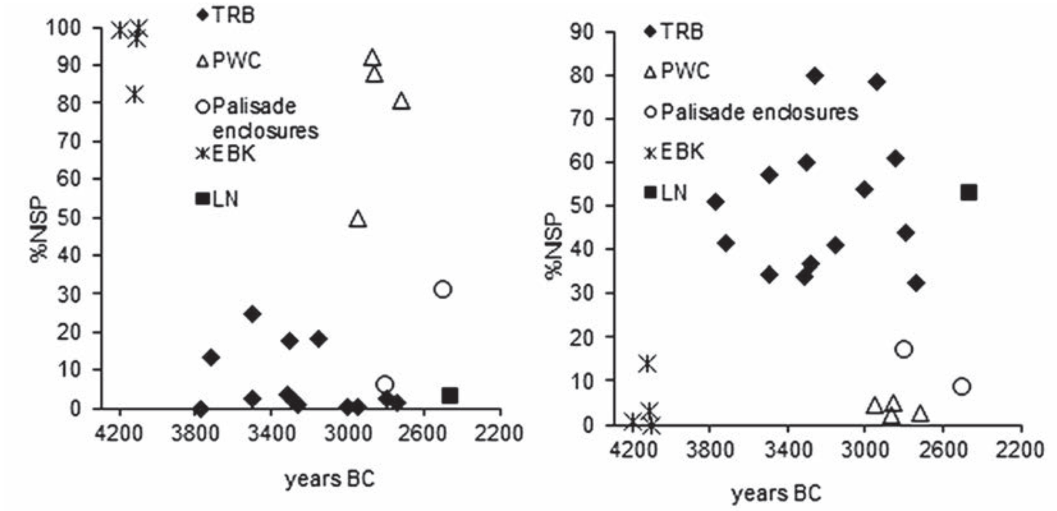

Fig. 2. Frequency (NISP) of wild game (left) and cattle (right) at Late Mesolithic and Neolithic sites from southern Sweden (Scania and Blekinge). TRB: Funnel Beaker culture, PWC: Pitted Ware culture, EBK: Ertebølle culture, LN: Late Neolithic.

fication antlers from deer have been excluded, since these specimens could originate from shed antlers and consequently not hunted animals. Due to the problems in differentiating wild from domestic pigs, especially juveniles and fragmented bones, pigs have been treated as one category. This means that wild boar is not included among the wild game from Neolithic sites, but the importance of wild boar will be discussed. From the Late Mesolithic sites all bones of suids have been assumed to be from wild boar since no osteometric data or kill-off patterns indicate the presence of domestic pigs during this period in southern Sweden.

Results

The transition from the Mesolithic to the Neolithic is evident in the relatively low frequency of wild game of the Early Neolithic (EN) sites, c. 3900–3300 BC, in comparison with the Late Mesolithic sites (Fig. 2). However, the exclusion of pigs and wild boar means that the frequency of wild game at the Neolithic sites is too low, but as discussed below, most of the pigs most likely represent domestic animals. As noticed in earlier studies, this indicates that the transformation from hunter-gatherers to farmers was a fast process taking place within a few generations in this region (Price & Gebauer 1993, p. 110; Sørensen & Karg 2012).

On Funnel Beaker sites no clear change in the frequency of wild game over time can be noticed, and sites with very few bones of wild game are from both the Early Neolithic and the Early Middle Neolithic (MN A), c. 3300–2800 BC. During the Late Middle Neolithic (MN B), c. 2800–2350 BC, a shift occurs with a large proportion of wild game on sites associated with the Pitted Ware culture (Fig. 2). It should be noted that the Pitted Ware sites are situated in peripheral areas of the region at the Blekinge coast, northwestern, northeastern and central Scania. It has been debated whether these sites should be associated with the Pitted Ware culture or not (Edenmo *et al.* 1997). At least the subsistence based on sealing, fishing, keeping of pigs and hunting on these sites is typical of the Pitted Ware culture in Eastern central Sweden (Edenmo *et al.* 2007, pp. 180). A difference at

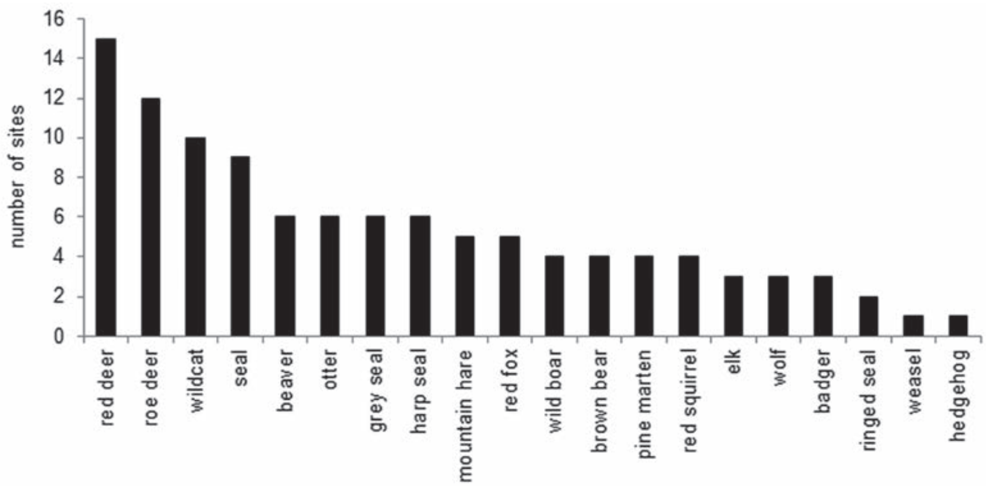

Fig 3. Mammalian wild game on Neolithic sites from Scania and Blekinge based on occurrence of bones of different taxa.

some of the sites from Scania, in comparison to central Sweden, is the high amount of red deer on the sites Nymölla I and Sjöholmen. This most likely represents regional and ecological differences in wild game populations.

The Funnel Beaker site Hunneberget from northeastern Scania has a higher proportion of wild game (EN: 25%, MN A: 18%) in comparison with most sites from the southwestern parts of the region (median: EN: 3%, MN A: 1%), indicating regional differences in the importance of hunting. Hunneberget is the only Funnel Beaker site with large bone assemblages (NISP: EN: 248, MN: 348) from northeastern Scania, but considering the fairly large sample sizes, the high frequency of wild game indicates that hunting was more frequent at this site than at sites in southwestern Scania. This possibly reflects an impoverishment of the wild game population in the southwest already during the EN, caused by a higher population density of humans in this area. Finds such as the high concentration of dolmens at Döserygg and flint mines in Södra Sallerup represent sites in this area which most likely gathered large groups of humans, which had an impact on the landscape and fauna.

Red deer was the most important wild game, followed by roe deer; these species occur on 75% and 60% respectively of the Neolithic sites. Due to the difficulties in separating wild boar from domestic pigs it is likely that the occurrence of wild boar was higher, comparable to that of roe and red deer. Seals are also common and are found on 45% of the sites. It was harp seal and grey seal that were commonly hunted, more rarely ringed seal. Among the fur animals, wild cat is the most common on 50% of the sites, but beaver and otter are also relatively frequent (Fig. 3).

On the primarily Late Mesolithic sites of Löddesborg, Skjutbanorna 1A and Nymölla III a few bones and teeth from cattle have been found in the otherwise typical Mesolithic fauna (Jennbert 1984; Wyszomirska 1988: Jonsson, E. 2005). Unfortunately, no radiocarbon datings of these early cattle are available. Efforts to date the cattle teeth from Skjutbanorna 1A and Nymölla III have been unsuccessful due to poor preservation of collagen. It is uncertain whether these finds of cattle represent intrusions of younger date or an early transitional stage of cattle herding.

The high proportion of cattle on sites from EN and MN A indicates the significance of cattle for the Funnel Beaker culture (Fig. 2). On

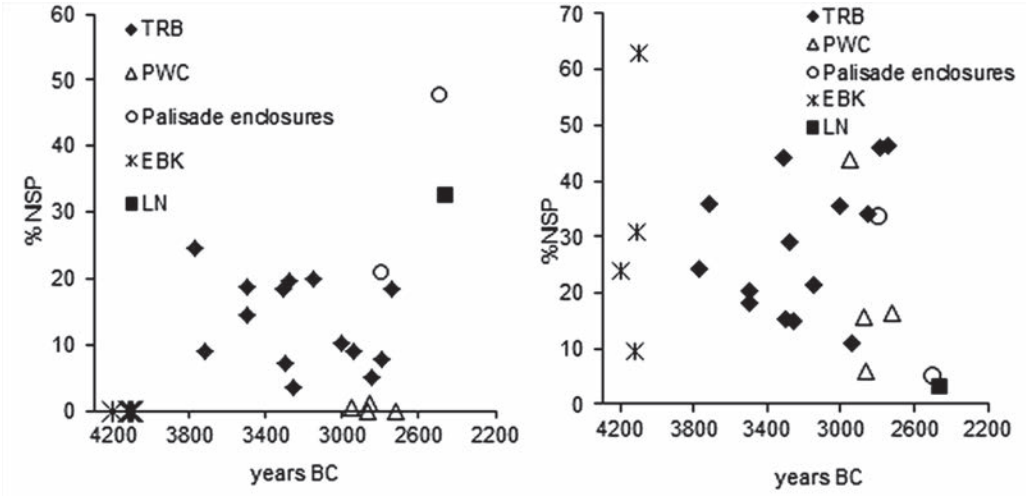

Fig. 4. Frequency (NISP) of sheep/goat (left) and (wild and domestic) pigs (right) from Late Mesolithic and Neolithic sites from southern Sweden (Scania and Blekinge). TRB: Funnel Beaker culture, PWC: Pitted Ware culture, EBK: Ertebølle culture, LN: Late Neolithic.

sites from the MN B, however, a clear decrease is noticed. This can be explained by the very low presence of cattle bones on sites of the Pitted Ware culture (Fig. 2). The low proportion of cattle at the palisaded enclosures dating to MN B also shows that cattle seem to have been of minor importance at these sites. The site Elinelund 2A has a high proportion of cattle bones, comparable to the Funnel Beaker sites, indicating that cattle at Late Neolithic settlements once again became important animals.

Sheep and goat are less frequently found in comparison to cattle on most sites (Fig. 4). It is also evident that sheep were of greater importance than goats in those cases where identification of the two ovicaprids has been possible. Sheep occur on more sites than goat and are also more numerous on all sites. As with cattle, a very low occurrence of bones from sheep/goat is characteristic of the Pitted Ware sites. The high proportion of sheep from the palisaded enclosures, and especially at the sites Bunkeflostrand 15:1 and Elinelund 2A, indicates a possible change in livestock practices during the Late Neolithic (Fig. 4). This could be interpreted as a response to a more open landscape with more grassland, but also as an effect of changes in animal husbandry practices, possibly influenced by the Battle Axe culture.

After cattle, pigs were the most important animal at most Neolithic sites in Scania, but a large variation is noticed between different sites (Fig. 4.). During the MN an increased diversification seems to occur on sites with either a high or a low proportion of pigs. On the Pitted Ware sites pig are in all cases the predominant livestock, but on the coastal sites of Jonstorp and Siretorp pig bones are relatively few in comparison with seals. On the latest sites the frequency of pigs is strikingly low (Fig. 4).

How large proportion of the pigs were wild boar or domestic pigs is important to consider. Osteometric analyses show that wild boar does occur, but that most of the Neolithic pigs are smaller than the Mesolithic wild boar, indicating that a large proportion of the pig bones probably are from domestic pigs (Fig. 5). The mean length of the lower third molar of Mesolithic wild boar from Scania is 45.3 mm, while a significant decrease to 40.3 mm is

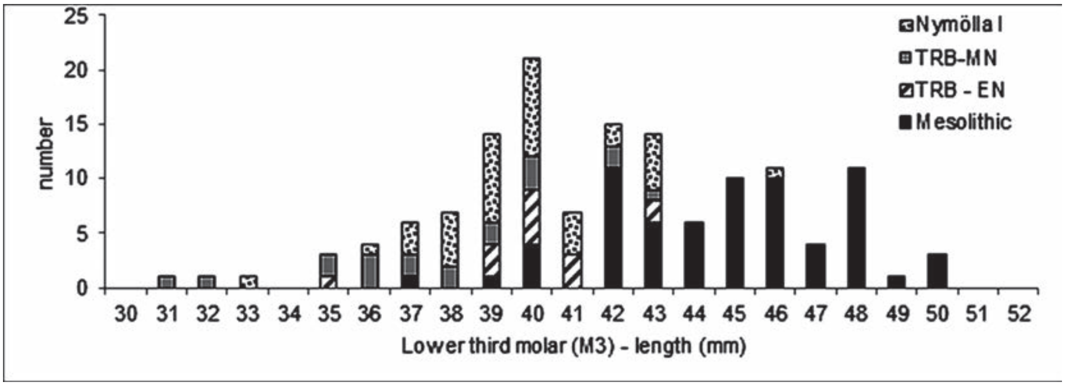

Fig. 5. Size of the lower third molar in Mesolithic and Neolithic pigs from Scania. Based on Nilsson & Nilsson (2003), Jonsson (2005), Magnell (2006), Hindbygården (Nilsson 2007), Lindängelund (Boethius 2009), Andersson, C. (2013), Nymölla I (unpublished).

evident on the Early Neolithic site of Almhov. On MN A sites from southwestern Scania a further decrease can be noticed to a mean of 38.2 mm. On the Pitted Ware site of Nymölla I the mean of the third molar is 40.2 mm. The decrease is most likely explained by the presence of domestic pigs, even though other explanations cannot be excluded. The large EN and Pitted Ware pigs are probably the result of cross-breeds between wild boar and domestic pigs. It could be interpreted as evidence of early domestication, but should rather be seen as breeding between introduced domestic pigs and wild boars. The decreased size in pigs during the MN A in southwest Scania can be interpreted as a decrease in breeding with wild boar due to a decreased wild game population or a change of pig husbandry. The larger size of pigs from Nymölla I in northwest Scania could be seen as an indication of a larger population of wild boar in this area. The age distribution of pigs from most Neolithic sites with many animals killed between 1.5 and 3 years indicates a characteristic slaughter and kill-off pattern of domestic pigs rather than hunting of wild boar (Mannermaa & von Moscinsky 2001; Boethius 2009).

However, some of the Neolithic pig bones most likely originate from wild boar. In an effort to estimate the proportion of wild boar, measurements above 41 mm have been used as a limit between wild boar and domestic pigs. Based on this, 33% of the pigs from Almhov were wild boar, and this would mean that the frequency of wild boar was 12%, which is similar to the frequency of red deer. A similar calculation of the faunal remains from Nymölla I results in 29% wild boar out of the pig bones and a frequency of wild boar of 13%, which can be compared with the frequency of red deer of 31%. This is a crude estimate of the amount of wild boar, but it gives reasonable quantifications in relation to red deer based on the frequency of wild boar and red deer of the Mesolithic sites.

In conclusion, the frequency of wild game on several sites would be at least about 10% higher with wild boar included. However, on sites with a very low frequency of other wild game it could be expected that the frequency of wild boar also was low.

Conclusions

It is important to consider that the frequencies of animal bones are not a simple reflection of the economy and animal husbandry practice of the Neolithic, but the are also expressions of social identities and ritual practices (Marciniak 2005; Russell 2012). Several of the faunal assemblages in this study are sites such as large feasting sites, depositions in wetlands and palisaded enclosures. The slaughter of livestock and consumption of meat during the Neolithic were probably to a large extent associated with ritual feasts on particular occasions at special places. It is obvious, however, that certain aspects of the faunal remains also represent local environmental conditions. The high frequency of seals from Jonstorp and Siretorp is explained by the fact that the sites were situated by the sea on islands during the Neolithic. Other aspects such as the minimal presence of cattle and sheep from Pitted Ware sites are not reflections of the environment, but rather an expression of identity and intentional distinction from the Funnel Beaker settlements. The high frequency of cattle on Funnel Beaker sites in Scania, together with ritual depositions of bones in pits and wetlands, indicates the importance of cattle in the subsistence, and probably also in the social identity of these groups. However, animal bones from passage graves in Västergötland indicate that pigs rather than cattle were the more important animals in the mortuary rituals of the Funnel Beaker culture (Ahlström 2009). The faunal remains show that the transition from hunter-gatherers during the Late Mesolithic to herders of cattle and farmers in the Early Neolithic was rapid in Scania. The faunal remains reveal local differences within the region between the southwest and northwest in the importance of wild game. This is possibly a reflection of human population density and the impact on wildlife populations, but could also be explained as local traditions with different social identities as either hunters or farmers. The cultural complexity of the MN B could also be traced in the faunal remains, with a higher diversification in animal husbandry and consumption patterns during this period. This study does to large extent confirm earlier studies and interpretations, but it is more substantial since it is based on a larger data set. Further, it reveals the complexity of the animal husbandry and the significance of animals for social identities during the Neolithic.

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The Neolithic house as a procurement, production and consumption unit

The case of the Late Neolithic at Çatalhöyük

Arkadiusz Marciniak

Abstract

The essay aims to discuss the pattern of acquisition, production, and consumption strategies applied by inhabitants of the Neolithic house by using high-resolution archaeobiological data. They provide a significant insight into the character and mechanisms of social change in the Neolithic, in particular in the light of hypotheses implying that significant social transformations in the Central Anatolian Neolithic involved a shift from the non-kin-based communal and collective organization to a more individualized mode of life, leading to the emergence of autonomous house units and individual farmsteads. These developments will be exemplified by sketching some changes taking place in the Late Neolithic at Çatalhöyük, Central Anatolia.

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Introduction

The house has played and continues to play a key role in Neolithic studies. It is usually debated in terms of its physicality, in particular size, architectural elaboration, monumentality, in-built structures, etc. The other dominant mode sees in the house a primordial cultural asset in creating and shaping Neolithic groupings. The nature and character of social entities inhabiting the house have been less intensively debated and often treated as unquestionable. Similarly, a range of actions aimed at physically maintaining the arguably family-based group, along with everyday activities performed in the house, were either treated as obvious and self-explanatory or left aside as uninteresting.

Recent developments in the social archaeology of the Neolithic provide a growing body of evidence indicating that social arrangements in subsequent periods were much more diverse and complicated than previously thought. These ranged from different forms of communal organization to nuclear and autonomous households inhabited by the kin-based family or extended family (Düring & Marciniak 2006; Hodder 2013). However, these claims are hardly based upon systematically analysed datasets; they extrapolate individual observations to larger processes and are not satisfactorily justified. This lack of in-depth understanding of a complex nature of social groupings in the Neolithic is largely due to excessive focus on monumental architecture and burial practices, which, important as they are, cannot possibly deliver firm and solidly grounded evidence to grasp the character of these pivotal social developments.

Hence, the chapter aims to focus on the Neolithic house as the unit of acquisition, production, and consumption. The recognition of these variables provides important insight into the nature of social groupings inhabiting the house and ultimately the nature of social changes in the Neolithic. These goals are now more achievable than ever before due to significant methodological advancements in Neolithic studies. These comprise integrated studies of the settlement micro-stratigraphy, often linked to the application of Bayesian modelling, the recognition of formation processes, and advanced scientific methods including stable isotopes, lipids and aDNA on a wide range of materials from systemically sampled contexts.

The aim of the chapter is to discuss the significance of the mode of acquisition, production, and consumption for understanding social changes in the Neolithic. This will be exemplified by the analysis of their character in the Late Neolithic house at Çatalhöyük, central Anatolia, as revealed by the results of high-resolution archaeobiological data. The observed changes in the house's existence will be scrutinized vis-à-vis a hypothesis implying the beginning of individualized social organization in the Late Neolithic at the expense of its communal character in the preceding period.

The transformative character of changes at the end of the Neolithic at Çatalhöyük

The site of Çatalhöyük is located on the Konya Plain in southwestern Turkey. According to the chronological scheme of James Mellaart (1967), it was occupied in 13 distinct horizons labelled XII to 0. The sequence as a whole can be dated to approximately 7100–5950 cal. BC (Bayliss *et al.* 2015; Cessford 2005; Marciniak, Czerniak 2007; Marciniak *et al.* 2015a). The early levels, defined by Mellaart as Levels XII–VI, are dated to the Early Neolithic. A major shift arguably occurred in Level VI around the middle of the 7th millennium cal. BC, and the following period is known as Late Neolithic.

Recent dynamic studies of the Near Eastern Neolithic provide ample evidence of significant changes in social and religious domains in the Late Neolithic (e.g. Düring & Marciniak 2006; Marciniak & Czerniak 2012; Hodder & Pels 2010). The Early Neolithic groups were believed to live in clusters of approximately 30 to 40 individual buildings, constructed directly adjacent to one another. The superimposed houses were constantly reused and reoccupied through centuries, indicating the sustainability of this social organization. The group buried their dead underneath the house floor and platforms. In some buildings, as many as 70 individuals were interred. The Early Neolithic house was pretty standardized. It was built of mudbricks and had neither windows nor doors. It was accessed from the roof in its southern part, which also served as a chimney It had one main room, usually divided into two parts. Its southern part had hearths and ovens and served for everyday activities, including manufacturing, tool making and food preparation. The northern part had platforms along the walls under which fully fleshed bodies were interred. The walls, platforms, and floors were systematically plastered over and the walls were often decorated. The house often had one or two side rooms used for storage (Hodder 2006b).

The spatial arrangements of buildings, along with asymmetric distribution of art, burials, and paraphernalia, indicate that individual houses were distributed amongst the members of the neighbourhood community rather than owned by specific families (Hodder 2006a). Evidence for units occupying discrete residences in which they performed most of their domestic activities is problematic. Moreover, individual clusters appear not be kin-based but made up of genetically unrelated people, as revealed by dental phenotypes of those buried underneath house floors (Pilloud & Larsen 2011).

However, the nature of this non-kin-based communal and collective organization of the Early Neolithic groups is difficult to grasp. One viable possibility implies a clustered neighbourhood (Özbaşaran 2000). Individuals inhabiting neighbouring houses were characterized by a considerable identity and differed from similar contemporaneous groupings. Hence, a single house served the needs of such a community rather than of a specific family. Individual houses possibly retained some autonomy, as implied by remains of domestic activities in a majority of them. Acquisition, production, and storage were organized by the group. The other possible interpretation indicates a "house society" (see Borić 2008, Gonzalez-Ruibal 2006). Following the original idea of Lévi-Strauss, the term "house" refers to larger entities beyond a lineage or extended family and inhabited by ever-moving individuals and social groupings. Hence, they might have been occupied by hereditary occupants, their cognates, agnates, and non-related individuals (see Gillespie 2000). They performed the production, everyday tasks, and ceremonial activities in and around multiple houses (Souvatzi 2008).

The demise of communal organization certainly had far-reaching consequences for the Neolithic mode of life. As indicated by a growing body of evidence, it was replaced by more individual and heterogeneous arrangements, which eventually led to the emergence of autonomous house units and individual farmsteads (Byrd 1994; Düring & Marciniak 2006; Marciniak & Czerniak 2007; Marciniak 2008). It became a locus of a more independent and more self-sufficient social group. These changes are inferred by transformations in house architecture, spatial organization, and burial practices. Houses were no longer placed in clusters; they were much larger and composed of a number of units around a big living room. Burials were no longer placed underneath the floor and the platforms. Further developments in the regional scale involved the occupation of different ecological zones, the emergence of numerous sites of different size and decreasing house size, all of which indicates the presence of a dynamically developing local population (Düring & Marciniak 2006; Marciniak & Czerniak 2012; Marciniak 2008).

These significant social changes may not have remained without consequences for subsistence practices. One would expect that the processing of plant and animal products by inhabitants of these increasingly more autonomous households became specialized and intensified while procurement, production, and consumption-related activities became individually controlled. As recently argued by Hodder (2013), a "techno-economic complementarity" was increasingly achieved. Unfortunately, the economy and subsistence of these groups have hardly been recognized to date due to a lack of solid empirical studies of a range of materials from individual houses. A fine-grained approach to their study, advocated in the current project at Çatalhöyük, provided access to the character of procurement, production, and consumption strategies of these groups. I would argue that they provide much more solidly grounded insight into the character of the group's activities than the building architecture. This will further contribute to an in-depth understanding of broader social changes in that period.

The Late Neolithic house at Çatalhöyük

The results of the recently completed excavations of the upper strata at Çatalhöyük carried out in the TP Area revealed a significantly different character of houses in the last 350 years of the settlement occupation. They were much bigger and made of a series of small, cell-like spaces surrounding a larger central "living room" with no symbolic elaboration. They no longer formed neighbouring clusters. Houses lacked intramural burials, which were replaced by a special burial architecture (Marciniak and Czerniak 2007, 2012).

Most houses in the TP sequence were occupied for one generation only. This challenges an admittedly largely speculative estimation of 60–70 years as the average life of the house. Instead, houses in subsequent generations may have shifted across the neighbourhood area, which implies that the sequential development of superimposed clusters of dwellings ceased (Marciniak *et al.* 2015a).

Altogether, four solid houses, one light structure and one open space made up a roughly 350-year long occupational history in the TP Area. The most distinct category of houses comprise a large and carefully designed dwelling structure (B.81, B.62 & 61). All three of them had similar size, internal layout, and distinctive solid floors made of white pebbles, which appear only in the final centuries of the mound occupation. They were constructed at the beginning and the end of the TP Area's stratigraphic sequence and separated by a solidly built house (B.74), light dwelling structure (B.73) and open space (B.72) (Marciniak *et al.* 2015a).

The oldest Late Neolithic house in this area was Building 81, which went out of use around 6300 cal. BC (see details of chronology of subsequent occupational events in Marciniak *et al.* 2015a). It was an approximately 70 m^2 structure with only one fire installation and platform. It was reconstructed a number of times. The uppermost floor was made of numerous white pebbles mixed with silt. No individuals were interred in the building. The walls were not preserved, implying a lack of deliberate infilling. A very similar structure (B.62) was constructed after only about 160–170 years in the very same area (Fig. 1). It was built on the midden and infill deposits making up the open area. It lacked any inbuilt features except for the centrally placed square oven built directly above one of the fire installations from the preceding open space. The walls were also not preserved, indicating a lack of a deliberate abandonment practice. B.62 was used for a single generation. Immediately after its abandonment around 6120 cal. BC, the almost identical B. 61 was erected in this very place. Similarly to their predecessors, it was reconstructed a couple of times. The latest floor was made of white pebbles set into a solid calcareous matrix. The building was almost devoid of any internal features except for a square oven placed in its central part. It also did not have standing walls, indicating that it was not backfilled following its abandonment.

Fig. 1. Çatalhöyük East, TP Area, Building 62. Photo: Jason Quinlan.

The period of some 160–170 years between the abandonment of Building 81 and the construction of Building 62 witnessed different occupation. Building 74 was built shortly after the abandonment of B.81 (Fig. 2). It was significantly smaller (approx. 47 m^2) than its predecessor and was composed of four distinct rooms built piecemeal and without internal features. In contrast to all three large buildings described above, it was deliberately abandoned and backfilled. It appears to be the very last time that this distinctively Early Neolithic practice was performed at the settlement. The following dwelling structure, Building 72, was built directly above B.74 immediately after its demolition. It repeated its size, shape, and internal layout. It was composed of an open space to the north, probably surrounded by walls, and a hut-type construction, with a light roof, to the south. The open space was intensively used, as

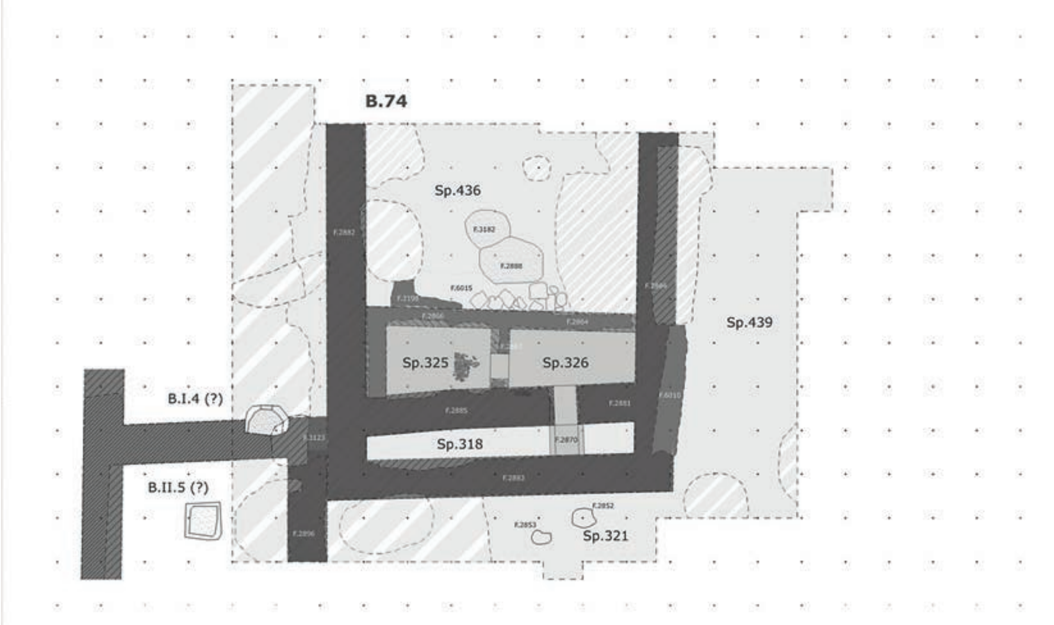

Fig. 2. Çatalhöyük East, TP Area, Plan of Building 74. Drawing: Marek Barański.

indicated by numerous hearths. This character of occupation continued in the next phase. The area became an open space on the accumulating midden (B.73). However, it appears to have been occupied, at least temporarily, as implied by five fire installations. When the open area went out of use, a solid B. 62 was built.

Changes in the house layout and its use are indicative of a continuous transformation of the Çatalhöyük community that began around 6500–6400 cal. BC (Marciniak and Czerniak 2007, 2012). They involved a gradual disassociation of domestic, ritual, and burial domains, previously integrated with the house premises. This in turn redefined regimes of acquisition, production, consumption, and reproduction performed by the differently organized social entities inhabiting the house.

Procurement, production, and consumption in the Late Neolithic house at Çatalhöyük

Intensive studies of a wide range of datasets unearthed in the TP Area make it possible to formulate some preliminary results as regards the regimes of procurement, production, and consumption of groups inhabiting different types of houses in the final centuries of the settlement occupation (see more Marciniak *et al.* 2015b). Some of them will be discussed here.

The Late Neolithic marks a significant change in clay and wood procurement strategy. Çatalhöyük is located on the Çarşamba alluvial fan formed by the eponymous river as it enters the Konya plain from its southern fringes. As argued by Doherty (2013), an Early Neolithic landscape was made of small streams connecting numerous shallow pools. The dark backswamp clays, carefully sourced from the thicker deposits that formed the Pleistocene channels around the mound, were used for mudbrick production. The Late Neolithic brought about a shift to the exploitation of redeposited fine colluvium located directly around the settlement as well as lower alluvium areas (shallow pools) in between drier grounds. Backswamp clay as well as marl and Pleistocene deltaic sediments were no longer exploited.

Even more pronounced changes occurred in wood procurement, as recognized by study of in situ preserved charcoal across the settlement (Asouti 2013b). The beginning of Early Neolithic is characterized by a dramatic rise of deciduous oak and later juniper charcoal values. Both trees comprised an important element of diverse semi-arid woodlands on the lower upland zone and the hills surrounding the Konya plain 25–30 km away from the settlement. The collection and transport of a large volume of timber to the site entailed considerable logistic complexity and probably involved combined efforts of larger social groups.

The wood procurement strategy changed completely towards the end of the Çatalhöyük occupation. The significance of oak and juniper declined radically and they were replaced by the narrow range of riparian taxa including elm, ash, hackberry, and Salicaceae. This may represent the switch of wood-gathering activities from the surrounding uplands to the locally available riparian vegetation. Long-distance trips aimed at procuring these resources were abandoned. This pattern is unrelated to climate-induced changes in woodland composition and oak and juniper availability and can only be explained by changes in the fuel and firewood economy of the site (Asouti & Heather 2001). As revealed by the Eski Acigöl pollen record (Roberts *et al.* 2001), both oak and juniper did not disappear from the lower upland zone at that time. This strictly localized wood procurement strategy in the Late Neolithic, replacing spatially extensive subsistence procurement systems in the preceding period, is indicative of a full-scale wood management pattern, in terms of territory definition and possibly also allocation of land use rights (Asouti 2013b).

In more general terms, changes in clay and wood procurement strategies between Early and Late Neolithic can best be characterized as a shift from exploiting high-quality resources derived from selected parts of landscape and requiring joint communal efforts at the expense of a wide range of poorer quality resources closer to the settlement as a means of meeting the needs of smaller groups.

A shift in production strategies between Early and Late Neolithic is well manifested in sheep husbandry and herd management practices, as revealed by studies of oxygen isotopes in sequential intra-tooth enamel samples and dental microwear on the occlusal surface of the same teeth (Henton 2012). Early Neolithic husbandry was characterized by a standard May birth season of sheep, which is in synchrony with optimal resources in the region. It further involved long-distance sheep herding and reliance on winter pasture, as indicated by dirty and later dry fibrous foods. The Late Neolithic husbandry was of a largely different character. It is manifested by a shift in sheep birth to March taking the breeding herds out of synchrony with resources. Keeping young lambs close to growing crops, however, is arguably more convenient for mixed farmers. This significant change implies that arable resources and fodder availability were now satisfactory to overcome losses arising from breaking natural resource synchrony. Equally significant were changes in pasture location in the Late Neolithic. They involved summer herding on the plains or in nearby river valleys while longer-distance herding remained minimal. This is another manifestation of integrated arable economy. This shift to exploitation of the areas adjacent to the settlement was only possible because the farmers were able to keep animals during winter, as indicated by the increase in soft food in the form of fodder. Changes in sheep husbandry in the Late Neolithic – involving a high degree of arable/pastoral integration and dependence, which required a range of advanced managerial skills, such as controlling the breeding cycle, keeping herds near growing crops, and providing dry fodder – required flexibility and integration in labour scheduling, which could have possibly been achieved by a more fragmented household-based society (Henton in press).

The Late Neolithic at Çatalhöyük brought about equally significant changes in consumption and display modes. It became largely idiosyncratic and diverse, as compared with the highly structured and repetitive mode in the preceding period. Timber in the Early Neolithic was consumed in the structured way. Vertical juniper posts were used for fittings set against the walls that might have served some symbolic and/or decorative purpose, lacking an obvious structural function. A diverse woody flora was utilized as fuel, including a significant component of oak, used also as timber. Changes in the Late Neolithic involved a shift to the narrower range of riparian taxa. It was accompanied by changes in architectural practices and construction techniques which, unrelated to wood availability, were less timber-dependent than the preceding period (see Asouti 2013a, 2013b).

The consumption of animal products also witnessed important changes. The Early Neolithic is characterized by significantly different consumption of cattle vis-à-vis sheep/goat. The former was of special significance and mainly used for ceremonial purposes, as manifested by feasting debris and bucrania set for the decoration of the house interiors. The latter were used for ordinary food consumption; their bones were by far the most abundant faunal remains found in middens and fills used as a primary location for dumping consumption debris. Special treatment of cattle was significantly less common in the Late Neolithic. No plastered bucrania were recorded, and the age and sex distribution is now dominated by females and more subadults, which appears to indicate a genuine shift. Overrepresentation of adults in sheep/goats mortality profiles may indicate changes in herding practices and a switch to the use of dairy products (Twiss *et al.* 2005).

Final remarks

As very briefly sketched in this chapter, the application of a wide range of high-resolution archaeobiological data made it possible to recognize the procurement, production, and consumption pattern in and around the Neolithic house. As these activities are at the core of any group's existence, this should potentially contribute to an in-depth understanding of the character and mechanisms of major social change in the Neolithic, in particular the demise of communal organization and emergence of a more individualized mode of living.

As the presented examples have amply shown, changes in the procurement strategies between Early and Late Neolithic involved a shift from the exploitation of high quality resources from selected parts of landscape at the expense of diverse resources of poorer quality closer to the settlement. This is particularly evident in a shift to summer herding in areas adjacent to settlement at the expense of longer-distance herding. This move facilitated easier access to fodder and triggered the practice of keeping animals in the house compound during winter. Similar changes occurred in consumption, moving from a highly structured and repetitive pattern to a more diverse mode.

The recognized changes in the procurement, production, and consumption pattern provide valuable insight into the nature of a major change in the course of the Neolithic involving a shift from some kind of communal organization (house society, neighbourhood community) requiring collective labour to more autonomous house units performing individualized and diverse activities. Life in the Early Neolithic was concentrated in and around clusters of elaborated houses that were set to establish historical and ritual ties. These large groupings organized acquisition, production, and possibly consumption. This typically Neolithic system came to an end some time after the middle of the 7th millennium cal. BC and were gradually replaced by smaller, less permanent and more self-sufficient houses. They initially developed as an intrinsic component of the Early Neolithic neighbourhood system and eventually contributed to their demise.

This process may have ultimately led to the emergence of individual farmsteads controlling storage and production. They appeared to become self-sufficient, shorter term, and more focused on consumption and the control of production (Souvatzi 2008) and increasingly more efficient in managing their own resources and inter-relations. Inhabitants of the emerging households had to accommodate the higher level of managerial and organizational skills in arable and husbandry-related activities. This increased autonomy of the household, along with the dominance of a domestic mode of production and consumption, contributed to a durable and successful economy in which crop and livestock husbandry were closely integrated and intensively managed. The increasingly more pronounced household ownership and autonomy may itself be linked to more intensive use of animals and plants. The ultimate outcome of these processes, as revealed by anthracological studies, were riparian woodlands around the settlement being converted into completely managed and distinctly anthropogenic habitats.

These significant changes provided solid foundations for large-scale developments far beyond the settlement or even the region. A largely homogeneous landscape exploitation in the Early Neolithic were fragmented and replaced by its differentiated use. More importantly, they provided necessary conditions for the appearance of strong, self-efficient, and flexible agricultural communities occupying a range of different ecological settings. Hence, it is possibly not surprising that these significant social changes in central Anatolia coincided with the spread of farming into adjacent areas. Paradoxically, the very foundations of this process have never been thoroughly and systematically scrutinized. Hence, explicit and fine-grained studies of practical and mundane aspects of dwelling in the Late Neolithic house can provide significant insight into this fundamental social change in the Near Eastern and European Neolithic.

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Burial in the Swedish-Norwegian Battle Axe Culture: questioning the myth of homogeneity

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Abstract

Archaeologists are caught in the force-field between the particular and the general. An example of this dilemma can be seen when we examine how burial customs in the Swedish-Norwegian Battle Axe Culture have been described. Mats P. Malmer emphasized the general in his extensive study *Jungneolithische Studien* from 1962. He measured and described the evidence and applied numerous quantitative and statistical manipulations to arrive at a picture of normal (in the statistical sense) behaviour. Although examples of investigations of Battle Axe Culture burials which emphasize the particular over the general do exist, Malmer's picture of homogeneity remains largely unchallenged. The aim of this short presentation is to examine the evidence from the currently known Battle Axe Culture burials in Scania in regard to Malmer's postulate of homogeneity. In many respects the results confirm Malmer's conclusions, while in others our new data and/or a different analytical approach call for a redefinition of some of the postulates.

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Introduction and aim

ARCHAEOLOGISTS ARE CAUGHT in the force-field between the particular and the general. An example of this dilemma can be seen when we examine how burial customs in the Swedish-Norwegian Battle Axe Culture have been described. Mats P. Malmer emphasized the general in his extensive study published in 1962. *Jungneolithische Studien* was a definitive work in which he attempted to collate all known empirical evidence for the Swedish-Norwegian Battle Axe Culture. He measured and described the evidence and applied numerous quantitative and statistical manipulations to arrive at a picture of normal (in the statistical sense) behaviour. Thus, although he acknowledged anomalies, his primary aim was to discover patterns and regularities in the empirical record. Malmer's approach, emphasizing the general over the particular, was typical for the movement which came to be known as processual archaeology. Scientific method, hypothesis testing, and the use of quantitative and statistical methods characterized this approach. In their analyses of Battle Axe Culture burials, Christopher Tilley (1982) and Helena Knutsson (1995), who used an approach characterized by compilation and analysis of statistical data, can be said to comprise further examples.

The reaction to this, which came to be known as post-processual archaeology, espoused emphasizing the particular over the general. Looking again at studies of Battle Axe Culture burial, During (1989) and Berggren & Brink (2010) are two examples using this type of approach. Ebba During carried out an osteological analysis of three of the burials from the Lilla Bedinge cemetery. Her analysis illustrated the highly complex nature of the burials and yielded a picture of great variety in burial practices. Archaeologists Åsa Berggren and Kristian Brink applied a practice perspective in their analysis of three Battle Axe Culture burials from the Malmö area in 2010. Through detailed study of each aspect of the material record they were able to suggest the order of events involved in the funerary rituals for these burials. Such an approach allows us to understand complexity and variation in burial practices; variation which undoubtedly was significant for the people who carried out the ceremony (Berggren & Brink 2010, p. 293).

In spite of the exceptions described in the preceding paragraph, I maintain that Malmer's weighty tome from 1962, with its emphasis on homogeneity, still influences our understanding of the Swedish-Norwegian Battle Axe Culture (cf. Larsson 2003, p. 155). Malmer himself remained true to the tenants of his book throughout his career, as is evident in his discussion of the Battle Axe Culture in *The Neolithic of South Sweden. TRB, GRK, and STR* (Malmer 2002), published five years before his death. Here he writes: "The professionally investigated or otherwise well documented grave finds nevertheless paint an unambiguous picture of strictly regulated, conservative burial customs, …" (Malmer 2002, p. 137).

The aim of this short presentation is to examine the evidence from the currently known Battle Axe Culture burials in Scania in regard to Malmer's postulate of homogeneity. If we focus on variation rather than similarity when we look at the whole population, we can search for correlations which may enable us to find new aspects of the norms of burial practice but at a finer level of detail. Recent archaeological activity provides an augmented empirical basis for testing Malmer's conclusions and osteological analyses have provided new information on e.g. age and sex of buried individuals (Johanson & Mårtensson 1976; Persson 1976; During 1989; Arcini 1990; Jantsch & Ranåker 2001) and isotope analyses can shed light on dietary and health issues (Lidén *et al.* 2004; Fornander 2013). In most cases I will use Malmer's postulates as my starting point.

Methods and material

I have compiled a database of burials containing skeletal remains in Scania ascribed to the Battle Axe Culture. Information has been culled from published sources, the most important being Malmer 1962; 1975; 2002; Winge 1976; Edenmo 2000; Lagergren 2008; Brink 2009; Berggren & Brink 2010; and Fornander 2013. In cases with bones from multiple individuals in one grave I have listed each individual as one case. Cases from Malmer's original list (1962) where a single artefact is considered to represent a burial are not included. The database contains 144 examples of graves containing bones interpreted as one individual; 105 of these are listed in Malmer (1962). Finds included are only those found in association with the buried individual(s); finds in the filling are not included. Grave structures were not included in the analysis.

Burials are located in most of Scania with the exception of the northwest quadrant, see Fig. 1. Of the 56 burials which could be archaeologically dated, four belonged to Malmer's period 3, 24 to period 5 and 28 to period 4 or 5. Organic material from 23 burials has been radiocarbon dated. The earliest C14 date is 4540 ± 35 BP (N. Hyllievång A14169; Ua-33977; Brink 2009, p. 175) and the latest is 3730± 50 BP (Vellige, RAÄ 17; Ua-5361; Söderberg 1990).

Number of individuals in the burial

Malmer defines the most common type of Battle Axe grave in the following way:

Fig. 1. Map of Scania showing the distribution of the burials in the database.

> Flat-earth graves containing one or two skeletons in flexed position together with objects belonging to the Battle Axe Culture, either lacking a subterranean structure or with such a structure consisting exclusively of unworked stones with an average length of 20 to 40 cm (Malmer 1975, p. 35; my translation).

As Malmer points out (1975, p. 35), the definition contains an element of circularity because only burials containing material culture identified archaeologically as belonging to the Battle Axe Culture will be placed in this category. Table 1 confirms that single burials are by far the most common form in Scania. However, they are not unique; six burials contain two individuals and at least four contain more than two.

Kastanjegården Anl. 105 contained the remains of a woman whose age at death was 30 years and two children aged 5–7 years. They were laid in what was interpreted as the remains of a wooden coffin. Two pots, seven amber beads, one flint axe, four flint blades, two scrapers and five flint flakes were found in association with the skeletal remains (Winge

Table 1. Number of individuals per burial, in those burials where traces of skeletons permitted a determination.

Number of individuals	Number of cases
One individual	57
Two individuals	6
More than two individuals	4
Total	67

1976; Johanson & Mårtensson 1976; Persson 1976; During 1989).

Burial 8184 at Dösjebro appears to have contained three to four individuals, including a child. Gravegoods were comprised of four pots, two battle axes, three flint axes, four flint blades, four amber beads and an amber ring (Lagergren 2008, pp. 100 ff.).

Lilla Bedinge grave 49 contained the remains of three adult males and two infants. The males were placed in a sitting position and the children lay between two of the adults. The only gravegood consisted of a bone needle. Malmer suggested grave 49 represents remains from a human sacrifice (Hansen 1934, pp. 142 ff.; Malmer 2002, p. 141).

A burial at Uppåkra attributed to the Battle Axe Culture contained a cranium from an adult and teeth from two children (Söderberg & Pilz Williams 2012, p. 43).

Body placement and position of the face

Malmer maintains that there were strict conventions for body placement in single and double graves. According to him, the deceased is always buried lying in flexed position on his/her side with knees drawn up, and the face of the deceased always faces east, never west (Malmer 2002, p. 139).

Body placement could be determined for 52 individuals. Certainly this study corroborates that the crouched posture was preferred, with 81% in this position. However, six of the individuals (12%) registered in the present study were placed in a supine position in the grave and four (7%) in a sitting position. Three of the seated individuals are from the same burial, Lilla Bedinge grave 49 (Malmer 1962, p. 163).

The direction the individual was facing could be determined for 44 individuals in the database. Thirty-four of them (77%) were facing

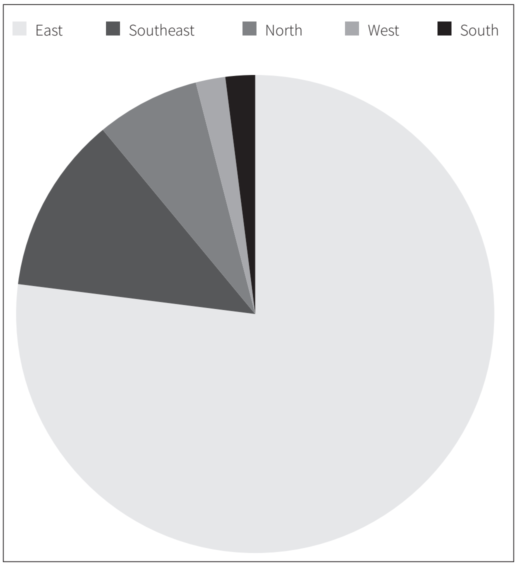

Fig. 2. Position of the face for 44 individuals.

east, five were facing southeast, three were facing north, and two were facing west and south, respectively (Fig. 2). The conclusion here is that regarding both body placement and position of the face, Malmer's observations are true in the majority of cases; however, some deviation was apparently permissible.

The relationship between the biological sex of the individual and other burial characteristics

In the absence of biological sexing of individuals in burials, Malmer proposed a hypothesis stating that weapons signify male burials while jewellery signifies females. He defined weapons at battle axes, antler daggers, pointed antler weapons, and projectile points. As confirmation for his hypothesis he lists the artefacts accompanying three osteologically sexed individuals. In grave 185, Linköping Bergsvägen, the male was associated with a battle axe and an antler dagger, the female with jewellery made of amber, copper, or bone. Grave 53 at Lilla Bedinge contained a biologically determined

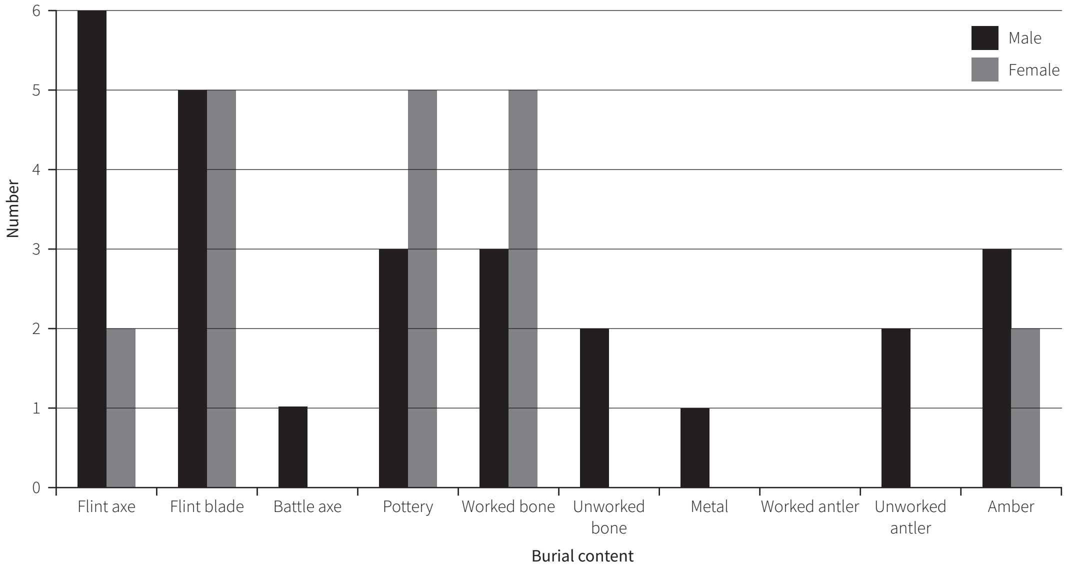

Fig. 3. Burial content for osteologically sexed individuals.

male accompanied by a pointed antler weapon. Further confirmation, according to Malmer, is that both weapons and jewellery never occur in association with the same individual (Malmer 1962, pp. 219 ff.; 2002, p. 141). Pottery, bone awls, flint blades and scrapers, and unworked bone can occur in association with both males and females. This is also true for flint axes, but they are more common in male burials, according to Malmer (1962, pp. 221 f.). Knutsson's statistics, where the individual's sex was determined by osteology or by grave content, indicated that battle axes only occur in male burials, but that jewellery can be found in both male and female burials (Knutsson 1995, p. 193).

Although Malmer does not identify principles governing the relationship between sex and body position, a consensus regarding this relationship is evident in published accounts. This dictates that for individuals placed in flexed position, those lying on their left side are males, while right side indicates females (Andersson *et al.* 1995, p. 34; Knutsson 1995, p. 193; Olausson 2000, p. 36). However the rule of thumb rests on shaky empirical ground, as the sex determinations cited are in some cases osteological but in others based on grave goods.

Today osteological sex determinations are available for 18 individuals from Battle Axe burials in Scania; 11 males and seven females. Are the above postulates confirmed if we use only osteologically determined sexing?

The battle axe, sometimes considered the symbol of masculinity *par excellence*, occurs in only one osteologically sexed burial in the database, a male. Data concerning the total contents of osteologically sexed burials are shown in fig. 3. Pottery occurs in association with three males and five females. Flint blades have been found in association with five male and the same number of females. Unworked bone was associated with two male individuals, while bone awls (worked bone) were found in association with three male skeletons and five females. These data all confirm Malmer's hypothesis. However, amber beads were pres-

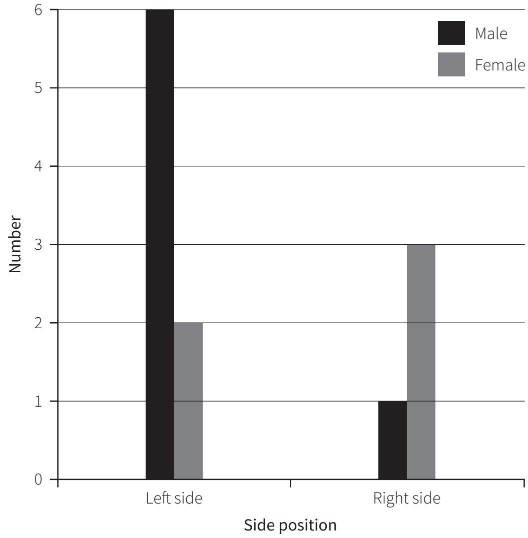

Fig. 4. Side position, when known, of osteologically sexed individuals. Twelve individuals total.

ent in three male burials as well as two female burials, in contradiction to his model which predicts that jewellery will only be present in female burials. In conclusion, for all variables except amber beads, Malmer's predictions for preferences in grave goods included in male or female burials, respectively, are confirmed even when only osteologically sexed individuals are considered.

The rule of thumb regarding a relationship between biological sex and side position is not corroborated when strictly osteological sexing is applied, however. Fig. 4 shows the side position for 12 of the 18 sexed individuals. Six of the eight individuals placed on the left side are males, as predicted, but two are females. Nor is there 100% correspondence between female sex and burial on the right side.

Battle Axe burials in dolmens and passage graves

In his original publication (1962, Tab. 32), Malmer quantified the presence of Battle Axe artefacts in association with megalithic tombs. Although much of the contents of these tombs is poorly documented, he nevertheless concluded that Battle Axe culture was present in a very large number of them (Malmer 1975, p. 50). Malmer suggested that Battle Axe artefacts associated with the tombs should be interpreted as burial remains, although he also pointed out that we lack examples of undisturbed Battle Axe burials in any megalithic tomb (Malmer 1962, pp. 246 ff.; 2002, p. 143). The evidence is ambiguous, since the contents of the tombs have been disturbed, destroying any contextual information which may have enabled us to identify burial activity. In a recent article (Olausson 2014) I have published the results of a re-examination of the evidence from Scania. I concluded that there is little convincing evidence that the artefacts found in and around megalithic tombs are remains of disturbed Battle Axe Culture burials. Rather, I suggest that in most cases the finds can be ascribed to ceremonial behaviour not necessarily related to mortuary practices, perhaps in connection with ritual destruction (Olausson 2014).

Interment vs. cremation and human bones outside of the primary grave

The typical burial form for Battle Axe Culture is interment, according to Malmer (1975, p. 35). However, he also describes six possible cremation burials, one of which lies in Scania: Västra Hoby 15 (II). This was one of four BAC burials lying in a linear arrangement but it was somewhat damaged before Hansen arrived in 1916, making the contextual information difficult to interpret. Hansen first suggested that the cremated human remains belonged to an Iron Age secondary burial intruding into the BAC burial (Hansen 1917, pp. 77 ff.). However, in his 1937 article he revised this interpretation in light of subsequent finds of cremation burials from the Late Neolithic, suggesting that the cremated bones, Battle Axe pottery and burnt flint axe belonged to a Battle Axe burial (Hansen 1937, pp. 206 f.). In his discussion Malmer commented that most aspects of the burial context in which the cremated bones were found, such as the size and shape of the pit, the stone packing, and the position of many of the gravegoods, follow the typical BAC pattern. His conclusion, however, was that it is unlikely that the cremation is a Battle Axe Culture burial. In support of this he cited the other 200 known Battle Axe Culture burials, none of which contain cremations (Malmer 1962, pp. 227 f.). Here again he emphasizes homogeneity over difference.

Lilla Bedinge grave 47 represents a radical departure from the single burial norm as described by Malmer. Osteologist Ebba During subjected the remains to intensive scrutiny, allowing us to understand some of the complicated practices carried out. She identified the remains of at least 10 individuals in connection with the grave. The primary burial contained a supine female whose age at death was 19. Her left humerus was shorter and less robust than her right and both fibulae had osteitis. Three skull fragments and one wisdom tooth from an adult were also found in the primary grave. On and above a stone packing overlying the primary burial lay a collection of human bones. Five crania were also part of the inventory (During 1989; Malmer 2002, p. 141).

In a recent article, Åsa M. Larsson reported on a search for examples of secondary burial practices in the Middle Neolithic (Larsson 2003). She describes the V. Hoby case but also mentions one other possible example from Scania at Löderup 15 no. 78. Here a hearth containing burnt human and animal bones and possible BAC potsherds was found in a feature containing a wooden cist (Larsson 2003, p. 157). She has not limited her search to features interpreted as graves, however. The so-called mortuary house excavated at Turinge parish in eastern middle Sweden is attributed to the Battle Axe Culture. The structure includes a trench with some 15 pits filled with charcoal, pottery, stone tools and cremated bones. Human bones from at least seven individuals of both sexes and all ages have been identified in the pits. The Turinge mortuary house is interpreted as a decarnation house where the bodies were stored before the bones were burned (Larsson 2003, p. 158, p. 161). While nothing similar to the Turinge mortuary house has yet been found in Scania, I mention it as an illustration of alternative treatment of human remains in BAC context.

It would appear from these examples that, once again, some deviations from what might have been regarded as normal practice were present. Indeed, given the limited number of buried individuals, it is obvious that other forms of post-mortem treatment were being practiced. Perhaps we should be applying more effort to finding evidence for them.

Finding what we are looking for

In the above discussion I have ignored both chronology and chorology and concentrated on the contents of the burials. The aim has been to test the validity of archaeologists' somewhat stereotypical view of Battle Axe Culture burial as rigid and formalized. Mats P. Malmer's definitions have been instrumental in forming our thinking about Battle Axe Culture burial. They are based on empirical examples but tend to emphasize homogeneity. Using his definitions causes us to ignore possible cases which fall outside them. In almost all cases classification as Battle Axe Culture relies on type fossils defined as BAC, so that burials lacking such objects will not be part of the data set.

Malmer emphasized characteristics which unite the burial practice; in this short article I have tried to dissolve some of the rigidity in order to investigate how much variation is present. In many respects the new data confirm

Malmer's conclusions, while in others our new data and/or a different analytical approach cause us to redefine some of the postulates. Confining sexing to osteological analysis of the skeleton, rather than using assumed cultural norms to sex burials, has shown that previous assumptions regarding a correspondence between left or right side and biological sex do not hold. Amber beads are associated with both males and females. A renewed look at Battle Axe presence in megalithic tombs in Scania failed to confirm Malmer's suggestion that tombs were used for burial by the Battle Axe Culture. While the majority of the skeletons have been placed in flexed position, there are also examples of placement on the back or in a sitting position. Interment in a pit containing a single individual is confirmed as the most common choice, but others are possible and there are examples of both burnt and unburnt human bones outside of the primary burial context.

Burials constitute expressive arenas for conveying social identity (cf. Berggren & Brink 2010, p. 274). Looking in more detail at how mourners have arranged the contents of the grave will reveal patterns which undoubtedly would have been significant to them. In such an analysis the particular as well as the general are of interest.

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A tale of the tall

A short report on stature in Late Neolithic–Early Bronze Age southern Scandinavia

Anna Tornberg

Abstract

Human stature as a measurement for evaluating physical status is used by the World Health Organization (WHO) as well as bioarchaeologists. The reason for this is that only about 80% depends on genetic factors, while 20% depend on the environment. Bad living conditions decrease stature in a population. This paper aims to make a short review of earlier reports on stature in Late Neolithic–Early Bronze Age Southern Scandinavia and to provide some new data. It is clear that stature in Late Neolithic–Early Bronze Age Scandinavia was very high, equal to modern statures.

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Introduction

IN RELATION TO the transition to agriculture in central Europe there seems to have been a decline in health (Meiklejohn *et al.* 1984; Papathanasiou 2005; Larsen 2006; Wittwer-Backofen & Toma 2008; Meiklejohn & Babb 2011; Mummert *et al.* 2011). There is no notable change within the south Scandinavian record (Bennike 1985) following this event. This is possibly linked to a different adaptation to agriculture (e.g. Richards 2003; Cramon-Taubadel & Pinhasi 2011; Isem & Fort 2012). However, there are interesting reports of indicators of good health, such as high statures in the Late Neolithic southern Scandinavia (Brøste 1956; Gejvall 1963; Bennike 1985), a time when farming should be seen as fully established and anchored as subsistence. One might speak of the Secondary Products Revolution (Sherratt 1981), when new ideas and technological innovations (i.e. using cattle also for milk and traction, not only for carcass products, and the use of e.g. ards) lead to the possibility to further benefit from the agricultural smorgasbord, giving more possible outcome (nutrition).

Human stature can tell us a great deal about health in a population, since it is affected by both genetic and environmental factors. About 80% of an individual's stature is considered to be genetic and about 20% is considered as dependent on environmental factors (Philips & Metheny 1990; Carmichael & McGue 1995), such as the amount of nutrition and diseases (Silventoinen *et al.* 2000; Carson 2011a; Carson 2011b).

Human stature is not a static, nor a linear matter through history, but has fluctuated through the ages, with high statures suggesting good physical status (Arcini 2003, pp. 56 f.). This can of course be dependent on genetic factors as well, but is shown to correlate well with poorer or better living conditions, with the highest statures at present (Arcini 2003, pp. 56 f; Statistiska Centralbyrån 2013). Stature, along with other anthropometrical parameters, is also used by the World Health Organization (WHO) as an indicator of physical status (WHO 1995), further emphasizing the strong correlation to human health. Stature adapts quickly to environmental factors and changes can be shown in matters of a generation (Silventoinen *et al.* 2000; Heijmans *et al.* 2008), therefore average statures over time can be used as a good health indicator, given that no large resettlements have taken place in the area of study, then being more affected by genetic factors.

New, interesting results are sometimes achieved by putting on retrospective goggles. This could be viewing old research with a new pair of eyes or examining old, forgotten, physical material, or both. Combining these two retrospective approaches can be used as a foundation for several new research focuses and serve as an overview of available data. The aim of this article is to gather both old and some new data for evaluating joint information about stature in the Late Neolithic as well as to discuss this data as a health parameter.

Methods for assessing stature

There are several methods for assessing stature in past populations. Most of them are based on calculations from long bones, but there is also a possibility to take measurements in the field. Measurements in situ at the excavation are preferable if possible and leave the least bias (Petersen 2005). In situ measurements, however, require extremely well preserved bones, since measurements are taken from above the highest point of the skull to the most distal point of the talus (ibid.), unfortunately making it impossible in most cases.

The most commonly used methods for estimating stature from skeletal remains are based on linear regressions, although through different mathematical formulae. One of the most commonly used methods is the one by Trotter and Gleser (1952, 1958). They made their model from measurements of deceased US soldiers from the Korean War. Their regression formulae are divided between Afro-Americans and individuals of European descent and could be calculated using all long bones, but preferably the maximum length of the femur. The long bones of the lower limb are more accurately linked to living stature than are the long bones of the arm regardless of regression model. The problem with the Trotter and Gleser model is that bioarchaeologists seldom analyse individuals from present populations. People from the south Scandinavian Neolithic and Early Bronze Age differ both in period of time and geographic location from the male soldiers being measured in the 1950s. Body proportions do differ between populations, and so there might be an advantage in using regression models that are non-dependent on population. Two models that are population-non-dependent and therefore suitable for assessing stature in unknown populations such as in the Neolithic or Bronze Age are presented by Sjøvold (1990) and Formicola (1996). In my research I primarily use Sjøvold's model for stature assessment, mainly due to the population non-dependency and a good reputation for the accuracy of regression, not underestimating the stature of short individuals or overestimating tall individuals.

There is no current standard for what method to use when calculating human stature. Different researchers have different preferences as well as having been professionally active in times with different methods in fashion. This could cause bias when data are compared and is one of the pitfalls when comparing research over a vast period of time. It is therefore crucial to be clear about what method is used, and also what elements have been measured. If this is done, any of the above methods may be applied. However, uncalculated measurements of long bones are generally preferable since they are easily compared and not affected by errors in any regression formulae. Because not all long bone measurements were available in the earlier publications referred to in this article, this option had to be ruled out, since comparisons between localities and publications thereby would have been unmanageable.

In this paper I will give values for the Trotter and Gleser model for Europeans as well as the Sjøvold non population-specific model. For the skeletons analysed by the author, maximum length measurements have been taken on all complete long bones. If present, the femur is used for calculating stature. If both femurs are measurable the mean of the measurements was used, otherwise the maximum length of the measurable femur was used (Arcini 1999).

Material

The available data concerning stature in Late Neolithic southern Scandinavia mainly come from three different sources, Kurt Brøste's book about prehistoric man in Denmark (1956), Nils Gustav Gejvall's analysis of the skeletal material from the gallery grave in Dragby, Skuttunge parish in central Sweden (1963) and Pia Bennike's dissertation about palaeopathology in Danish skeletons (1985). Brøste and Bennike analysed the same skeletal material, deriving from several localities in Denmark, though using different methods for calculation, giving somewhat divergent results. Therefore only Bennike's more modern results are used in this paper.

The new data of Late Neolithic and Early Bronze Age stature derives from the author's current research on diet and health in southern Scandinavia as well as from a pilot project conducted in the summer of 2011, also by the author (Tornberg 2013). The results are based on 18 individuals from Scania, southern Sweden, and consist of mound 1 in Abbekås, Skivarp parish (grave 4), which is dated by ^{14}C to the Late Neolithic (3600 ± 50 and 3585 ± 50 uncal. BP, LuS 10619 and LuS 10620) (Tornberg 2013), a secondary burial in a passage grave remade into a gallery grave of Öllsjö no. 7, Skepparslöv parish, flat-earth graves from Snorthög, Lilla Isise parish, dating to early Late Neolithic (c. 2200–2000 cal. BC) (UB-22849, UB-22853) and a gallery grave at Ängamöllan, Vä parish, dated to the Early Bronze Age (c. 1400 cal. BC) (UBA-23996, UBA-23999). Some re-measurements of the Dragby material, Skuttunge parish in central Sweden, previously analysed by Gejvall, have also been made and evaluated by the author.

Stature in the south Scandinavian Late Neolithic–Early Bronze Age – old and new examples

By summing up earlier data on the topic and renewing it with recent data, further insight as well as more empirical data are gathered in this paper, giving opportunities for further interpretations of general health.

Unfortunately, Swedish Late Neolithic data for stature are scarce in published literature. Gejvall (1963) analysed a Late Neolithic gallery grave from Dragby, situated in Uppland, central Sweden. He reported almost extremely high statures, with mean statures of 181.4 cm for males and 169.0 cm for females, the number of individuals being 21 (eight males and 13 females). It should be noted, however, that not only femurs could have been measured since not enough measurable femurs are available in the material – that is, if all of the original material was available for me and not lost in recent times. Because the material is commingled due to burial custom it is also problematic to assess each element to sex. It is therefore hard to sort out small males from large females, possibly biasing the results further. In my analysis of the Dragby material I found only seven measurable femurs, notably divided into three longer femurs and four significantly shorter. It is reasonable to believe that the three shorter and also more slender femurs originate from female individuals and

Table I. Mean stature in Scanian Late Neolithic.

Locality	No. Males	No. Females	Mean stature T&G (M)	Mean stature Sjøvold (M)	Mean stature T&G (F)	Mean stature Sjøvold (F)
Abbekås, mound 1	2	3	177 cm	176 cm	162 cm	163 cm
Öllsjö 7	2	0	178 cm	179 cm	-	-
Lilla Isie, Snorthög	3	2	177 cm	176 cm	164 cm	165 cm
Vä, Ängamöllan	4	2	179 cm	179 cm	161 cm	161 cm
Total	11	7	178 cm	178 cm	162 cm	163 cm

the longer, more robust femurs are those of male individuals. This is my assumption when discussing stature by sex in this paper further. Standardized metric sex determinations of the femoral head, as suggested by Garvin (2012, pp. 240 f., and references cited there) and recently by Spradley and Jantz (2011). have not been applied in this study due to current lack of references on postcranial metric sex assessments in Scandinavian Neolithic skeletal assemblages. My measurements when dividing the three longest femurs from the four shortest femurs in the Dragby material instead suggest mean statures of 175.9 cm for males and 167.3 cm for females using Sjøvold's model. That differs a great deal from the statures reported by Gejvall in the 1960s. Instead, the statures based on re-measurements correspond quite well to the Danish Late Neolithic, where Bennike (1985, p. 51) reports statures of 176.2 cm for males and 162.8 cm for females (50 males and 16 females, using Trotter and Gleser's model for the femur).

The new data from Scania indicate statures during the Late Neolithic similar to earlier investigations from Denmark and central Sweden. Table I shows the mean statures in whole centimetres in the different localities and as a whole. The table is divided both by sex and by regression formula. It shows that the mean statures are slightly different between the localities, especially considering female stature. The mean statures, 178 cm for males and 162–163 cm for females, correlate very well with the mean statures reported by Bennike (1985), even though the male statures in the Scanian example are a couple of centimetres higher. Both male and especially female statures are several centimetres shorter in the Scanian material than in the central Swedish material reported by Gejvall (1963). This discrepancy does not occur in my re-measurements of the same central Swedish material as already noted above, where the Dragby males have a mean stature of 175.9 cm instead of 181.4 as reported by Gejvall. This means mean male statures lower than in the Scanian and Danish Late Neolithic examples. However, the new measurements for female stature (167.3 cm) in the Dragby material confirm Gejvall's reported high statures (169.0 cm), significantly distinguishing them from female statures in Scania and Denmark (162–163 cm). The difference between Gejvall's measurements and my own is not significant and possibly a result of different regression formula. The mean statures are remarkably high, almost as high as in present-day Sweden, where mean statures are 179.4 for males and 165.7 for females (Statistiska Centralbyrån 2013). Only during the Early Roman Iron Age did the statures reach the same height as in the Late Neolithic (Arcini 2003, pp. 56f).

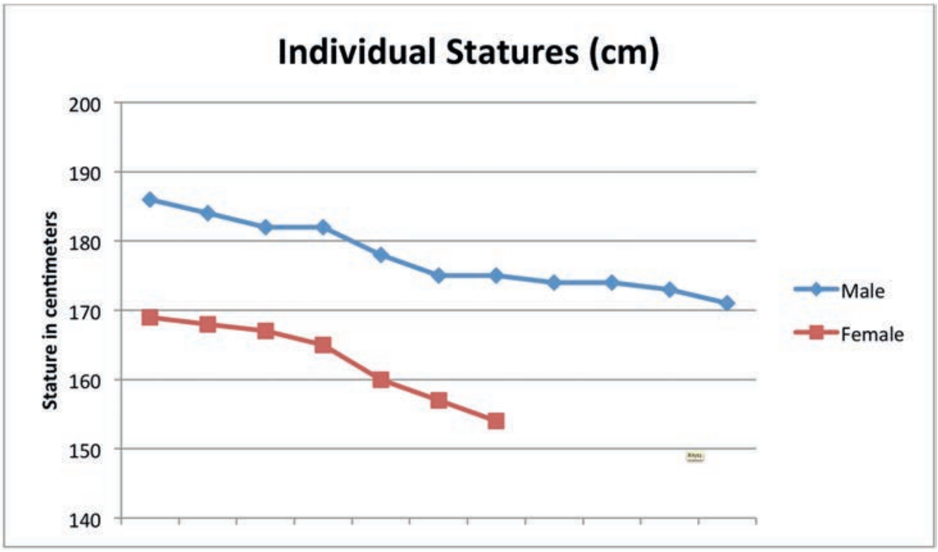

Fig. 1. The spread of individual statures in whole centimeters for males and females according to Sjøvold's (1990) model.

Naturally, the shortest and the tallest individuals differ from each other, both among males and among females (Fig. 1), the shortest and tallest male being 171 cm and 186 cm respectively and the shortest and tallest female being 154 cm and 169 cm. However, a majority of the male individuals are clustered in the span 175–180 cm and the females 165–170 cm. This is to be expected and is probably a hint of genetic variation.

Discussion

The aim of this article was in one part to gather both old and some new data regarding stature in the Late Neolithic and Early Bronze Age and in another part to evaluate and discuss this data in relation to health. The effort to join old and new data together is well spent considering the very sparse amount of data that has been present up to date. Some of the old data also needed revision through newer methods. It is unclear why Gejvall's reported statures differ so pronouncedly from my own calculations. I do not believe that this difference can be blamed on the use of different regression formulae, where Sjøvold's formulae actually give higher statures for tall individuals than that of Trotter and Gleser, nor do I think that Gejvall measured the bone incorrectly. What I do believe could be the cause is a probable inclusion of measurements of other long bones than the femur, known to give different, and also less reliable values for calculations. This also explains why Gejvall was able to find so many more measurable individuals than I could.

The need for more data is obvious but is increasing day by day. The effort is also well spent for evaluating Late Neolithic–Early Bronze Age stature in relation to health considering the very interesting data available. It seems conclusive that the stature of Late Neolithic individuals are high with means statures for males and females being approximately 178 cm and 162 cm respectively. This could be compared to Danish Middle Neolithic data where statures are 10–15 cm shorter for males and 10 cm shorter for females (Bennike 1985, p. 51). Both old and new investigations of Late Neolithic–Early Bronze Age skeletons suggest similar statures that all are almost as high as the present day. This is to be considered quite remarkable considering the welfare in western societies today. It is evident that something quite revolutionary happens in the Late Neolithic, providing one of the highest statures in human history.

Further, it seems clear that the high statures of the Late Neolithic/Early Bronze Age are not a local matter, but consistent over a larger area from central Sweden in the north to, at least, Denmark in the south. High statures and good health can probably be linked to a number of factors in society, not forgetting the rising knowledge and possession of metal and a possible agricultural intensification. New agricultural practices and technical innovations such as the ard, the labour from draught animals to pull it and perhaps the use of manure, made it possible to cultivate larger areas and thereby feed more people. Further, the genetic possibility to digest milk is also linked to an agricultural intensification and might be one reason for the high statures in the Late Neolithic, providing the growing population a good base for calcium and vitamin D, components proved to be closely linked to skeletal growth.

Recent studies of aDNA and lactase persistence (LP) suggest that the high ability to digest milk in Scandinavia is connected to the larger opportunity to survive starvation in history if one could do so (Sverrisdóttir *et al.* 2014). However, the question of where, when and how the LP gene occurred and spread is currently hotly debated and under research, but with results still quite inconclusive, with a variety of different indications (e.g. Bersaglieri *et al.* 2004; Burger *et al.* 2007; Enattah *et al.* 2007; Itan *et al.* 2009; Malmström *et al.* 2010; Vuorisalo *et al.* 2012). This theme also lay outside the area of research in this specific paper.

The possibility that changes in mortuary practices, with a higher degree of social stratification in the graves, are the reason for the increase in stature cannot be definitely excluded. However, it seems less likely since, in an ongoing study, I can find no evident difference in stature, or other parameters for evaluating physical health, between individuals inhumed in different grave construction during the Late Neolithic–Early Bronze Age. It is also possible, but maybe less likely, that the high statures are a result of large migrations and exchange of population, giving one with a new biological basis for stature. Even though it is highly probable that there was increased mobility during this period, an exchange of population finds little support in the archaeological record.

Of course more data are needed for interpreting health in the Late Neolithic and Early Bronze Age, regarding both stature and other health-indicating parameters. Still, current data show signs of good living conditions during the period. Certainly, investigations of human stature should be discussed in relation to archaeological and other bioarchaeological evidence when trying to address questions about subsistence and the impact on human health, which was beyond the scope of this article.

Investigating stature is only one method for discussing health status in a past population, although it is a very important one, giving information sensitive to change over shorter time spans. A large quantity of data is of absolute necessity and is insufficient at present. New data are being registered continuously making it possible to interpret the results from a more solid base and compare it to other health-indicating analyses, nuance and deepen the understanding of human health in the last part of the Stone Age and the first part of the Bronze Age.

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II. PERSPECTIVES ON MONUMENTS

Frydenlund – Early Neolithic settlement and “barkaer” structures in the Sarup area

Niels H. Andersen

Abstract

As part of the Sarup Project, an Early Neolithic site was excavated at Frydenlund, 2 km east of Sarup, revealing a settlement covering an area of about 1000 m^2, together with extensive finds dating from TN Ic, c. 3600 BC. On the settlement were the remains of one, or possibly two, houses of Mossby type which had been demolished and covered by two barkaer structures. One (structure A) comprised a large stone pavement, while the other (structure B) was a post-built enclosure standing in a trench. Both had a façade trench at their western gable, and in each of these stood three 90 cm wide planks thought to have extended as much as 7 m above ground level. In the middle of barkaer structure B was a plank-built cist containing diverse grave goods. The cist had been placed directly over the remains of a house which, shortly before, must have been demolished and removed. No burial feature was found in barkaer structure A, but several artefacts suggested some form of similar deposition. The large finds assemblage from the site is presently under analysis.

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In 1971, Moesgård Museum, in collaboration with Odense City Museums, began archaeological excavations on a sandy promontory near the village of Sarup in southwest Funen. These resulted in the uncovering of two causewayed enclosures in which post-built fences and system-ditches had framed areas of several hectares. The earlier of the two – named Sarup I – was established during the Fuchsberg phase, c. 3400 BC; i.e. the time when dolmens were constructed. The second enclosure – Sarup II – was established during the Klintebakke phase, when passage graves were built.

Following conclusion of the excavations in 1984, it was decided to initiate a series of landscape studies in order to understand the landscape in which these two extraordinary monuments functioned. The aim was to locate possible traces of contemporaneous settlements and megalithic monuments such as dolmens and passage graves. An area of approximately 3 x 4 km around the Sarup site was selected for the study, thereby including a range of landscape types such as the coastal zone, watercourses with wetlands and hilly terrain. Prior to the study, the only records from the area were of two scheduled megalithic graves, a dolmen and a stone cist, two damaged megalithic structures and a Neolithic settlement.

Since 1984, detailed reconnaissance of the area has been carried out, involving field-walking over cultivated fields, and private archaeological collections, often on farms, have been recorded and find sites noted. Maps of the area, both old and new, have also been examined (Andersen 2009). A 14 m series of cores was obtained for pollen analysis from sediments in the lake Sarup Sø by GEUS (the Geological Survey of Denmark and Greenland); 5 m of these sediments represented the Neolithic period (Rasmussen *et al.* 2002).

Hundreds of new sites were found and recorded around Sarup; of particular interest were the traces of 88 settlements dating from the Funnel Beaker culture and more than 100 demolished megalithic structures. Over the course of 17 excavation campaigns, investigations were carried out of parts of three settlements, 32 megalithic structures – some of which overlay the remains of settlements with house sites – and the Frydenlund complex, which will be dealt with in more detail below.

Frydenlund

About 2 km east of Sarup, on a horizontal plateau providing a commanding view over the Hårby river valley, lay a circular elevated area of about 30 m in diameter and 0.5 m in height. Reconnaissance on this area revealed a quantity of potsherds dating from the Funnel Beaker culture, together with a large number of fieldstones. The landowner informed us that many cartloads of stones had previously been removed from the site. A magnetometer survey of the elevated area revealed that it was surrounded by a ring of kerbstones, 28 m in diameter, and inside this were several anomalies attributable to stone structures. On the face of it, this could suggest that we were dealing with the remains of a large passage grave. However, it was perplexing that the structure was so large, and that there were no remains of sandstone flags or concentrations of fire-cracked flint on the surface, as these finds usually characterize the site of a demolished megalithic structure.

In spring 2009, an area of 1200 m² was uncovered, exposing parts of a fine ring of kerbstones and some of the mound fill within this. These kerbstones probably represent the remains of a large Early Bronze Age barrow. A possible central grave feature inside this barrow had been removed years ago. However, subsequent excavation, carried out by trowel, revealed traces of a large number of features and structures. Of these, a series of Early Neolithic structures in particular prompted much deliberation and several changes in excavation strategy. First in autumn 2012, after four long excavation campaigns, was it possible to close the excavation. The material recovered from the site is very extensive and post-excavation analysis is still in progress. As a consequence, only preliminary results and conclusions can be presented here.[1]

On opening up the first excavation areas, it became apparent that the surface was densely covered with large numbers of stones. It was clear that some of these formed parts of structures, while others appeared to be the result of windfalls lifting stones in the subsoil up to the surface. A total of more than 12,000 finds, primarily of Early Neolithic date, have been recorded and plotted-in on the excavation surface. These finds have not as yet been subjected to detailed analysis.

To date, it has been difficult to interpret all of the many stone structures present, some of which overlap with each other, and others, due to extensive stone removal, appear badly damaged. An interpretation will be attempted nevertheless.

Two basis structures were identified, termed A and B, which corresponded in form to those uncovered in the 1940s at barkaer (Glob 1949, 1975; Liversage 1992). The latter constituted a series of burial structures, placed within elongate constructions, which appeared to overly settlement remains. Inspired by similar structures found in England, these structures are usually referred to as Early Neolithic long barrows (Madsen 1979; Kristiansen 1991; Larsson 2002; Midgley 2008, pp. 11–22; Hansen 2010). However, this term is rather unfortunate as in only few cases do these structures represent the remains of actual long barrows, and we rarely know much about their extent and date relative

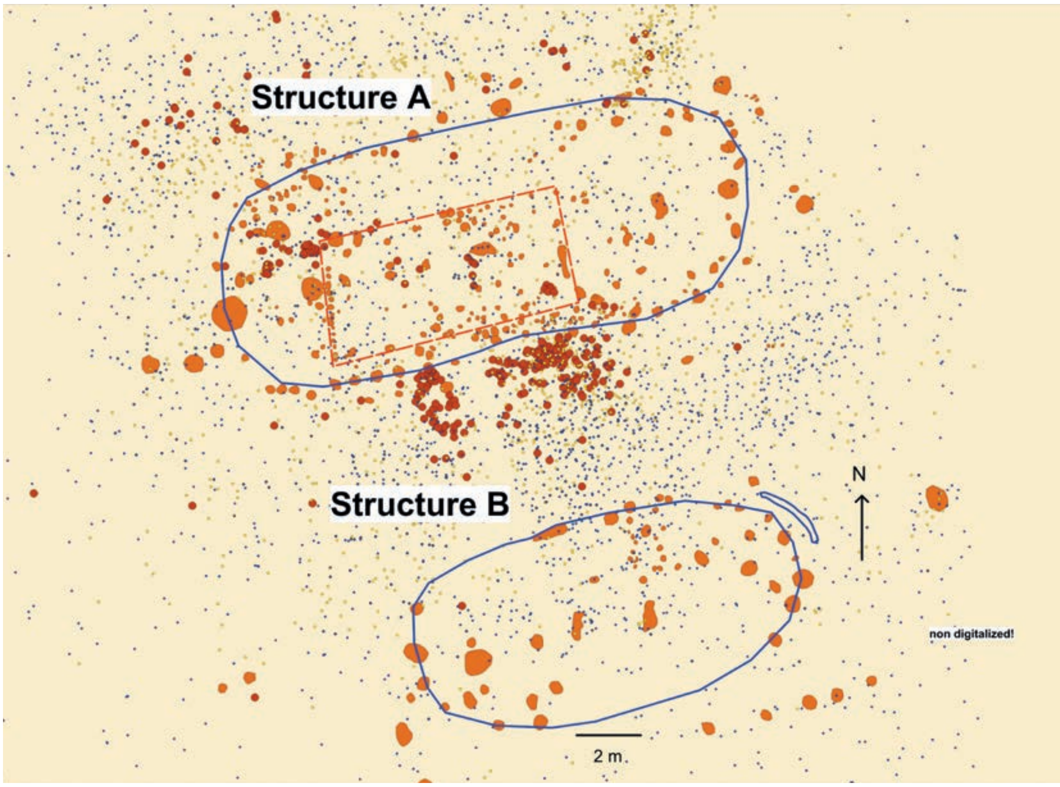

Fig. 1. The surface beneath the stone pavements at Frydenlund, with traces of two possible two-aisled house sites – framed in blue. Red lines mark traces of a possible rectangular construction. The small dots show the location of Early Neolithic finds and the brownish-red patches indicate the position of daub. Fewer finds in the southeast could be due to removal of material for the Bronze Age barrow.

to the burial features. As a consequence, the term used here is barkaer structure, which is a more neutral description and refers to the fact that these are complex structures, possibly not covered by a mound, corresponding to those found at the barkaer site.

Frydenlund's earliest structures with house remains

Beneath the stone pavements, numerous features corresponding to pits and presumed postholes were recorded. It was possible to identify some of the postholes as belonging to a house site, possibly two, of Mossby type (Nielsen 1997, pp. 11–13; Larsson 2012, pp. 64–67). The same deposits were found to contain numerous finds, and a preliminary mapping showed that these were evenly distributed across the excavated area (Fig. 1).

The presumed house site in structure A was apparent as a series of stake- and postholes, constituting the wall, as well as a row of slightly larger postholes running through the middle of the structure. This was presumably the site of a two-aisled house with a length of 17 m, a width of 6.6 m, and covering an area of 106 m^2. The uncertainty with respect to this house site is due to the fact that the presumed wall posts could be of later date, having formed part of an enclosure around the stone pavements which later came to cover the structure (see below). In favour of the house theory is, however, the fact that a quantity of daub, albeit often in quite small pieces, was found around the structure, especially to the south. Remarkably, traces of a rectangular structure were discovered inside the house site (Fig. 1).

In the western part of the house site in structure A, a thin layer of cultural deposits was uncovered, overlying some small, shallow pits. Already under excavation, the presence of a quantity of charred grain was recognized here and this was later confirmed by the flotation of a large number of soil samples. A preliminary analysis of this assemblage, carried out at Kiel University by Professor Wiebke Kirleis and Elske Fischer, shows a lot of cereal grains, threshing remains and wild plant species. Out of 473 rachis segments, 269 could clearly be identified as originating from tetraploid free threshing wheat (*Triticum durum* Desf.) or macaroni/rivet wheat, which so far was not identified for any Funnel Beaker context yet (Kirleis and Fischer 2014).

Five samples of charred grain and charcoal from this possible house area were dated by the AMS ^{14}C Dating Laboratory at Aarhus University to c. 3650–3360 BC (AAR 15359-15362; AAR 18501). Two dates for the same material produced at Kiel University gave results of 3950–3750 BC (KIA 49228 and 24118). At the time of writing, it has not proved possible to discover the reason for the marked difference in the dates produced by the two laboratories.

The remains of the house in structure B were initially very difficult to recognize because the subsoil here was very gravel-rich, relative to the situation at structure A, which was located on fine, sandy soil. Moreover, parts of the house site had been destroyed in connection with the construction of the ring of kerbstones for the Bronze Age barrow. The house in structure B had been 12.2 m long, 6.2 m wide and covered an area of 64 m^2. In the northeastern part there were traces of rows of smaller posts and stakes about 0.6 m outside the eastern gable evidence of leaching was observed in the subsoil. The latter can be interpreted as traces left by roof run-off and, consequently, an indication of the extent of the roof overhang.

The majority of the finds thought to be associated with the occupation of these houses correspond to those seen in the finds assemblages from Stengade house I (Skaarup 1975) and from Siggeneben Süd (Meurers-Balke 1983). On completion of the current analyses, it is expected that the Frydenlund site will be able to make a significant contribution to our understanding of the artefact inventory associated with the end of the first phase of the Early Neolithic (TN Ic).

Frydenlund's monumental structures

The presumed house site in area A was subsequently covered by one or more stone pavements in the form of up to three layers of stones. Due to the removal of stones in modern times, these stone pavements were only partially preserved. However, it appears they were laid within the area delimited by the presumed wall posts for house A. The stone pavements appear to have originally been very carefully laid (Fig. 2).

In the centre of the structure, between the stones, an intact thin-butted axe, the sherds of a funnel-necked vessel and some amber beads were found. There was no trace of a burial structure, but the area has suffered heavy damage due to stone removal.

Towards the west, the western half of structure A terminated in a robust façade construction which showed traces of three radially-cleaved planks, placed in a 2.4 m deep trench (Fig. 2 A36).

Structure B (Fig. 3) had, in its later phase, a somewhat different construction in that an oval enclosure was built around the house site, made up of posts set in a roughly 0.5 m deep trench. This enclosure measured 30 x 8 m and

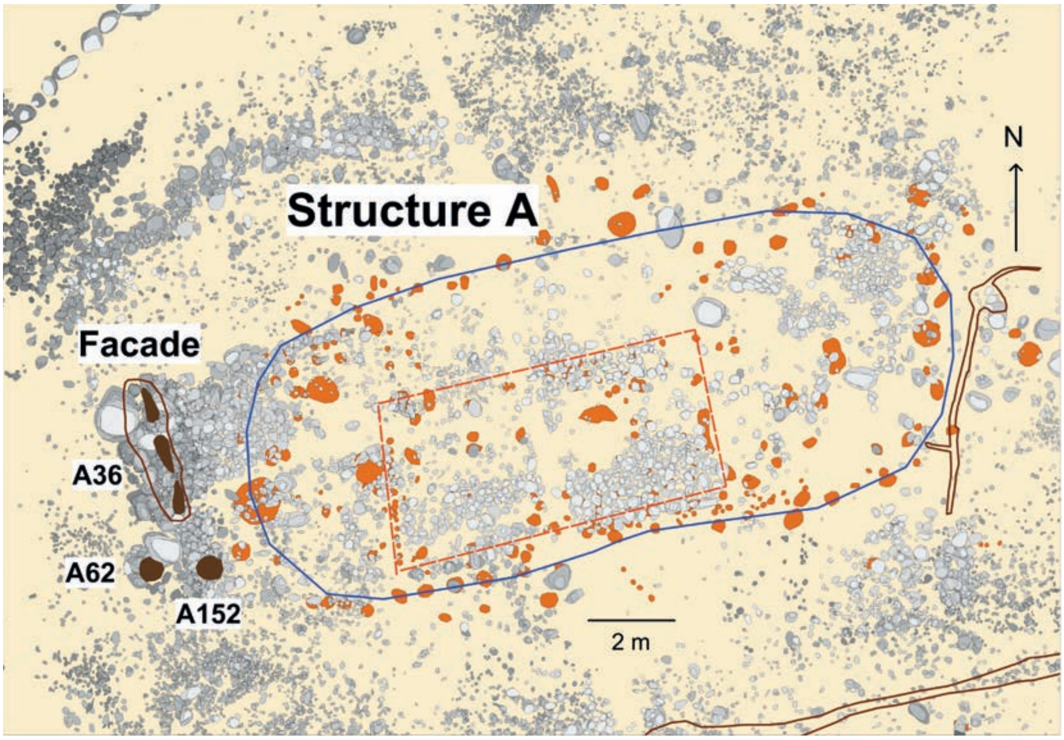

Fig. 2. In structure A, a stone pavement more or less covered the area under which lie traces of a possible house construction (Fig. 1). In the western part were two façade structures, one comprised of three radially-cleaved posts or planks placed in a deep trench (A36) and, to the south of this, a structure with two round posts (A62and A152).

lay completely parallel to barkaer structure A, but located 4.3 m to the south. To the west, the enclosure had a façade trench containing three radially-cleaved planks, exactly as seen in structure A (see below). In the enclosure's eastern gable there was a gap in which a large, almost cuboid stone had been placed. Another stone, tall and slender, had stood directly inside the western façade.

Inhumation grave A18 in barkaer structure B

In the middle of the enclosure, between the traces of the two central postholes in house site B, was an inhumation grave, referred to here as A18 (Fig. 3). To the west of this lay a quadratic stone pavement comprised of several layers of stones (A13). Unfortunately, this had been destroyed by stone removal and lacked finds which could provide clues as to its function.

Grave A18 (Fig. 4) had comprised a small plank-built cist, with two planks (now decayed) approximately 1 m long and 30 cm wide at each side. The base of the grave took the form of a fine surface of rounded cobblestones, 5–10 cm in diameter. The cobbled area was rectangular in form and measured 2.4 x 0.7 m. This cobbled surface had sunk a little at each end, because the soil here was soft at the time of construction. It was precisely here that the central roof-bearing posts of house B had previously stood. The grave structure must therefore have been built shortly after the house had been demolished and the large posts pulled up, leaving uncompacted soil in the postholes. On excavation, sections

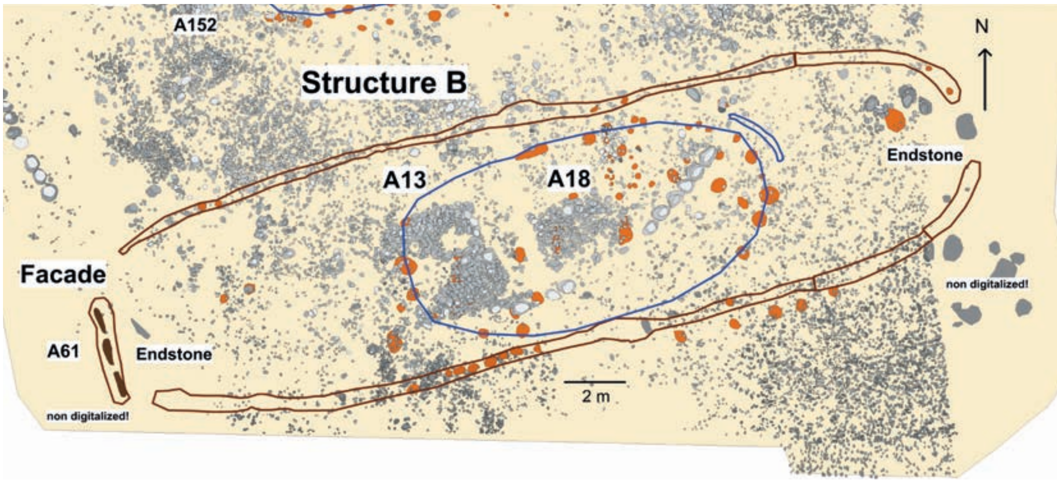

Fig. 3. The later phases of structure B, during which the area of the former house site was framed by an elongate enclosure with a robust façade to the west and an opening to the east containing a large stone. A burial structure (A18) had been positioned in the middle of this, and immediately to the west was a quadratic stone pavement (A13).

through the postholes revealed an hourglass form and this can be interpreted as showing that the posts had been rocked back and forth in order to loosen them before being pulled up.

Inhumation graves such as A18 are often encountered in barkaer structures and are referred to as inhumation graves of Konens Høj type, after an intriguing structure found on the Djursland peninsula (Stürup 1966; Madsen 1979). It has been assumed that these structures represented a burial with a tent-like superstructure, as it was presumed that the large postholes at the ends of the grave had formed part of the actual grave construction, with the posts carrying a horizontal ridgepole. This interpretation was questioned by David Liversage who, in 1983, suggested that rather than a tent-like structure there was a plank-built cist with sturdy posts at each end (Liversage 1983, 1992).

Many grave structures corresponding to A18 have been found in England. One of the better known is Wayland's Smithy, where traces of radially-cleaved posts were found at the gables of an inhumation grave. In 1965, the excavator, R. J. C. Atkinson, interpreted these as part of a tent-like structure. However, an analysis by Gordon Nobble showed that the two posts were offset relative to each other and could therefore not have formed part of the actual grave structure. A similar situation is seen in burials such as those at Fussell's Lodge and Haddenham (Noble 2006, p. 88). Fussell's Lodge has given rise to a much used interpretation and illustration, whereby the large posts originally carried a platform on which corpses were laid out for skeletonizing, and after the posts had rotted away the resulting fleshless bones were laid in a wooden burial cist, constructed in the same place (Scott 1992).

The best explanation relative to an interpretation of grave structure A18 comes via Preben Rønne's excavation in 1977–78 of a barkaer structure at Bygholm Nørremark, on the western outskirts of Horsens. In the eastern part of this structure lay an inhumation grave, which had been positioned between the postholes of a two-aisled house that had been demolished prior to construction of the grave (Rønne 1979, p. 5). In contrast to the situation at Frydenlund, only few artefacts were found at

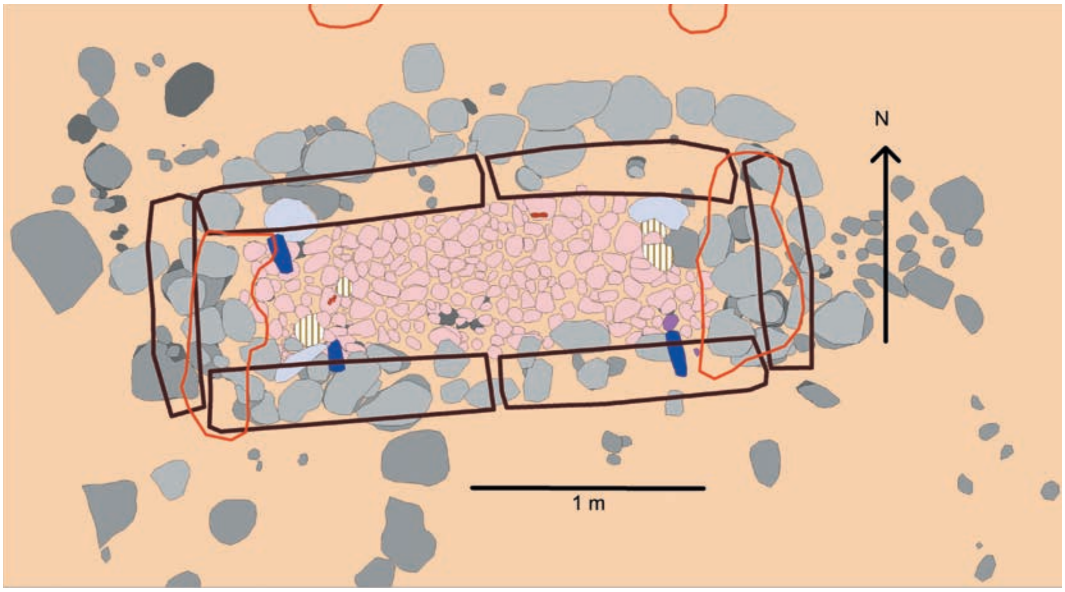

Fig. 4. Grave A18 in structure B. Here the rectangular grave base can be seen, surrounded by large stones which supported the (now decayed) planks (shown in brown). Red marks the position of two postholes which were part of the earlier house site B. It can be seen that the postholes are slightly offset relative to one another. On the grave base there were three intact flint axes (marked in blue), an amber bead (red-brown), a couple of transverse arrowheads (between the axes on the left – to the west), a collared flask (violet), three flat stones (cross-hatched) and some patches of fine clay (vertically-hatched).

the site, leading Rønne to interpret the house as some kind of ceremonial building, in which the inhumation grave constituted the final act.

Observations at both Bygholm Nørremark and Frydenlund therefore demonstrate that these inhumation graves were placed where, shortly before, a house had stood – a house which, moreover, must have been intentionally demolished. The absence of charcoal at the house sites is an indication that they were not burned. Their removal must have taken place no more than a year prior to construction of the grave, otherwise the earth in the postholes would have become compacted such that the ends of the grave floor would not have sunk. The numerous finds from Frydenlund suggest, furthermore, that the house could have formed part of a settlement. Similar house sites have been found beneath megalithic structures in the Sarup area, i.e. during excavations at Damsbo. In two cases, the dolmen chamber was located directly between the postholes for roof-bearing posts in a two-aisled house (Andersen 2009, p. 33, fig. 11).

Through studies of inhumation graves uncovered during other excavations, it can be seen that the large posts at each end often stand offset relative to one another, as seen for example at Flintbek (Mischka 2011, p. 70, fig. 3). One can speculate whether excavators have overlooked the stake- and postholes which could show that these inhumation graves were located in the remains of two-aisled houses. Early Neolithic house sites can be difficult to recognize, as the postholes rarely contain much topsoil. Furthermore, these houses were intentionally demolished and removed, as seen at Frydenlund, leaving no remains of decayed posts in the postholes.

It is an intriguing discovery that burial structures such as plank-built cists and dolmens were constructed in places where, shortly before, houses had stood and, moreover, that these burial structures were positioned between the central pair of roof-bearing posts. All the house sites in the Sarup area are located in settlements areas with large numbers of artefacts. These settlements appear to have been abandoned and the houses demolished in connection with the establishment of burial structures.

Inhumation grave A18 at Frydenlund can be interpreted as a plank-built cist with two sets of planks at each side and one at each end (Fig. 4). The thereby framed grave base was about 2.4 m long and just less than 70 cm wide. The planks stood in a roughly 10 cm deep furrow and decayed in situ. As they decayed, objects from the grave chamber slipped partly down into the trench/furrow, suggesting that these objects must have stood up against the side planks. The cist was probably closed with a large plank which, in turn, was covered with a layer of hand-sized stones.

Despite very careful excavation of the grave, using wooden spatulas and with subsequent flotation of the soil, no traces of the deceased, for example tooth enamel, were found. However, it is presumed that there was only one person in the grave and that they lay with their head to the west. It was here that two thin-butted flint axes were found with their edges facing outwards. In between them, and slightly to the south in the chest region of the deceased, lay two flint transverse arrowheads. One of them had its edge facing towards the east, i.e. away from the head, so any arrow shaft present must have lain over the deceased's head. Roughly in the middle of the grave, by the northern edge – possibly by the deceased's left hip, was a large hour-glass-shaped amber bead, perhaps a belt fastener. In the southeastern part of the grave, presumably by the deceased's right foot, yet another flint axe was discovered. This had slipped down into the furrow below the decayed plank. Close to the axe lay some sherds from a collared flask, which unfortunately had been destroyed in connection with establishing the kerbstones in the Bronze Age. Some strange flat stones, referred to as "pizza stones", had stood up against the planks at the head end and by the left foot.

The deceased must be presumed to have been male, and it is not impossible that the arrowheads in his chest region were the cause of death, i.e. he was shot with arrows. However, is also possible that the arrowheads had simply lain in for example a small pouch, because beside them were a couple of very red stones, about 1 cm in diameter.

In 1910, a very similar grave containing two skeletons was excavated in Lohals on the island of Langeland. Here too, an axe was found in the shoulder region, with further examples by the right foot and in the pelvic region. Between the two skulls lay the sherds of a collared flask (Skaarup 1984, pp. 324 f.)

The three flint axes had been slightly resharpened, suggesting that the deceased could possibly have been an active woodcutter! It is remarkable that graves are often found in the Early Neolithic barkaer structures in which an entire corpse, or possibly several as at Bygholm Nørremark and Skibhøj, appears to have been buried (Rønne 1976, p. 6; Madsen 1993, p. 97). Conversely, we still lack clear evidence for the burial of entire corpses in the first phases of the dolmens; the preserved finds show that only parts of corpses were deposited here (Eriksen & Andersen 2014, chapter 21).

Façade trenches

Elongate trenches are often found at the east gable of barkaer structures. These trenches constituted the foundations for sturdy planks which stood several metres above ground level and clearly marked the structure in the terrain (Madsen 1979, pp. 311–15; Kaul 1988, pp.

64–71). At Frydenlund, in contrast, there were very prominent façade trenches at the western end of the two barkaer structures, A36 and A61 (Figs. 2 and 3). There were no traces of façades to the east, and the fact that they were located to the west here shows that they must have been intended to be seen from a great distance, which was only possible with this location.

The two façade trenches at Frydenlund are very similar, although with one difference: that in A36, structure A, was cut into layers of gravel and sand, whereas that in A61, structure B, was cut into solid clay soil. It is remarkable that both trenches were of the same length, i.e. about 3.4 m, but had very different depths. Trench A61, in structure B, cut into clay, had a depth of only 1.1 m, although some of the top had been dug away in connection with the construction of the Bronze Age barrow. Trench A36, cut into gravel and sand, was dug to a depth of 2.4 m.

Both trenches had been filled with a large number of stones, up to 50 kg in weight. In the trench A36, structure A, it is estimated that more than 5 tonnes of stone were used in stabilizing the posts, or rather planks. Trench A61 was 52 cm wide and had almost vertical sides, whereas trench A36 was, due to the loose soil, 2 m wide uppermost, with a step halfway down, where the width was halved

In the northwestern end of trench A36 lay a roughly 1 m diameter stone, which could have stabilized the plank standing here. Partly under the stone lay sherds from part of a funnel-necked vessel and in another place there was a fragment of a thin-butted axe.

In the trenches, traces could clearly be seen of the decayed planks which had remained in situ. In trench A36, the planks had been positioned up against the eastern side of the trench, whereas in trench A61 they were placed virtually in the middle of the narrow trench. Three radially-cleaved planks had been placed in each trench. These were triangular in form, with a width of 85 cm and a thickness at one end of 25–40 cm. These large planks must have been split from an oak trunk with a diameter of approximately 1.7 m and, consequently, a circumference of about 5 m. If we assume that the planks were 40 cm in their outer part, then half a trunk would have produced six planks. We cannot of course know whether all six planks came from the same oak trunk, but their uniform shape and dimensions mean that this is likely. Moreover, it is remarkable that the planks in coeval inhumation grave A18 had more or less the same dimensions, and that this is also true of the two posts associated with the underlying house; the latter must, however, be slightly earlier in date.

The fact that the planks in façade trench A36 were placed in a 2.4 m deep foundation trench and were stabilized using at least 5 tonnes of stones leads to the conclusion that they must have stood very tall. It is possible that they extended above the surface by as much as three times the depth of the trench, i.e. 7.5 m. Each plank would then have had a length of 10 m and a weight of some 1.7 tonnes. It is not certain that the planks in trench A61 would have been of the same length, as we do not know the original depth of the trench. However, this is possible, given that the trench was dug in solid clay soil, had a couple of tonnes of stabilizing stones and probably a depth of at least 1.5 m.

The above evidence shows that the Early Neolithic barkaer structures were monumental in scale and their construction must have involved the gathering of large numbers of people. Great efforts must have been involved in first finding an oak tree with a virtually straight trunk at least 10 m in height and 1.7 m in diameter. In order to fell the tree flint axe heads would, in advance, have had to be produced and mounted. Then the oak trunk had to be cleared of branches and split using wedges to produce six planks. These had then to be transported to the already dug façade trenches, in which they were raised into a vertical position and stabilized using several tonnes of stones. The earliest monumental structures were truly impressive!

Immediately south of façade trench A36 in structures A62 and A152 (Fig. 2) there were two posts placed in a stone feature. The westernmost post was supported by a 90 cm high stone on one side and pile of boulders of corresponding height on the other. Here too, we have a remarkable and intriguing structure.

Conclusion

The preliminary results of the Frydenlund excavation presented here show that we are dealing with a very complicated site; first there was a settlement, comprised of one, perhaps two houses. Subsequently the remains of these houses were covered with two barkaer structures. These two latter were very different in form; one comprised a stone-covered area, whereas the other was framed by a post-built fence placed in a trench. Both structures had their western gable marked with a plank-built façade of perhaps as much as 7 m in height. Intriguingly, a plank-built cist was found in the post-enclosed structure, and it is evident that the cist was positioned in the remains of a house which had been demolished and removed shortly before.

Translated by David Earle Robinson and Anne Bloch

Notes

1 The excavation was funded by Moesgaard Museum (FHM 5025) and the Danish Agency for Culture (2009-7.24.01/FHM-001).

2 The Frydenlund Project has its own blog which can be followed on: http://frydenlundsarup.wordpress.com.

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Megaliths and timber structures in northeast Scania, Sweden

Anders Edring

Abstract

In 2010 an area with several megalithic monuments and timber structures was excavated on the Kristianstad plain in northeast Scania. The stone and timber structures were part of a large Neolithic burial site located at the edge of a large ridge. The architectural design of the site shows that the structures had been spatially separated, which can be seen as an indication of diverse functionality. It is suggested that different generations of timber structures evolved from single structures and semicircles into more traditional timber circles during the Neolithic. The site of Skepparslöv is seen as a miniature of a larger Neolithic landscape where activities of ritual character were closely connected to natural features in the surrounding landscape.

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Introduction

THE LANDSCAPE OF northeast Scania, in the southern part of Sweden, is characterized by a plain with several lakes and rivers. Large ridges and highland areas to the north and south delimit the area. A number of hills of bedrock are significant features in the landscape, and large stones and boulders cover the hillsides and the hills of bedrock. During thousands of years the transgressions and regressions of the Baltic Sea have made a significant impact on the landscape. In the Neolithic period the sea rose approximately 5–7 metres above the present sea level and a large bay divided the plain. Modern agriculture and drainage projects during the nineteenth and twentieth centuries have changed the landscape dramatically.

The Kristianstad plain is one of five areas in Scania with concentrations of Neolithic monuments such as dolmens and passage graves (Strömberg 1980; Tilley 1999). A study of the Early and Middle Neolithic period of the Kristianstad plain has shown that the Neolithic monuments are situated below the ridges and the bedrock hills (Edring 2005).

In 2010 an archaeological excavation took place on the slopes of the Nävlinge ridge (Edring 2011). This archaeological site, Skepparslöv, is situated immediately below the ridge, in an area with several megalithic monuments.

The megaliths

The megaliths were situated along the slope of the ridge (Fig. 1). Stones and impressions of removed stones were frequent in the area. The first construction to be located and excavated was a stone circle with a central large boulder which had traces of modern breakage. The stone circle was about ten metres in diameter. Most of the stones were preserved and traces of the missing stones were clearly visible. Imprints of larger stones were documented and a segment of smaller stones was interpreted as the preserved

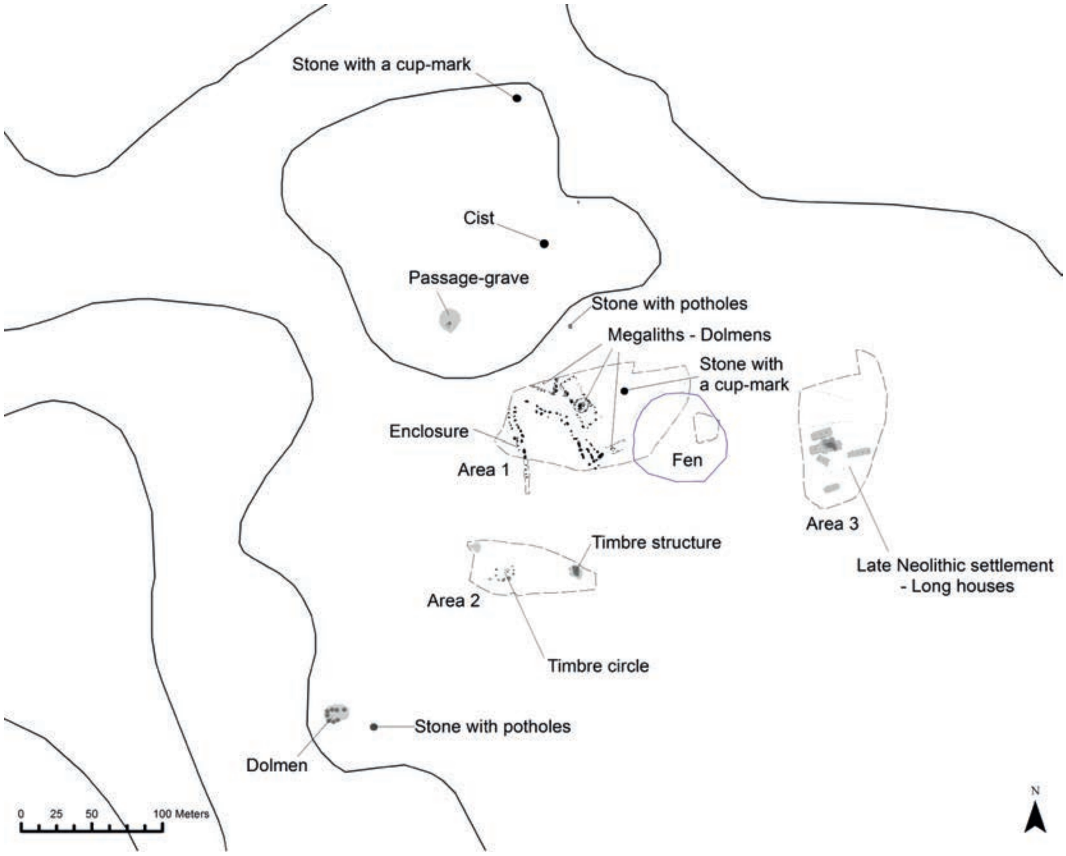

Fig. 1. The excavated areas and the megaliths and other features at the Skepparslöv site.

parts of a floor in a megalithic chamber. Several stones and traces of removed stones, forming a north–south orientated rectangular structure (36 x 12 metres), surrounded the chamber and the stone circle.

Thirty metres to the south, a second accumulation of stones was detected. This structure was orientated east–west and had a rectangular form. The length was approximately 16 metres and the width 6 metres. In the centre of the structure there were some larger stones and several stone impressions.

Another megalithic structure was excavated in the northern part of the area. This rectangular structure stretched outside the excavation area and was destroyed during the building of a road over 50 years ago. The original length of the structure could not be established; however, it must have been at least 20 metres long and 13 metres wide. The remaining parts of the structure consisted of larger stones at the edges and in the centre of the structure. After the removal of a foot of shifting sand, an accumulation of smaller stones was discovered. In this area three large stone impressions were documented, possibly traces of a megalithic chamber.

The three megalithic structures were all rectangular. All three constructions had large stones or clearly visible traces of removed stones in their central parts. The meagre amount of artefacts and the absence of burials were common features in all three features. The shape of the structures, the construction of large stones in the central part and the artefacts, although

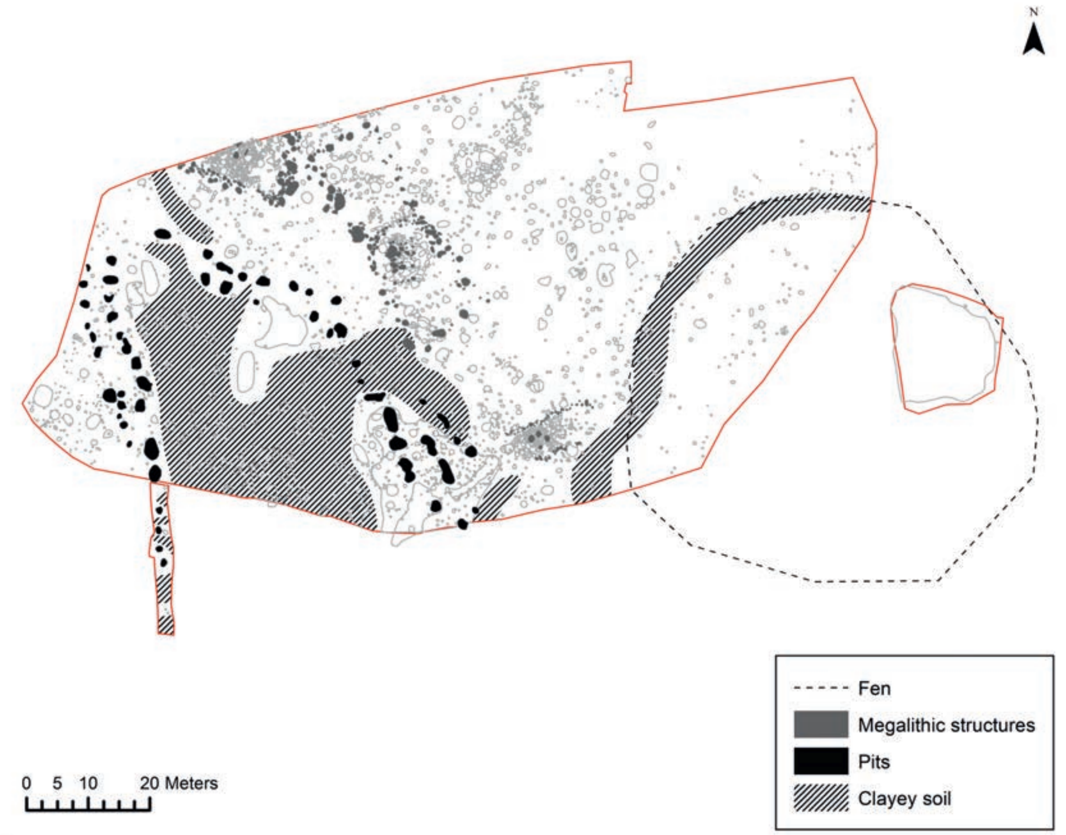

Fig. 2. The enclosure, the megaliths and the fen in area 1. Note the two rows if pits enclosing the area with clayey soil.

scarce, indicate that the megalithic structures were the remains of dolmens.

An enclosure and a fen

South of the megalithic structures, several man-sized pits were arranged in two parallel rows, forming an oblong arch-like shape (Fig. 2). Soil and charcoal samples were collected from the features, and an analysis of charcoal of pine-tree from one of the pits was dated to 7906±98 BP (Ua-42084, 7100–6500 2σ cal. BC). This result does not correlate with the Early Neolithic pottery found in the pits. The pits had been dug at the foot of the ridge and they seemed to follow the outline of the rectangular stone structure of the dolmens.

Soil studies revealed that the pits almost exactly surrounded an area with clayey soil. There were some small accumulations of occupation deposits, pits and postholes in the enclosed area, but these features did not seem to form any recognizable pattern. The excavation of the layers and the pits did not result in any artefacts or other materials that gave any clues as to what kind of activity took place within the enclosed area.

To the east there was a large dried-up fen where a part of a burnt flint axe indicated ritual activities in and around the fen.

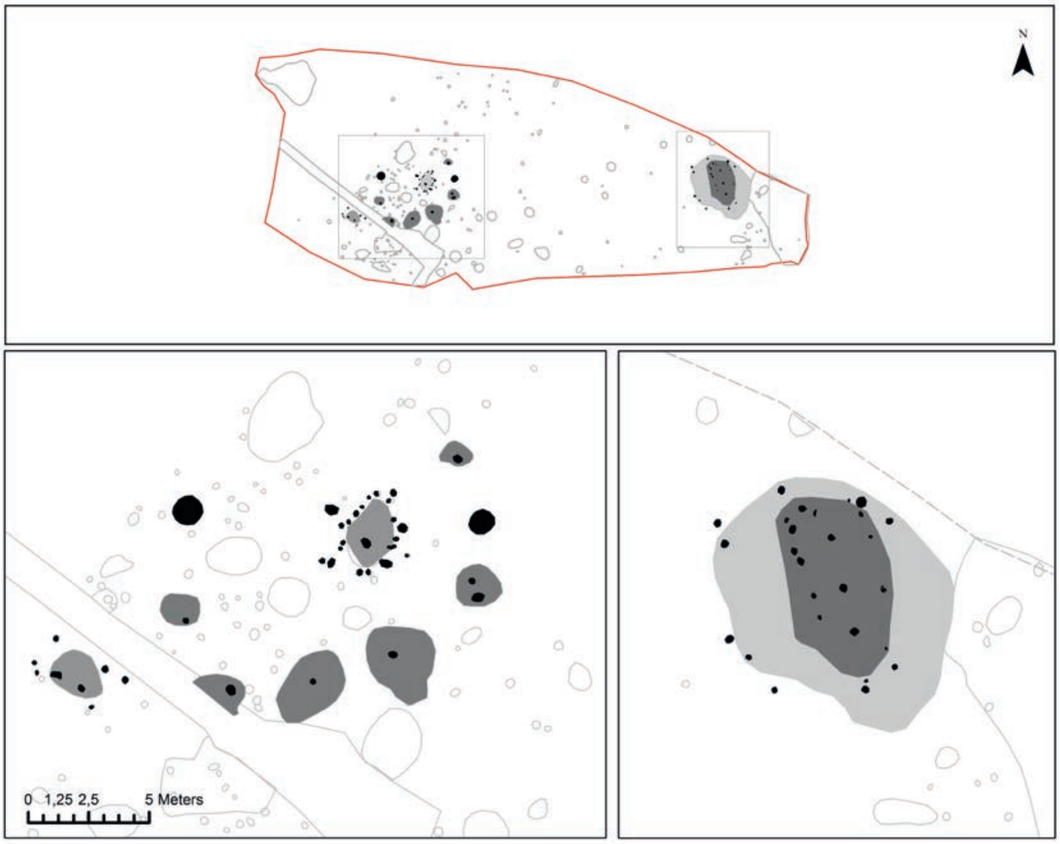

Fig. 3. The timber structures in area 2 (above). The single timber structures and timber circle (left) and the recessed structure (right).

Timber structures

Approximately one hundred metres south of the megalithic structures, a number of large pits and postholes were concentrated in two small areas with sandy soils (Fig. 3). In the eastern part there was an oval area with occupation deposits. An analysis of the flint technology found in the deposits shows that it can be dated to the Early or Middle Neolithic (Högberg 2011). The flint material corresponds well with the pottery that dates to the Early Neolithic or the transition between the Early and the Middle Neolithic. Bones from the deposit were scarce and mostly burnt, but the few identified fragments are from cattle and sheep/goat/roe deer (Boëthius 2010).

Soil samples were analysed from the deposits and a carbonized hazelnut was dated to 4761±36 BP (Ua-42086, 3640–3380 2σ cal. BC) and a piece of charcoal of hazel from the bottom of the deposit was dated to 8207±56 BP (Ua-42091, 7450–7060 2σ cal. BC).

When the layers had been removed, several postholes became visible. They formed a pattern similar to an Early Neolithic type of house called "Mossby houses". These houses were two-aisled structures with two to eight roof-bearing posts (Artursson *et al.* 2003, p. 116). The posts in the walls formed an oval structure with a length that varied from 9 to 18 metres and a width varying from 4 to 7.5 metres. There are some differences in the proportions between Mossby houses and the current structure. Unlike the Mossby houses, the latter had been recessed into the ground in a large pit or a natural recessed area. Outlining the central timber structure (that of the shape of a Mossby house), there were some postholes forming a larger oval structure. These posts symmetrical position indicates that they are part of a construction coherent with the central timber structure.

Forty metres to the west of the recessed timber structure, in another sandy part of the area, there were several oval pits and postholes. One of the pits, 2 × 2.8 metres in size, was surrounded by several postholes. In the centre of the pit, below 0.5 metres of filling, was a posthole with a depth of 0.3 metres. A polished flint flake and an Early or Middle Neolithic pottery sherd were found in the pit.

A similar structure was discovered ten metres to the south. This pit was 1.7 × 2.3 metres in size and surrounded by six postholes forming a rectangular structure. Several sherds decorated with vertical or horizontal lines of two-ply cord, dated to the Early Neolithic, and parts of a polished flint axe or chisel were found in the pit. In the bottom of the pit there was a posthole with an impression of a pointed pole. The pole penetrated layers of sand deep into the ground before reaching more stable clayey soil. The depth of the posthole suggests that the pole must have been of considerable height. A hypothesis is that the pits in these two features were dug in order to raise large timber-poles.

Soil samples from the fillings of the pit and from one posthole belonging to the structure were analysed. Charcoal of ash-tree from the filling was dated to 4681±33 BP (Ua-42092, 3630–3360 2σ cal. BC) and charcoal of ash-tree from the posthole was dated to 8636±45 BP (Ua-42093, 7750–7580 2σ cal. BC).

Within the area of the two timber structures there were several other large pits with postholes. These "post pits" formed a twelve-metre large semicircle with an opening to the north. There were eight "post pits" in the construction. Their size varied from 1 to 3.5 metres in diameter and their depth from 0.25 to 0.4 metres. Two of them were interpreted as large postholes. The others contained postholes at the bottom of the pits. The depth of the postholes varied from 0.06 to 0.34 metres, excluding the depth of the pits. The two largest pits in the southern part of the semicircle contained about 100 pottery sherds and the same amount of worked flints. Only seven of the sherds were decorated, originating from Early Neolithic funnel beakers. Among the pottery there were also pieces from a clay disc.

The flint from these two "post pits" consisted of two types of flint – one local type (Kristianstad flint) and one that was imported from the southern part of Scania or Denmark (Senonian flint). The pits contained both types of flint, but one contained some polished pieces of flint and the other burnt flints. There were also some pieces of red flat stones in both pits. These red stones had been processed, but they were not tools or implements of production (Högberg 2011). A similar red stone was found in one of the other "post pits" in the semicircle. This other pit contained only single sherds of undecorated pottery and five of the eight pits contained burnt pieces of flint.

Soil samples from the fillings of the pits and the postholes were analysed. Charcoal from birch from the largest pit was dated to 4911±33 BP (Ua-42094, 3770–3640 2σ cal. BC) and a charred grain of naked barley (*Hordeum vulgare var. nudum*) from the posthole was dated to 4719±31 BP (Ua-42090, 3640–3370 2σ BC cal.). Charcoal of birch from one of the pits, interpreted as a large posthole, was dated to 5534±44 BP (Ua-42088, 4460–4270 2σ cal. BC).

The two first samples correlate with the pottery in the pits and with the results of the radiocarbon analyses from the recessed timber structure to the east (4761±36 BP, Ua-42086, 3640–3380 2σ cal. BC), but also from a sample from the pit in one of the timber structures (4681±33 BP, Ua-42092, 3630–3360 2σ cal. BC). Though the radiocarbon datings from the site show that a Mesolithic "breeze" is continuously present, there are no artefacts or settlements know at the site or from the surrounding area. Most of the radiocarbon dates, the pottery and the worked flint indicate, however. that the semicircle dates to the Early Neolithic.

The architectural setting of the site

The archaeological remains of the megaliths and timber structures are a part of a larger Neolithic burial site. The existence of megalithic monuments in the area has been known for quite some time and in the 1940s, a passage-grave and a cist were excavated only a hundred metres to the north (Bagge & Kaelas 1952; Magnusson 1947).

In a meadow southwest of the excavated dolmens, there is a visible dolmen. The dolmen was built a few metres from a large boulder with several glacial potholes. Large stones, boulders and areas with outcrop dominate the hillsides of the Nävlinge ridge and some of the boulders have potholes.

Looking at the architectural design in a larger perspective, it is clear that the megalithic structures had been placed in an arched line below the Nävlinge ridge. The chamber of the passage-grave and two of the chambers of the excavated dolmens are aligned. This is probably not a coincidence, but not all the megalithic structures in the area correspond to this pattern. Below the ridge and the megaliths there is an area with dried-up fens and a number of pits and postholes. Two rows of pits enclosed an area of clayey soil. There are Neolithic sites in the south of Scandinavia with similar structures of pits and ditches (Larsson 1982; Andersen 1997; Thörn 2007). These sites have primarily been interpreted as gathering places with ceremonial functions or as places to prepare the dead before burial in megalithic tombs (Andersen 1997, p. 309; Svensson 2004, p. 224). On these sites there are also remains of what can be described as regular settlement activities, but also of activities of more ceremonial character (Nielsen 1999, p. 153 ff.; Svensson 2004, pp. 226 ff.). These sites could have been multifunctional, and were probably used for economic, administrative, social and spiritual purposes (Andersson 2003, p. 46).

There are only a few artefacts that can be used for interpreting the activities that took place at the site of Skepparslöv. A fragment of a burnt flint axe and potsherds deposited in the former fen indicate ritual activities. Axes or parts of axes and pottery deposited in fens and bogs are generally interpreted as evidence of ritual activities (see Karsten 1994; Kock 1998; Berggren 2007). Fragments of burnt axes are also a common feature in Neolithic ritual contexts (see Larsson 1989).

The timber structures were located between the excavated dolmens and the preserved dolmen in the meadow. It is likely that the timber structures were related to the megalithic structures and that they were significant features of the Neolithic burial site. The spatial separation of monumental structures, those built of stone and those built of timber, was most probably intentional, indicating areas with diverse function. It can be questioned, however, whether the semicircle at Skepparslöv was a timber circle of the same type as those excavated in the British Isles, Germany and the Netherlands (see Bradley 1998; Thomas 1999; Gibson 2005). There are, however, some Scandinavian examples of timber circles on the sites of Vasagård, Risbebjerg and Grødbygård on Bornholm, Denmark (Nielsen 1999; Thörn 2007). These structures are connected to activities dated to the later part of the Middle Neolithic A. Similar circles have been excavated at

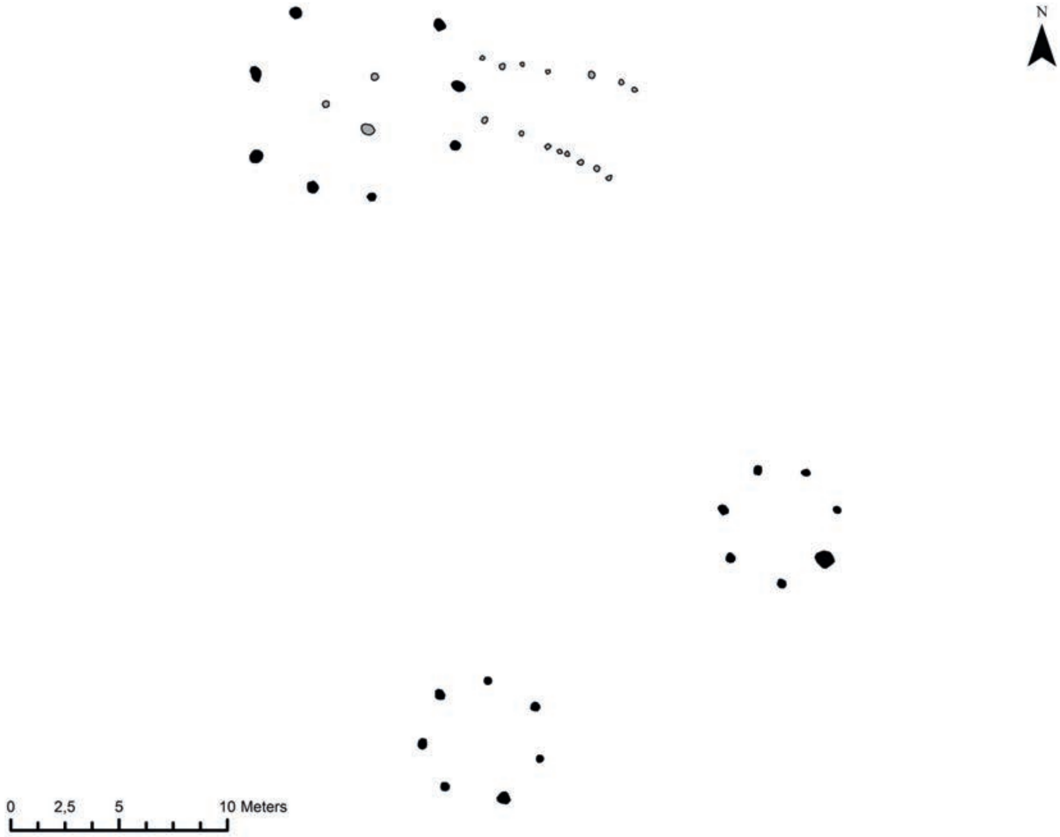

Fig. 4. The timber circles at Fjälkinge.

Fjälkinge, ten kilometres east of Skepparslöv (Edring 2005). Of the three timber circles at Fjälkinge, the largest was ten metres in diameter and the two smaller five metres (Fig. 4). These timber circles, like those on Bornholm, are dated to the later part of the Middle Neolithic A (Edring 2005). One interesting observation is that the remains of what was interpreted as a dolmen were excavated eighty metres northeast of the timber circles at Fjälkinge. Another interesting observation is that an enclosure of Sarup type was discovered within one hundred metres northeast of the circular timber structures at Vasagård on Bornholm (Kaul *et al.* 2002). In contrast to the timber circles on Bornholm and at Fjälkinge, the semicircle at Skepparslöv is dated to the Early Neolithic. The single post-pits surrounded by postholes in Skepparslöv could have been contemporary with the semicircle, but they could also represent another phase of the timber monuments. The single posts in the semicircle could have been erected separately, but with the purpose of creating a complete construction. Maybe we are looking at different generations of timber structures that evolved from single structures and semicircles into more traditional timber circles during the Neolithic.

The recessed timber structure forty metres to the east of the semicircle has some similarities to Early Neolithic houses, and the artefacts found in the structure can be described as a material that is normally found on Neolithic settlements. Activities on and around

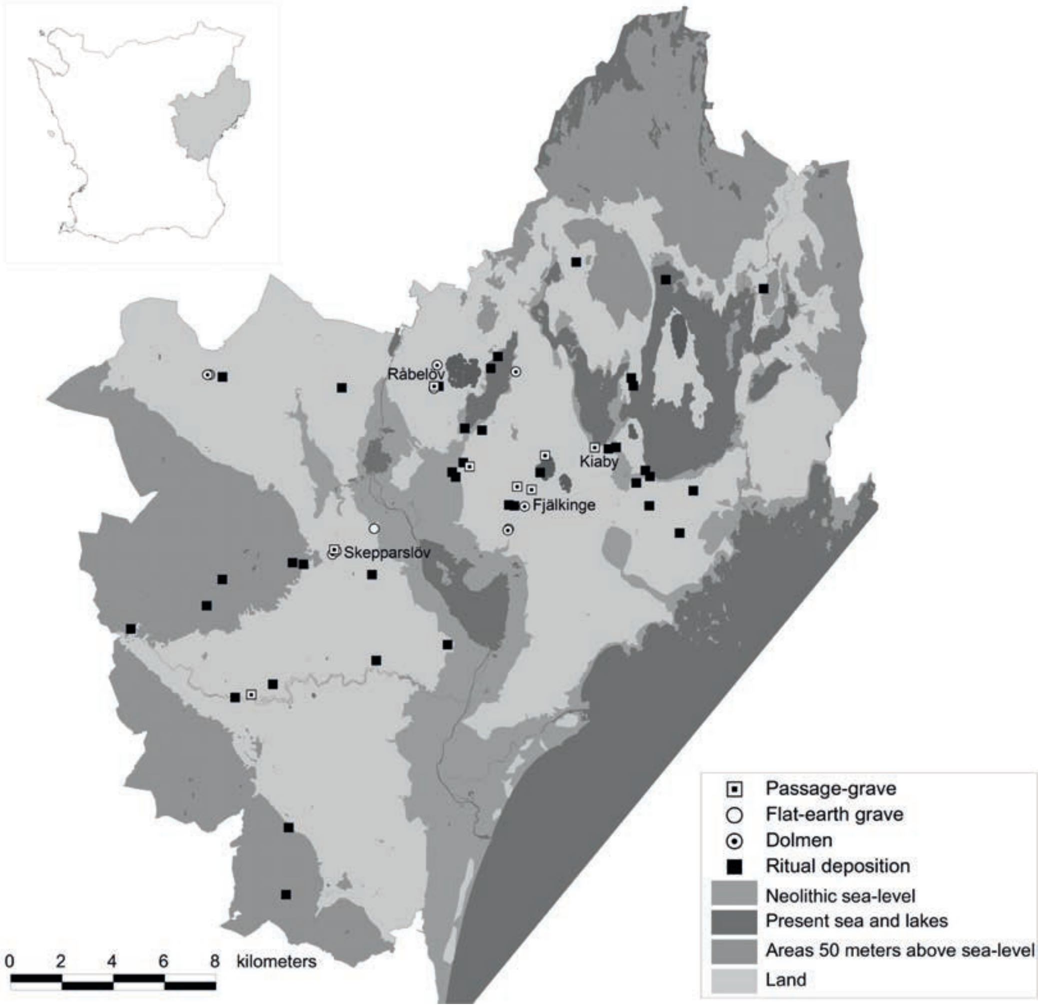

Fig. 5. The Kristianstad plain with megaliths and depositions.

a Neolithic burial site would normally have gathered a lot of people. The recessed structure may have been used as a temporary dwelling, but it could also have played a part in ceremonial practices in connection with burials or commemorations.

The timber structures, the megalithic structures and the pits that formed the enclosure could have existed simultaneously. The decorated pottery and most of the radiocarbon dates from the timber structures indicate the same date. The same types of decorated potsherds were also found in a couple of pits of the enclosure. That the two rows of pits in the enclosure seemed to follow the outline of the rectangular shapes of the megalithic structures is an indication that they were dug with this relationship in mind. The absence of artefacts and material suitable for radiocarbon dating in the three dolmens excludes an interpretation of the temporal relation between them and the enclosure. However, dolmens were generally built during the late part of the Early Neolithic or in the first part of the Middle Neolithic period.

The Neolithic landscape of the Kristianstad plain

During the Neolithic period a bay covered large parts of the Kristianstad plain (Fig. 5). The Neolithic burial site at Skepparslöv was situated between the Nävlinge ridge and the bay. Studies of the geographical distribution of megalithic monuments have shown that they were often sited along communication routes, e.g. rivers or streams (Tilley 1994, Parker Pearson *et al.* 2007). From the Skepparslöv site and along the ridge north there are two other dolmens.

About one kilometre to the east there are several megalithic monuments on the other side of the bay in the Fjälkinge area. The area of Fjälkinge was part of a large island, separated from the mainland by the bay and large adjacent lakes in the north. The Skepparslöv site was strategically located for passages to the north, along the ridge, and to the east, across the bay to the island.

Studying the location of dolmens and passage-graves, Neolithic stray finds, settlements and ritual depositions on the Kristianstad plain, we see that they are predominantly concentrated to four areas: Skepparslöv, Fjälkinge, Råbelöv and Kiaby (Edring 2005). Among these areas the Fjälkinge area is the one with the most numerous Neolithic remains. The site with the three timber circles and the remains of a dolmen has already been mentioned, but there are also two other dolmens and at least three passage-graves in the area. The passage-graves are situated below a large hill of bedrock that is a significant feature on the Kristianstad plain. This hill was located in the centre of the island. The high status of the Fjälkinge area is clearly shown by the concentration of Early and Middle Neolithic copper flat axes (Larsson 1984, p. 245). Most of these axes have been interpreted as ritual deposits (Oldeberg 1974; Karsten 1994; Klassen 2000). Two of the axes were found on the southern slope of the hillside close to a large boulder, between the passage-graves and the hill. On the hillsides are several boulders and some of them have glacial potholes. Due to glacial activity some boulders have been placed on top of each other, and this makes them similar to dolmens. This phenomenon of rock formations and boulders with a strong resemblance to megalithic tombs and their connection to Neolithic sites has previously been noted at sites in the British Isles (Bradley 2000, p. 109).

Below another large hill of bedrock in the area of Råbelöv, northeast of Fjälkinge, there are three megalithic monuments, two dolmens and a passage-grave (Bagge & Kaelas 1952; Edring 2005). In the area there is a large farm, and about 70 thin-butted flint and stone axes have been recovered in the process of agricultural work on the estate. On the hills, as in Skepparslöv and Fjälkinge, there are large boulders on the hillsides. A couple of kilometres to the north of Fjälkinge, in the Kiaby area, several Neolithic sites have been excavated. Sherds from pedestal bowls were discovered on one of the sites; the pedestalled bowl is a type of vessel that is primarily found in and around megalithic tombs. North of these sites there is a hill of bedrock with several large boulders and rock formations. In the area between the Neolithic sites and the hill there is a bog and some old fens – previously parts of the great lakes in the area – where several thin-butted axes have been discovered. The connection between ritual deposits and water, islands, hills and megalithic structures has been noted in Denmark (Koch 1998). Koch's study of Neolithic pottery from Danish bogs has showed that the deposited pots were often placed close to the shore in what was open water at the time, often where a stream entered a lake or where two watercourses met (Koch 1998, p. 171; Bradley 2000, p. 61). A number of the bog pots in present-day Denmark were found directly opposite some prominent islets or hills, and there were also megalithic tombs in the same area (Koch 1998, p. 171).

The concentration of megalithic tombs below the hills of bedrock, the ritual deposits in bogs and beside large boulders close to these sites, sometimes between the megalithic structures and the hills, form a pattern. On the Kristianstad plain the hills clearly had a central significance to the people during the Early and Middle Neolithic period, perhaps as places signifying the coming together of heaven and earth. As a miniature of the larger Neolithic landscape on the Kristianstad plain, the megaliths, the timber structures and the enclosure at the site of Skepparslöv have been organized in relation to the hill and its natural features. Activities of ritual character connected to burial ceremonies took place at the timber structures, the megalithic tombs and the enclosure and in the fens. The connection between natural features and monuments is important for our perception of both individual sites and the surrounding landscape.

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The Hamremoen enclosure in southeastern Norway

An exotic glimpse into the process of Neolithization

Håkon Glørstad and Steinar Solheim

Abstract

The article presents an Early Neolithic site from southernmost Norway called Hamremoen. Here, the Museum of Cultural History excavated the remains of an enclosure in 2010–2011. This part of Norway has little solid evidence of agrarian activity from the Early Neolithic. Instead it looks like the forager way of life was sustained. The appearance of an enclosure in such a context is important for our understanding of the whole process of Neolithization or the cultural transformation that took part in Northern Europe at the beginning of the Neolithic. A short phase of occupation took place in the beginning of the fourth millennia and four succeeding use phases have been identified. The pottery at the site shows influence from several regions of the Early Neolithic TRB culture. The pottery style is however locally developed. The ceramics and the enclosure reveal crucial aspects of the acculturation process. Their presence can be explained as the arrival of new people with new ideas and customs in southern Norway at the beginning of the Neolithic. Although their presence did not alter the fundamental structures of subsistence in the area, new ideas and new technologies were nevertheless introduced, demonstrating alterations in cosmology or worldview. The new worldview demonstrates a wider horizon, the importance of far-reaching social networks and new ideas about representation and time. Such changes could have been more intrinsic for the process of Neolithization than new subsistence strategies, not just in southern Norway, but also in northern Europe at large.

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Life in the backwaters of world history

IN REGARDS TO the grand overview of the prehistoric world, one always feels humble as a Norwegian. It seems as if all of the significant inventions and developments took place far from Norway. The best to hope for is to be included as a fringe on the maps displaying European developments. In everyday archaeology this is not a problem because it is quite clear from the archaeological sources that even though Norway is a European periphery, people have been able to live here for the last 11,300 years. Admittedly, this life has not made a strong impact on the general development of the prehistoric world until the Vikings as the first people of history were sailing on all the oceans surrounding Europe (Cunliffe 2008).

There are actually benefits in being marginalized. This position allows for new and surprising discoveries to be made, because certain phenomena might be more visible in the fringes than in the core. This could also be true for our understanding of the introduction of agriculture in Scandinavia or the process of Neolithization during the 4th millennium BC. This article presents an Early Neolithic site

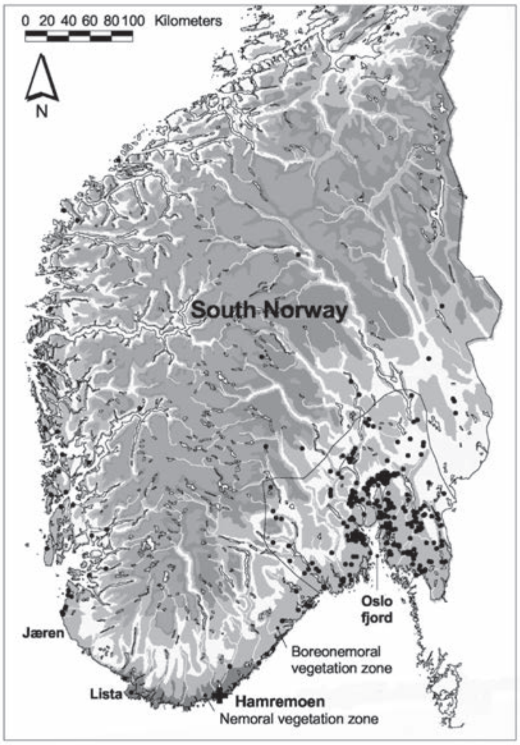

Fig. 1. The location of the Hamremoen site in south Norway. The map also displays the distribution of stray finds from the early Neolithic TRB complex in south Norway (black dots). The line around the concentration of finds around the Oslo fjord area denotes the traditional interpretation of the impact of the TRB complex in Norway. The different vegetation zones are displayed as a background. TRB finds are closely associated with the boreonemoral vegetation zone of eastern Norway. The nemoral vegetation zone found in the southernmost part of the country has very few finds. The conditions for agriculture in this latter vegetation zone is however comparable to Denmark. (Source data for vegetation: miljostatus.no. Source data for TRB: Glørstad 2010).

from southernmost Norway called Hamremoen (Fig. 1), where the Museum of Cultural History conducted excavations of an enclosure in 2010–2011. This region has little solid evidence of agrarian activity from the Early Neolithic. Instead it looks like the forager way of life was sustained. The appearance of an enclosure in such a context is important for our understanding of the whole process of Neolithization or the cultural transformation that took part in northern Europe at the beginning of the Neolithic. The site has provided crucial information about the mechanisms of transmitting culture and knowledge.

Norway and agriculture

In the stories about the evolution of agrarian societies, Norway certainly deserves its peripheral position. With only three per cent arable land and having the entire landmass situated north of the 58th latitude, the conditions for agriculture are poor in comparison to a European scale. In this respect, it is not surprising that Norwegian archaeology has demonstrated that people were dependent upon marine resources, starting from the first colonizers in 9300 BC until the commencement of metal using societies in 2400 BC. The transition to the Neolithic in Norwegian archaeology, taking place 4000–3900 BC is therefore not primarily a change in subsistence (Prescott 1995), but defined by changes in artefact inventory and technology (Olsen 1992; Nærøy 1993; Glørstad 2004).

A closer and more historically sensitive approach will, however, reveal a much more complicated pattern. The southeastern brim of Norway has nemoral vegetation and arable conditions comparable to Denmark (Fig. 1). During the Stone Age, this favourable climatic zone encompassed a much larger area of southern Norway (Høeg 1997). Here weak evidence of Early Neolithic agriculture has been established in pollen diagrams (Høgestøl and Prøsch-Danielsen 2006). The presence of cereal pollen and pollen from *Plantago lanceolata* in Early Neolithic bog horizons is still a much disputed theme and many researchers seem to reject this as solid evidence of early agricultural activity (Prescott 2009; e.g. Lahtinen and Rowley-Conwy 2013). As of today, no firm evidence, such as fossilized and charred grains or bones from domesticated animals, has been dated to the Early Neolithic in Norway. Such evidence does however exist close to today's Norwegian border, in Bohuslän, western Sweden (Sjögren 2013). Bohuslän is tightly interwoven, both culturally and communicatively, with the Oslo fjord area during the Stone Age, and should be considered as part of the same cultural/social sphere. As such, it is highly likely that evidence of Early Neolithic farming will be discovered in areas surrounding the Oslo fjord in the future. In addition, the Oslo fjord region is the only region in Norway where the material culture of the south Scandinavian TRB complex is present in some quantity and variation (Østmo 2007; Glørstad 2008).

If agricultural activity was to limited societies living in the Oslo fjord area, what then with the people and societies in the rest of the nemoral landscapes? Are we observing the activity of two different ethnic communities – immigrating farmers in the east and indigenous hunters and gatherers in the rest of the country?

Fundamentally, the analyses and possible solutions to these problems depends on the status of two loosely connected ontologies; with social evolution to social history at one level and the relation of agriculture to the Early Neolithic Funnel Beaker Culture (TRB) on the other.

Let us be more specific. In the grand evolutionary perspective, perhaps it makes sense to analyse the Early Neolithic of Norway as a periphery of the fundamental economic change that took place at the Continent. But then, what process did actually take place along the Norwegian coast in the Early Neolithic? How can this enlighten the process of Neolithization in general?

What is clearly displayed in the archaeological sources is a continuation of the hunter-gatherer way of life, with the sea as the backbone of subsistence and occupational life. Contemporaneous to the invention and spread of TRB pottery in the south and central Scandinavia, pottery craft also became a part of the cultural repertoire of the coastal population in southern Norway. The adoption of pottery craft clearly displays that technological changes took place at the transition to the Neolithic. Other changes in tool technology are also well documented. This demonstrates that the changes that took place c. 4000 BC were not only a question of diffusion of new artefacts from agrarian communities to hunter-gatherers. These material changes appear to have been far reaching, and they seem to have been intimately involved in the cultural and social developments that took place further south.

Why then, did foragers adopt pottery for processing food at the same time as the TRB complex and agriculture was established in south and central Scandinavia? A tentative answer could be that pottery itself, as well as the making of food in such vessels, was a significant element in the Early Neolithic social fabric. Whether it was grains, milk, meat or fish that was prepared in the vessels was perhaps not of significant importance. As such, the situation could be quite similar to Christmas traditions throughout western Europe today, where different dishes are served for Christmas day/eve. The pan-European feature is, however, to celebrate Christmas with a special meal. This celebration unites western Europe societies more than the different receipts divide them.

In order to proceed with this argument, some kind of ritual or more precisely, communal use of pottery must be specified. This is clearly demonstrated in the TRB complex where pots are ritually deposited in bogs and lakes, in burials contexts in votive pits and in enclosures (Andersen 1988; Koch 1998; Hallgren 2008; Whittle *et al.* 2011).

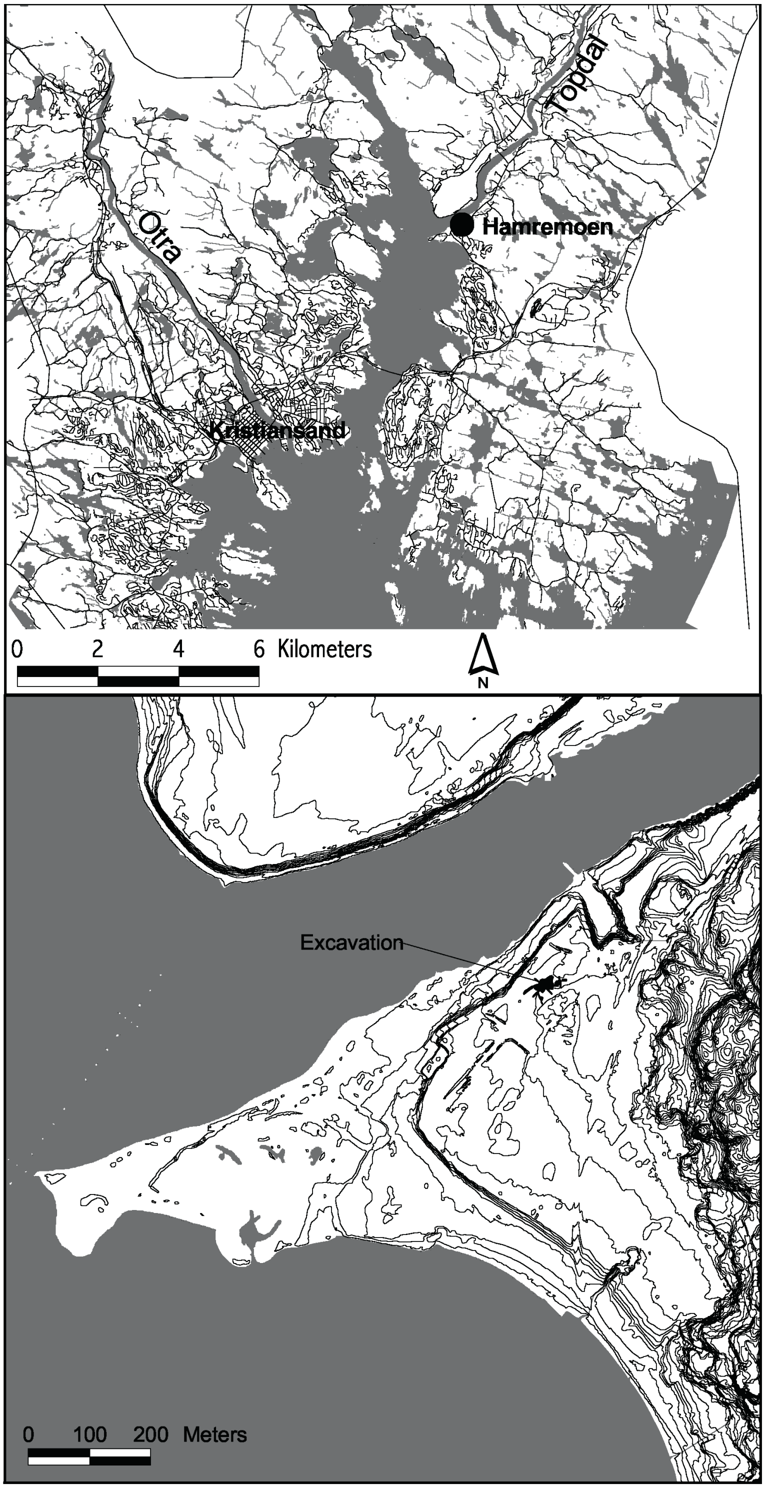

Fig. 2. The location of the Hamremoen site in Vest-Agder County, Kristiansand municipality.

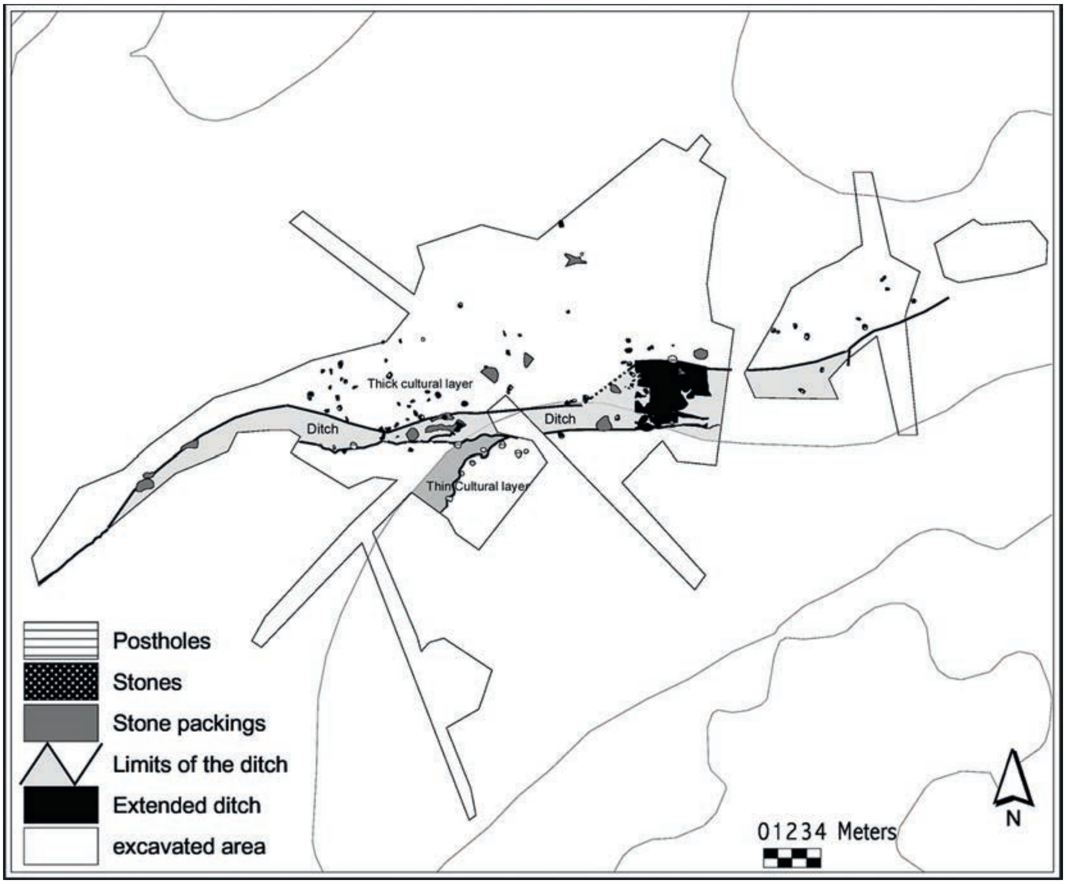

Fig. 3. Simplified overview of the excavation.

A question then arises, is there any evidence for ritual or communal use of pottery in the Norwegian Early Neolithic? Apart from some shards of early Middle Neolithic TRB pottery found in front of a megalith in the southeasternmost part of the country (Østmo 1985), no such finds were previously known. In 2010, however, a new type of site was found in Kristiansand municipality, Vest-Agder County (Sundström *et al.* 2012; Glørstad & Sundström 2014).

The Hamremoen site – general presentation

Hamremoen is located on the south side of the estuary of River Topdal, close to Kristiansand in southernmost region of Norway (Fig. 2). Today, the site is situated eleven m a.s.l., at a mighty riverbank. The River Topdal transports large quantities of fine sediments and sand, creating an unstable and shifting peninsula at the estuary. This process has developed continuously from the end of the Ice Age until today.

The excavation of the site revealed a distinct large scale (at least by Norwegian standards) layout of ditches. Most likely, one long ditch or several shorter ditches organized along the same line delimits an area of approximately 350 square metres facing the river to the north (Fig. 3). The system of ditches was dug into the sand at the prehistoric tip of the peninsula. It was crescent-shaped and probably very visible when travelling by a dugout canoe

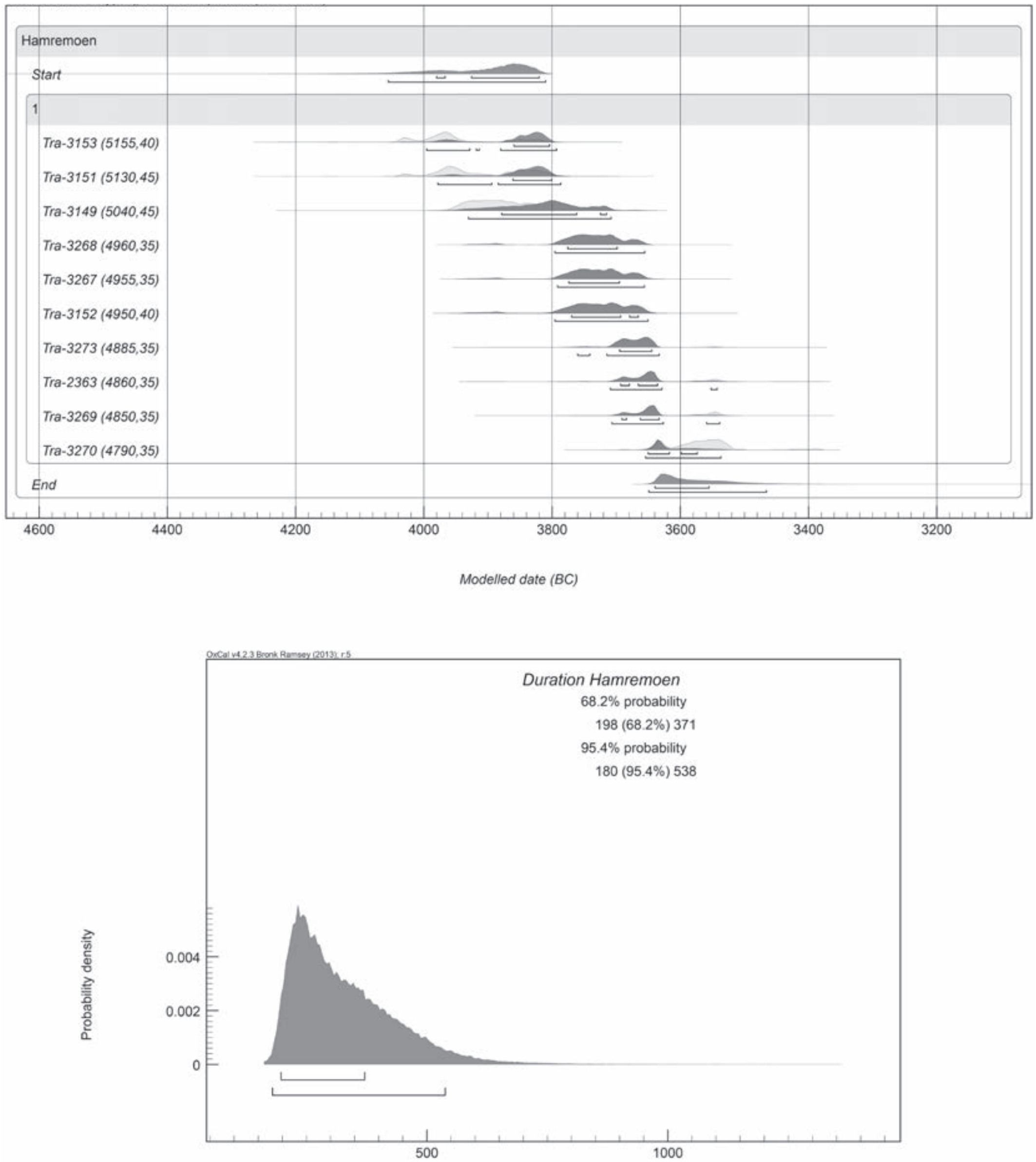

Fig. 4. Top: The OxCal plot shows probability distribution of modelled radiocarbon dates from the cultural layer at the Hamremoen site. The modelled radiocarbon dates estimates activity start between 3990–3820 cal. BC and end at 3640–3560 cal. BC (68% probability). Below: Probability distribution showing estimated duration of activity at Hamremoen using Span analysis in OxCal 4.1.

along the coast or up the river. Posts or walls of wood and stones along the northern side of the ditch enhanced the layout created by the crescent-shaped ditches. Observations made during excavation supports the interpretation that the posts detected were at least partially connected by walls of wood or branches.

The site was exposed to wind and waves coming from south and southwest. Storms and strong waves have at several occasions flushed over the ditches and into the enclosed space behind. The site has been restored or rebuilt at least four times after such events. Finally, the site was buried by sand and abandoned.

Determining the length of the occupation phase at Hamremoen

Ten ^{14}C-results date the site to 4000–3500 BC. The ^{14}C-datings fit very well with the artefact assemblage, containing tanged points, cylindrical blade cores and pottery where the clay is tempered with coarse grained granite and burnt at a low temperature.

The radiocarbon dates indicate a time span for the use of Hamremoen from 4040–3530 cal. BC (Fig. 4). However, the actual occupational phase is most likely shorter. By applying Bayesian statistics, an attempt has been made to narrow the time span of the occupation phase and date the use of the site more precisely (e.g. Bronk Ramsey 2009; Bayliss *et al.* 2011). Bayesian devices in OxCal 4.1 were used to create a site phase model, and the ten Early Neolithic radiocarbon dates from the cultural layer were grouped within a single-phase model.

The model indicates that the Neolithic occupation of the site started in 3990–3820 cal. BC and ended in 3640–3560 cal. BC (68% probability). The dating of the cultural layer covers most of the first half of the Early Neolithic period in the region and the modelled radiocarbon dates indicate that the site was in use for some 300–400 years.

To obtain further information about the duration of the occupation we used the OxCal span function to measure the time difference between the estimated start and end phases (cf. Wicks *et al.* 2013). This suggest that the activity associated with the cultural layer could have taken place within a period most likely lasting between 180 and 540 years (95.4%) with a 68.2% probability of it occurring in between an interval of 200 and 370 years. This suggests that the site was used for a shorter time span than previously assumed (Glørstad & Sundström 2014). However, stratigraphic observations indicate that the activity envelopes at least four rebuilding phases of the site. To summarize, it looks like the site was used at several occasions within a time span of a few hundred years.

The Pottery of the Hamremoen site

Pottery is a new kind of technology and inventory of the Early Neolithic in southern Norway and is introduced simultaneously as the TRB pottery is invented and spread to central Scandinavia and the Baltic Region. The pottery from Hamremoen will be dealt with in greater detail as we believe that understanding the pottery is decisive for understanding the whole site, the relation to the TRB complex and the question of farming as initially discussed.

Pottery is the main artefact category found at Hamremoen. Approximately ten kilos of pottery were collected during the excavation, compared to only 500 gram of flint artefacts (507 pieces). The pots were decorated, mainly with cord impressions around the rim and neck. A few of the pots were almost intact and the majority of them were probably deposited as complete vessels. Most shards were found in dense clusters and are interpreted as collapsed, single pots.

The pottery is of coarse-tempered goods with cord impressions on the neck and rim, a rounded bottom section and a defined neck, but no abrupt transition from the neck to the belly. This vessel type is very typical from the Early Neolithic in eastern middle Sweden where they are considered as part of the TRB complex (Hallgren 2008). In Norway, they traditionally belong to the Early Neolithic, from about 3900 BC (Olsen 1992; Glørstad 2004; 2009; Østmo 2008). Sites with such pottery have been found along the Norwegian coast, at foraging and fishing sites in the prehistoric nemoral zone.

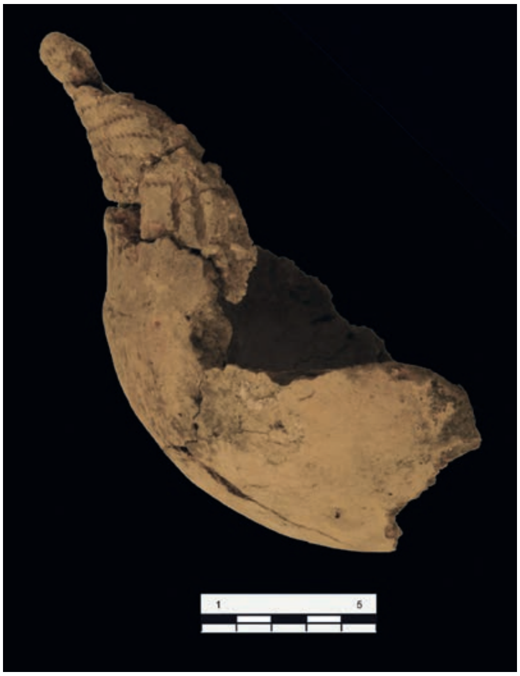

Fig. 5. One of the best preserved pots from the Hamremoen site. The vessel shape follows the design of TRB pottery, especially the funnel beakers, the style is however locally developed.

Usually, the pottery left on open-air sites is very fragmented. The shape and exact size of the vessels are therefore seldom determined. The extraordinary situation at Hamremoen allows us to study quite intact pots. Fig. 5 illustrates one of the best preserved pots. Some details in its shape and composition deserve some further comments. The vessel shape follows the design of TRB pottery, especially the funnel beakers. In profile, the neck is shaped as a concave line. The splayed rim section gives the neck a funnel-shape and the pot an overall open V-shaped profile. The neck/belly transition is consistently accentuated in a horizontal line. The shoulder is only slightly curved. The widest part of the belly is close to the shoulder. The lower part of the belly is curved and goes into a convex base which is quite small in comparison to the orifice.

Similar vessel shapes can be found in the early TRB pots from Denmark, for instance type 0 in Eva Koch's classificatory system (Koch 1998). The vessel shape also bears some similarities to Koch's type I and III.

An interesting *difference* concerning the Hamremoen vessel and the types 0, I and III is that the relative height of the neck compared to the height of the belly is much larger on the Hamremoen pot than on the Danish pots. The belly represents only 85% of the height of the neck, while on the 0-types from Denmark the belly section represents 200% or more of the neck section, measured vertically. In this respect, the proportion of the Hamremoen pot bears much more resemblance to the funnel beakers of Koch's type VI (Koch 1998, p. 103).

The Hamremoen pot differs from the typical profiles of the vessels from the TRB complex of eastern middle Sweden in that the latter pots are wider around the belly than at the rim (Hallgren 2008, p. 161).

The ornamentation is very different from Koch's type 0 and I. This does not make it exclusive in a TRB context as the composition and decor elements are quite common in the TRB culture. The ornaments are created by twisted cords pressed into the wet clay in nine horizontal lines on the neck. The lines are ended towards the shoulder by a section of short, vertical lines of twisted cord. These latter lines are organized in pairs with open areas dividing them. The rim is decorated by short, crossing impressions with twisted cord. This way of decorating pots is very similar to the TRB tradition in eastern Middle Sweden (Hallgren 2008, pp. 167–168), in addition to having close parallels to the material from other Early Neolithic sites in southern Norway (Glørstad 1996).

To summarize, the most complete pot from Hamremoen has a strong resemblance to the TRB pottery found in other parts of Scandinavia. However, no perfect match can be found with any other pottery group within the

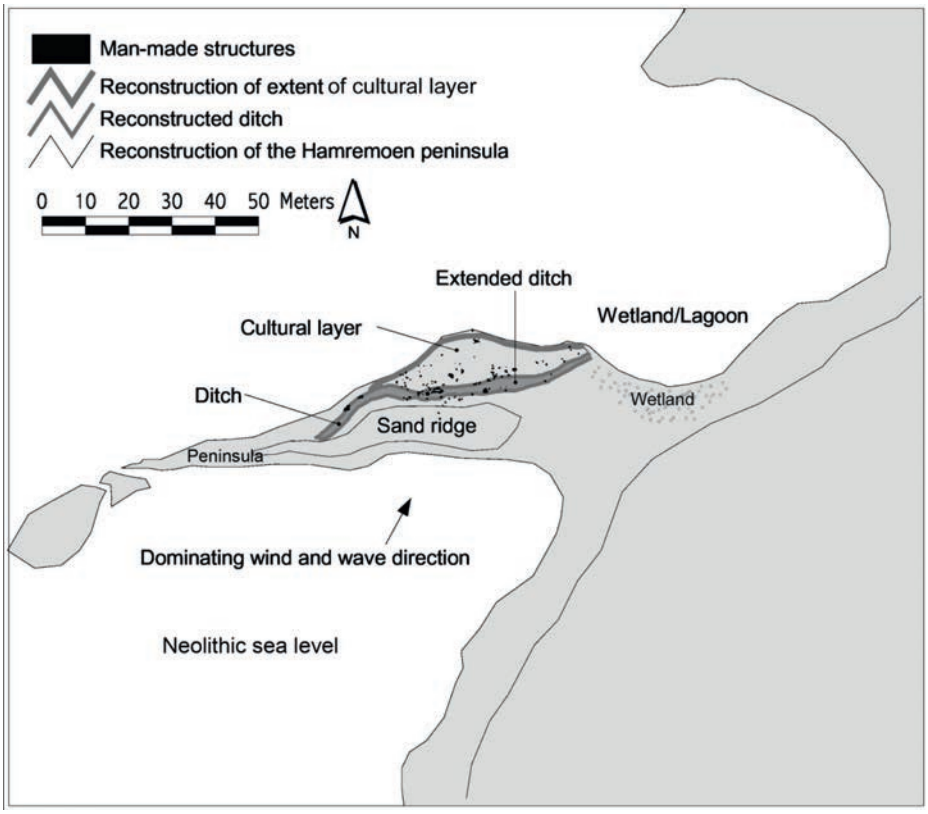

Fig. 6. Preliminary reconstruction of the Hamremoen site in the early Neolithic. The shape of the landscape is only tentative. The reconstruction is based on field observation, the geological interpretation of the formation process and the present shape of the landscape.

TRB area. Aspects of the pottery form resemble Koch's type 0 from south Scandinavia, as the decoration points toward the eastern Middle Sweden and south Norway, while the relative proportions of the pot resembles other types of TRB pots from south Scandinavia. Therefore, we conclude that this pottery is an indigenous tradition developed inside the framework of TRB design.

The use of the pottery and its relation to the different site elements at Hamremoen

The conditions for preservation of organic remains were poor at the site and the ecofacts provided no significant information concerning diet. Traces of lipids from terrestrial animals, plants and marine species were detected in the ware (Isaksson 2012), but no decisive conclusion can be drawn whether the food was domesticated or not. Marine lipids strongly indicate that the diet included fish or other wild, marine animals.

As mentioned, a distinct cultural layer was detected inside the ditch surrounding the site. The layer was in average 15–20 centimetres thick. It consisted of clayish soil, infused with charcoal, other organic debris and large quantities of fire cracked stones. Towards the southwest and the ditch, the layer was horizontally divided into three sub-layers. By studying the profiles in the ditch and the cultural layer, it could be concluded that the layer was divided into four separate occurrences, due to several occasions of the influx of sand from the southwest. Thus, only the southwestern part of the layer was covered with sand. During these occasions, the layer had been recreated by adding a new ground cover of mixed clay. In the areas where the clayish layer was continuously exposed, it grew in thickness. In the areas where the layer was covered with sand, the original extension of the layer was recreated above the sand. From this one can conclude that the original extension of the cultural layer was of significance and that it was recreated when the site was destroyed by wave deposited sand dunes. The second conclusion is that the layer itself was of importance. It cannot be considered as a random accumulation of debris from settlement activities. The clayish substance must have been brought to the site in order to make an effect inside the ditch. The effect was partial in that a deviating colour and texture from the surroundings was created within the secluded area, thus making the site appear like a dark crescent surrounded by a ditch and perhaps walls in an environment with light sand and water.

The relationship between the layer and the pottery is noticeable as it was only in connection with this layer that pots were found. A possible interpretation is that the pottery vessels have been left in a near complete state at the top of the layer and was shattered by the storms sealing off parts of the site with sand.

A ritual site

Hamremoen is in our opinion a ritual site comparable to the enclosures or ditch sites of the TRB complex (Glørstad & Sundström 2014). A ditch and perhaps a wall delimit a crescent-shaped area. Within the boundaries of the ditch, a dark, clayish floor covered the area, which distinguished the area from the light and sandy surroundings. The strategic position, by being situated on a peninsula in the river mouth and the distinctive architecture, make the site a landmark when travelling by boat along the coast or the river to the upland areas (Fig. 6).

This area was used in large scale cooking activities, if we are to judge from the huge quantities of fire cracked rocks found at the site. It is tempting to think that the pottery too was part of the preparation of meals.

In sum, the site seem to be an enclosure for the gathering of many people, not as a part of the ordinary, domestic life, but as a place for special (annual?) occasions. The site itself can be considered as a monument. The construction of it seems to be a deliberate attempt to make something outstanding of everyday life and with its structured architecture and layout, Hamremoen is very different from contemporaneous settlement sites in southern Norway.

There must have been some mission integrated in the construction of the site concerning materializing an idea of a new type of society or a new form of social cult with reference to similar constructions in societies further south. This act of deliberate materialization of memory, events, ideas or history is very different from the social manifestations known from the Mesolithic of Norway. It is therefore tempting to conclude that Hamremoen is a local variant of a widespread social ritual including communal gatherings, feasting and creation of monumental architecture created through inspiration from other parts of Europe. Expanding the Christmas metaphor, which was initially presented, the site could be interpreted as a pan-European Neolithic tradition reshaped into a local design and custom.

Discussion

Judging from the radiocarbon dates, we have reasons to claim that the site represents a relatively short phase of usage at the beginning of the Early Neolithic. What does this short event, in archaeological relations, represent in regards to the Norwegian prehistoric context? In our opinion this case study gives us a unique insight in what the process of Neolithization was about. It was not primarily about agriculture or food production and not necessarily an overt strive for power or prestige either. Judging from the Hamremoen evidence the Neolithic defined a new idea about communicating memory through monumentalization of a collective commemoration. Pottery was part of this complex and it is tempting to think that the vessels were used for cooking at these occasions.

If Claude Levis-Strauss (1969) was right in claiming that society is defined by the exchange of spouses (or women, as he puts it), words and gifts, then one may imagine that pottery was spread along the Norwegian coast by the exchange of people with knowledge of this craft (Hallgren 2008; Olsen 1992). In this network, new ideas about situation and representation were also communicated. The recreation of a local style inside the TRB repertoire certainly indicates the movements of people into southern Norway, not just artefacts. The locally developed style, however, also demonstrates that large-scale migration into the area did not take place. On the contrary, the fact that several local styles developed indicates that only a limited number of people, knowing the craft of pottery entered the local societies, but not enough to ensure the sustainment of a strict foreign style.

One can ask why only pottery and the monumental contextualization of its use were introduced to southern Norway at the beginning of the Neolithic. The Late Mesolithic in southern Norway is characterized by a relatively tight integration of the area in networks stretching from Halland in Sweden to Lista in Norway (The area is more or less the same as the landscapes the Vikings termed Viken or "The Bay". The area constituted a unity in this period too.) The main communication lines followed the coast and the area is characterized by sheltered and convenient coastal communication lines where lakes and rivers connect the coast and significant parts of the rich inland areas. South and west of this area a very different coastal environment is present, with a much more exposed coastline and a different kind of landscape. The Late Mesolithic of Viken is characterized by the well-defined Nøstvet/Lihult complex. The communication patterns are quite intense in this period, where apparently large quantities of goods are exchanged in small-scale networks (Glørstad 2010; cf. Zvelebil 2006).

During the last six centuries of the Late Mesolithic the stable Nøstvet/Lihult complex is gradually replaced by a much more indistinct inventory of artefacts. The subsistence patterns, however, seem to be a continuation of the Nøstvet strategies. This final period of the Mesolithic is characterized by more widespread communication patterns, intensification of big game hunting and the introduction of transverse projectile points of flint, undoubtedly inspired by similar traditions in south Scandinavia (e.g. Andersen 1978; Fischer 2002). We have previously interpreted this development as an intensification of interregional communication, most likely based on task group activities connected to hunting and an exchange motivated by prestige (Glørstad 2008; Solheim 2012).

This extended network seems to be transformed at the transition to the Neolithic. The transformation could partially be explained by the adding of a new social component to the existing repertoire of exchange, namely the exchange of marriage partners from more remote areas. Consequently, new ideas and new types of craft could have been exchanged along the same channels. Apparently, agriculture was not an essential part of this exchange system. Why then, were monumental assembly places and pottery of importance?

As discussed, pottery is useful when processing different kinds of food. The use value of this craft could therefore easily have been acknowledged along the Norwegian coast. Pottery may have been introduced as part of a new ritual meal or as part of a new consumption ideology and/or practice where the way of processing food was important and the actual ingredients of the dish were of secondary importance. For the crafters of pottery, the technology could also have been acknowledged as something connecting them to their place of origin or their local community. Polished flint axes, imported raw materials *etcetera* would have been considered as exotic goods with a remote place of origin. Contrary to this, pottery represented something uniting the exotic and the familiar: Even though it was a new type of object and a hallmark of an exotic society, it could easily have been produced locally.

No doubt, the Norwegian pottery is locally produced. Analysis of Early and Middle Neolithic wares in south Norway have demonstrated that pottery usually are made of local clays, but produced according to the same craft tradition as in the TRB complex (Hulthen 1977). It is therefore tempting to claim that pottery was the transcending gift of affluence *par excellence*. In so far as the *craft* was given in the shape of a spouse, pottery could be produced in large quantities of locally available raw materials. As such, it represented a materialization of the unity of the local and the exotic and the productive potential of this alliance. Pottery represented a materialization of the same productive and reproductive unity as the marriage. The gift in the shape of a spouse was therefore a gift of a *modus* of prosperity and not just an *opus*, as pointed out long time ago by several ethnographers (e.g. Levi-Strauss 1969). It goes without saying that pottery was only *one* of several aspects in such a gift economy. It is however of significant importance because the products from this craft are among the few preserved for archaeological examination.

Finally, there is the question of the meaning of the enclosure. The tradition of building enclosures is widespread in northwestern Europe and it covers a long time span, from the final LBK expansion in the 6th millennium to the peak of the TRB tradition in the middle of the 4th millennium. A reoccurring theme in the interpretation of the European enclosures is that they were erected as a device to commemorate important events or deeds (Jensen 2001; Whittle *et al.* 2011). The work of Whittle *et al.* (2011) has suggested an existence of a long-lived tradition for constructing memorial monuments at the Continent, connecting the LBK and TRB tradition. Thus, the new wave of enclosure building in the fourth millennium represented a renaissance movement of an old and maybe almost forgotten tradition of the first continental European farmers. We adhere to such an interpretation, based on an evaluation of the Hamremoen enclosure.

There are a few examples throughout the Old World that foragers experience some great events or revelations that called for the erection of monuments. Such monuments are for instance the ornamented stone pillars at Göbekli Tepe in Turkey from the epi-Palaeolithic (Schmidt 2010) and the Giant Churches (megastructures) in Bothnia from the Late Neolithic (Nunez 2004). These monuments occur at very different times and places but still they might represent similar responses to important events in history. We think that the Hamremoen enclosure represent a similar monumental response to an important historical event. This event was not the introduction of agrarian production techniques *per se* but a significant extension of the social horizon. It could be that the monument at Hamremoen was erected by people coming from far away – from agrarian societies in south Scandinavia or Germany, and just like the recreation of pottery craft at the site, the enclosure was also build according to the local prerequisites, still as something fundamentally new, a portal between the local and the foreign.

In such a perspective the Hamremoen site captures crucial aspects of the process of Neolithization. The site shows us the allure, and at the same time, the fragility in the development in question. A new idea about society, cosmology and/or history was created in the beginning of the 4th millennium. Here, a weave between the local and the exotic was at the core. The meaning and the transformative force in this social alteration were, however, dependent upon the volume and robustness in the social relations as well as the local setting. In the southernmost part of Norway this alteration apparently meant no significant change in subsistence. The process of Neolithization is more likely considered as a new awareness of the world involving new partners and customs. In the shape of the pottery and in the erection of the enclosure one can glimpse that these new ideas concerned the productive potential of uniting the local and the exotic as a new modus of being.

The TRB complex is in general characterized by heterogeneity and hybridization (Thomas 1991; Midgley 1992). What is observed at the Hamremoen site is therefore not very different from what can be deduced from north European evidence in general. It is already stated, many years ago, that the south Scandinavian pottery styles are significantly different in the different landscapes at the same time (Madsen & Petersen 1984). The same heterogeneity can also be observed in the creation and layout of the European enclosures (Whittle *et al*. 2011). We think that this heterogeneity is an essential part of the "new" Neolithic of the fourth millennium, simply because the core of this new social development was an idea about the productive potential of this state of being. Life could only prosper by uniting the familiar with the exotic.

Sites such as the Hamremoen enclosure are rare examples where this process can be studied with some precision because the cultural setting contrasts the changes with clarity and because the conditions for preservation allows for studying in detail a very limited time slice in prehistory. The emancipation from the ever-lasting discussion about the role of agriculture in the Neolithization process also highlights the historical vectors in the course of events. Thus, one can understand why the hunter-gatherer societies also were transformed around 4000 BC. Such is the benefits of being in the backwaters of World history. It is in such fringes that history demonstrates its importance to the evolution of man, culture and society.

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Occupy time!

The construction of design and monuments in Tiefstich central Europe

Johannes Müller

Abstract

Besides the reconstruction of high-precision chronologies for single sites, the construction of precise time scales for stylistic developments enables archaeologists to answer questions about regional developments. The dimension of change in stylistic developments, in monument use and in environmental changes on a generational scale brings us nearer to the prehistoric individual: We start to talk about memory culture and involvement from generation to generation. Here, a case study from north central Europe – the Altmark region – is used to disentangle aspects of memorizing (on the household level) and monumentalization (on a supra-household level) in TRB Europe: two different social institutions occupy time in different ways.

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Research questions

With the application of scientific dating methods, a shift from analyses of the development of material culture, settlement patterns and ritual activities on supra-regional and regional scales was initiated to enable detailed detections of processes and stages of local sites and local activities, e.g. the implemented Bayesian approach on radiometric dates mainly addresses individual sites and combines the results into stories about regions (cf. Whittle *et al.* 2011). An additional approach, which has been developed in recent years, returns to "quantitative typology": statistical gradients on the similarities of artefacts or assemblages are combined with absolute chronological dates and time developments modelled in depth. As a result, every pot or assemblage used in the analyses could be assigned to an individual time probability (Hinz and Müller, 2014).

With such possibilities in mind, I would like to analyse the stylistic development in one distinctive stylistic area of the north central European TRB societies: the Tiefstich pottery area of the Altmark (Fig. 1). The investigation leads to a precise chronology of the typological development, which then enables us to answer the following questions:

1. Is the development of stylistic elements continuous or are significant deviations visible which might hint at changes in the memory culture of the non-literate communities?
2. Are there detectable, significant breaks or accelerated developments in the production, distribution and consumption of material culture?
3. What can be assumed about the quantities of depositional processes in different spheres of society?
4. Do individual sites reflect the overall development, as visible in the comparison with Lüdelsen 6?

Methods and database

To quantify the typological development of sites with "Tiefstich pottery of Altmark type" (Preuss

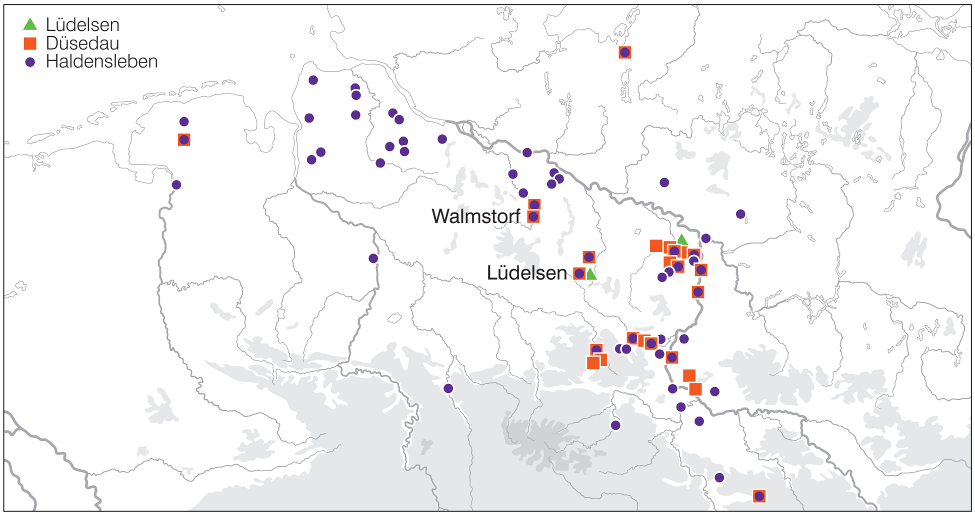

Fig. 1. The distribution area of Altmark Tiefstich. The distribution is marked with respect to the phases: Lüdelsen (3650–3600 BCE), Düsedau 1–3 (3600–3350 BCE) and Haldensleben 1–4 (3350–2900 BCE). Sites mentioned in the text are mapped: 1 Lüdelsen; 2 Walmstorf.- The sites are the selection of assemblages, where vessels with more than one decoration type and a fully reconstructed vessel shape were found (graphic: Holger Dieterich, CAU Kiel).

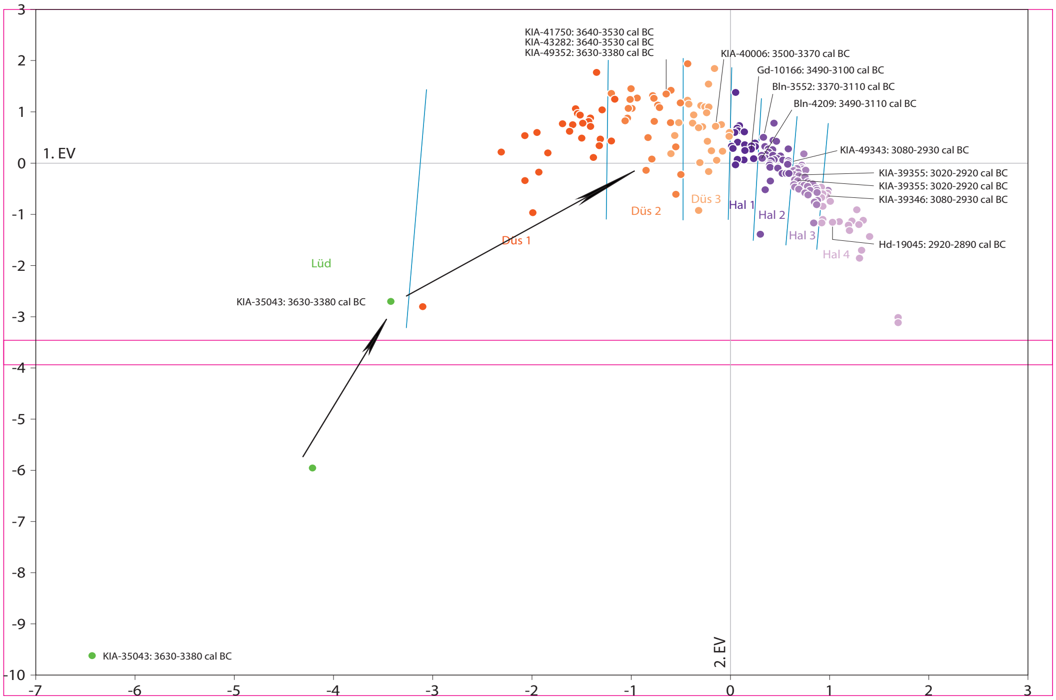

Fig. 2. Correspondence analysis (CA) of 264 Tiefstich pots according to decoration motifs. ^{14}C-dates and stratigraphies (arrows) indicate the chronological meaning of the sequence, which is reflected in Fig. 3 (cf. Tiede *et al.* in press). The phases and sub-phases are marked (graphic: Holger Dieterich, CAU Kiel).

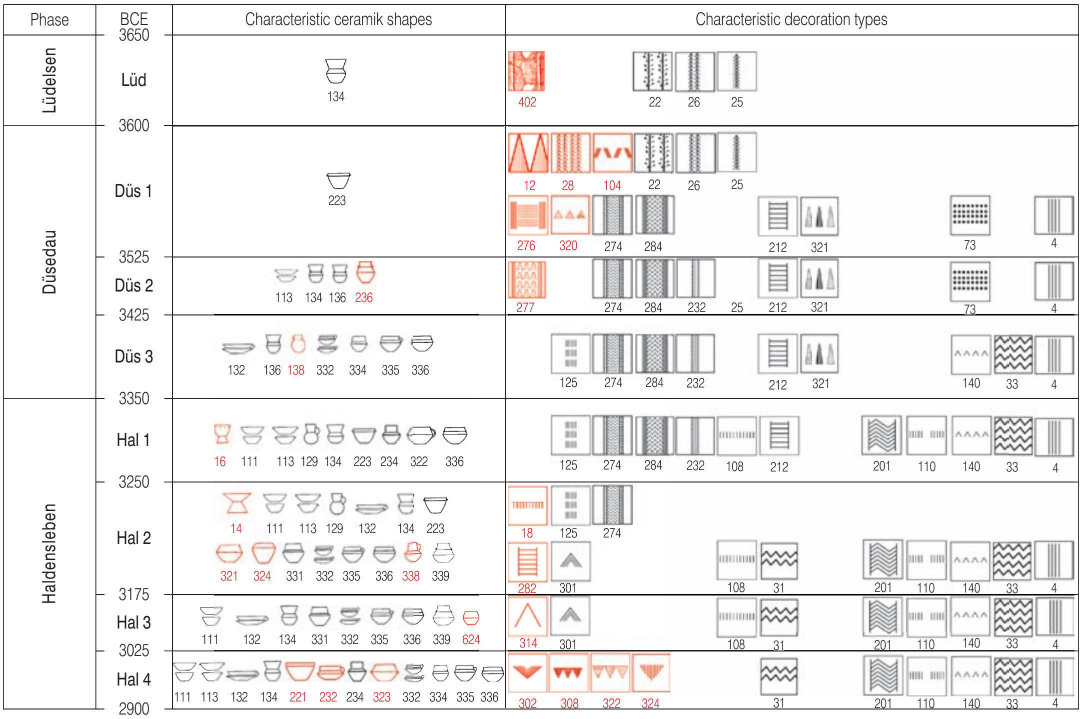

Fig. 3. The general development of Tiefstich pottery of the Altmark group, resulting from CA. The absolute chronology is gained from Non-Metric Multidimensional Scaling (NMDS), processing a linear time span on the basis of available ^{14}C-dates (cf. Tiede *et al.* in press).

1980), Correspondence Analyses (CA) were used in a recent study (Tiede *et al.* in press). As many of the Tiefstich sites do not resemble closed units but are rather features used for a longer time (e.g. megalithic burials), well-preserved ceramic pots were chosen as the closed unit for the analyses. Typological classification was carried out on the basis assumptions of NoNek (north European Neolithic Ceramic, an open-access recording system, www.nonek.uni-kiel.de (Mischka 2008). Overall, 263 individual pots with more than one decoration pattern were classified and used in the CA. As a result, by using cluster analyses, 8 different stylistic groups were artificially separated in the resulting matrix, judging from the values of the 1st and 2nd eigenvalues. Context analyses identified 19 radiometric datings that are associated with individual pots. Furthermore, 3 stratigraphies of pots were identified. Both stratigraphies and ^{14}C dates prove that we are dealing with a valid chronological gradient in the CA analyses (Fig. 2). In consequence, the 8 assemblage groups were identified as 8 chronological phases. We label them in relation to 3 sites: Lüdelsen, Düsedau 1–3 and Haldensleben 1–4. The typological backgrounds of Düsedau and Haldensleben correspond to the two distinct Tiefstich horizons which Preuss identified 35 years ago (Preuss 1980).

Both by using the linear chronological gradient of Non-Metric Multidimensional Scaling (NMDS) analyses as well as the position of individual ^{14}C-dates on the matrix, an absolute chronological model could be developed for the 8 phases (Tiede *et al.* in press). Mapping and statistics about spatial and further developments are now available to verify hypotheses.

After identifying the precise chronological development of Tiefstich ceramic styles in the

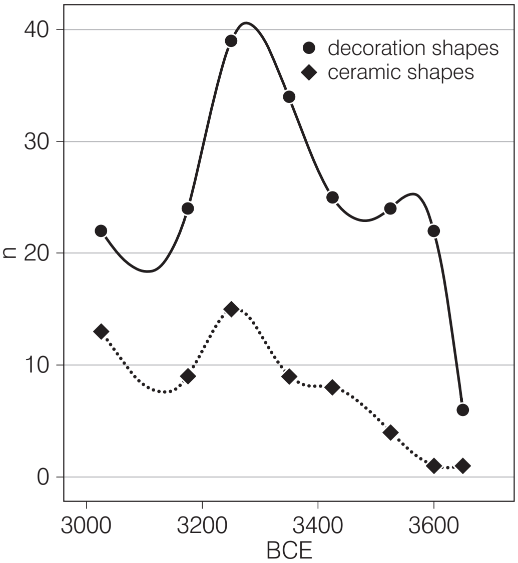

Fig. 4. The development of the sum of pot shapes and decoration types. Despite the small number, statistically significant tendencies are indicated: increases in absolute variability *c.* 3650–3250 BCE in contrast to reduced absolute design variability after *c.* 3250 BCE (graphic: Holger Dieterich, CAU Kiel).

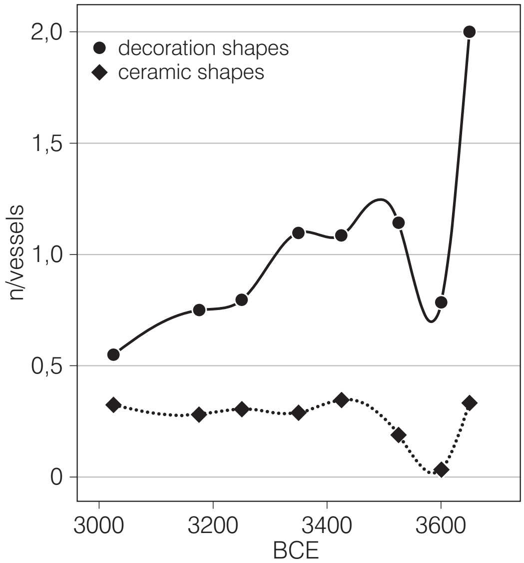

Fig. 5. Relative quantity of pot shapes and decoration types (divided by the quantity of pots). While the low diversity around *c.* 3600 BCE is due to the small number, the general tendency of a decrease in variation is statistically significant (graphic: Holger Dieterich, CAU Kiel).

Altmark region, individual sites were analysed in relation to the general pattern. To this end, both individual site reports and the reconstruction of activities at early rescue excavation sites were used.

Above all, we take household-produced ceramics with their design systems as a proxy for the transfer of knowledge from one generation to the next and within communities. For instance, changes indicate breaks in the memorizing of household or communal principles or divergences between households and sites in the use of design in expressing old, new and changing identities over certain spatial levels.

Results

1. Continuous knowledge transfer

The reconstruction of the development of the design of household-made ceramics with their decoration variety is one tool to identify processes of knowledge transfer. On a linear time scale, for example, shifts in the rate of changing ornament patterns reflect the ups and downs in the institutional transfer from one generation to the next.

With respect to Altmark Tiefstich pottery, design variation is extraordinary (Fig. 3). From funnel beakers with only few plastic elements, for instance filled triangles near the rims, to various forms of vertical engravings and zigzag decorations, the number of both ornament types and pot shapes increased from *c.* 3650–3250 BCE (Fig 4). Interpreting the observation, the increase could be explained by households which deal with a growing complexity of tasks associated with the societal spheres in which pottery is used. In addition, the rising number of decoration designs could hint at an evolving necessity to express household identities via individual sign systems.

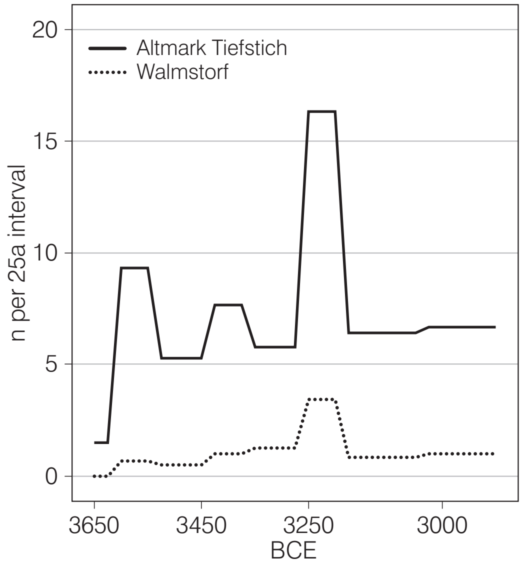

Fig. 6. The absolute rate of deposited pots, calculated for 25-year steps. A higher deposition (and probably production) rate is visible for the 32nd century BCE both in general for Tiefstich sites and for the Walmstorf enclosure (graphic: Holger Dieterich, CAU Kiel).

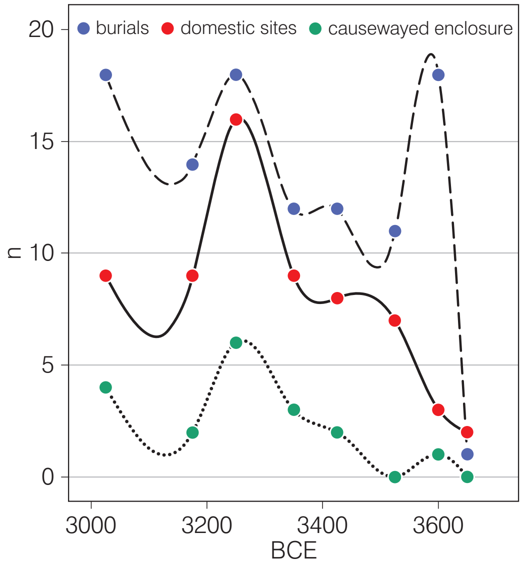

Fig. 7. The absolute quantity of deposited pots in domestic sites, burials and causewayed enclosures. While differences around 3600 BCE are due to the small number, the general pattern of similar deposition rates independent of site types is displayed (graphic: Holger Dieterich, CAU Kiel).

In contrast, the relative quantity of pot shapes and decoration types (calculated on the basis of the quantity of produced [or deposited] ceramics) leads to a different interpretation (Fig. 5). The number of ceramic shapes remains stable over about 700 years, while the relative number of decoration types continuously decreases. Obviously, the complexity of social practices in which ceramics were involved did not change over many centuries, but rather followed a centuries-long pattern that was traditionally grounded within the communities. Furthermore, as longer-lasting TRB communities were present in the Altmark, a decrease of ornament variation might indicate an increase in stability: The common method of the Altmark societies to distinguish separate households by design clusters (here using household-produced pottery) became increasingly obsolete, as the social roles within social practices were increasingly embedded in the memorized ideology. In line with such an interpretation is the observation that in an NMDS analysis the rate of stylistic change stays quite low (Fig. 11).

2. *Development of production and deposition*

Nevertheless, the quantity of deposited pots, which might be taken as a proxy for the production rate of ceramics, shows significant differences (Fig. 6). The overall number of pots increases on a significant level around *c.* 3250 BCE. Further differences in the quantities cannot be verified statistically because of the small overall number recognized. In combination with the observation about the continuous figures of ceramic designs, rates of production and deposition are apparently not linked to changes in social practices in which ceramics are involved. The steep increase appeared at a time at which (judged by ceramic design and ceramic shapes) the Tiefstich society was in a stable mode.

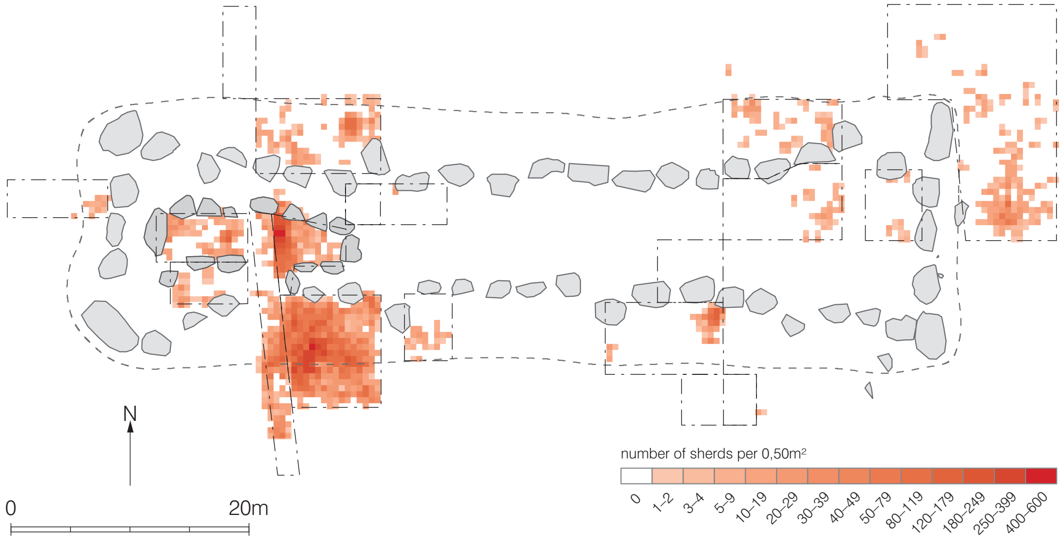

Fig. 8. Ground plan of the long mound and passage grave Lüdelsen 6, Altmark (Demnick *et al*. in press; Müller 2011, 34 fig. 18). The distribution of ceramics indicates depositional areas around the mound.

Obviously, the density of sites in the core Altmark area must have increased at a similar moment in time, which would indicate a population increase. Furthermore, the area in which Altmark-Tiefstich pottery was used also increased immensely. Thus, the production/deposition rate of Altmark Tiefstich pots would point to a population increase and an opening of networks to further neighbouring communities that would explain the huge distribution area of Altmark-Tiefstich.

3. Societal spheres and depositional processes

The little data available indicate that, in general, the quantities of known, well-preserved pots from burials, domestic sites, or causewayed enclosures follow a similar pattern (Fig. 7). Except perhaps during the Düsedau 2 phase, increases and decreases in the quantity of pots from settlements are generally mirrored in a same manner in megaliths, flat graves, and in the enclosure of Walmstorf (cf. Fig. 6). Thus, it seems to be clear that not many changes are visible in the production, distribution and both domestic and ritual consumption of Tiefstich items.

Drawing such a general picture from one aspect of material culture bound to household production (ceramics and their contexts) leads to the question whether the steady flow of information exchange from generation to generation without important interruptions is also valid on other societal levels.

4. Common memories

In my opinion, in addition to activities on the household level, monuments and communal sites play a significant role in the transformation of knowledge and norms from one generation to the next in non-literate societies. Gatherings at the places of the ancestors serve as opportunities for the rememorization of communal knowledge. In such a sense, the chronological development of architectural activities and depositions at such sites could be analysed with respect to our introductory questions. One example of an Altmark monument is appropriate for this purpose.

Lüdelsen 6, a long mound with a passage

grave, 37.5 m in length, 11 m in width and still measuring 1.7 m in height, is one of the largest monuments of the Neolithic Altmark area (Figs. 1 and 8). Intensive excavations of the site took place in 2009 and 2010, resulting in a model of the monument history and the depositional processes associated with it (Fig. 9) (Demnick *et al.* in press; Diers and Demnick 2012).

Phase 1 (layers 5/4 [>3700 BCE; activities on 4 [3700–3570 BCE])

Actually, the first phase of activities at the site is bound to the creation of a non-megalithic long mound at the location of an already slightly elevated ridge within the landscape. The first mound builders used weakly sorted, fluvio-glacial sand with inclusions, which was deposited at the locality during the Saalian glaciation. They particularly selected this material, which is lighter in colour than other locally available materials, to construct the 11 m wide, 35 m long and about 1 m high mound. The building activities occurred after the placement of a gravel fundament layer. The raising of mound 1 was possibly accomplished in two stages (layers 5 and 4). Activities on top of the first mound can be associated with small fires and the digging of shallow pits. These ritual activities took place between 3840/3570 and 3630/3500 BCE. The construction of the long mound marks one or two peaks of activities, probably before 3700 BCE, if we use the average probability of the earliest "firestorms" on the mound (*c.* 3700 BCE). Different postholes are also associated with these activities.

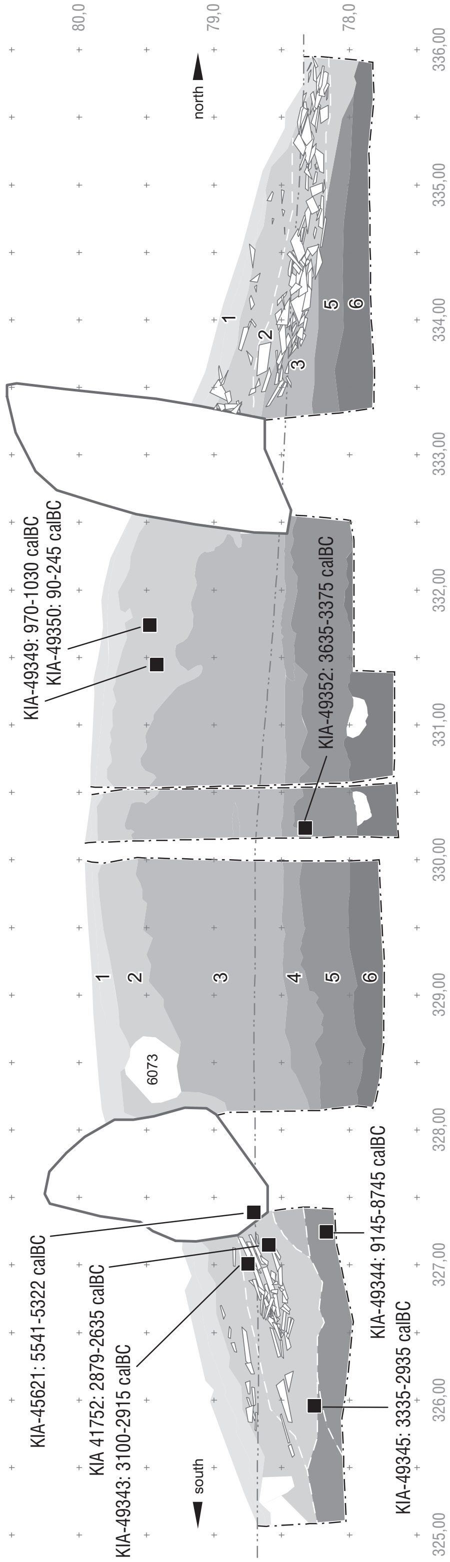

Fig. 9. The stratigraphy of Lüdelsen 6 (selected profile) enables the reconstruction of different monumental phases (Demnick *et al.* in press). After a non-megalithic long mound the construction was changed into a megalithic long mound with a passage grave (graphic: Holger Dieterich, CAU Kiel).

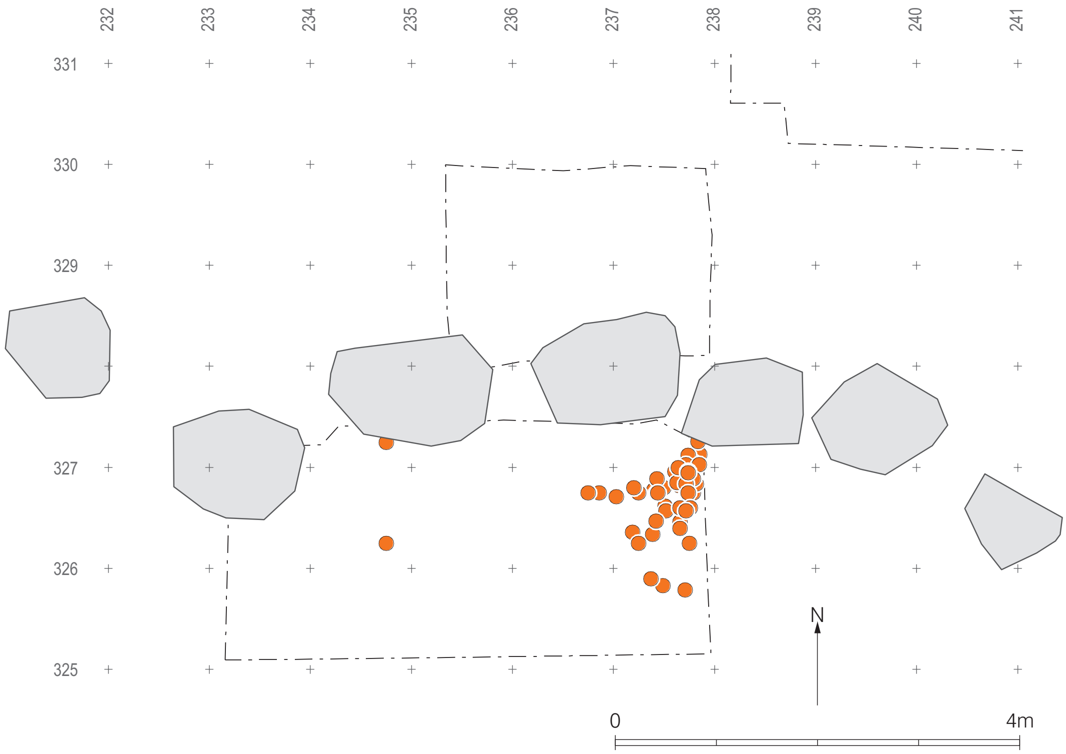

Fig. 10. Lüdelsen 6 with vessel 125 on the ground in the forecourt. The spatial distribution of single pot sherds reflects the throwing down from one top position into the forecourt (Demnick *et al.* in press).

Phases 2 (layer 3 [3470–3390 BCE]) and Phase 3 (megalithic phase [3390–3320 BCE])
A rebuilding in the form of a second long mound took place between 3570/3380 and 3500/3280 BCE. The mound was elevated to a height of at least 2 m above ground level. Silty-sand depositions of different types were used as a building material. During construction, fires blazed again, discovered in the form of a small fireplace.

The orthostats of the passage grave were dug into mound 2. The same is also true for the blocks of the megalithic kerb. It is still also possible that mound 2 and the megalithic architectural features were constructed during one single building process. In the first case, Phase 3 (the megalithic phase) dates between 3490/3280 and 3330/3310 BCE, in the second case as Phase 2. Both datings are possible as they overlap in a statistical sense.

The megalithic construction involved 53 kerbstones for the resultant megalithic mound, 15 orthostats and 3 capstones for the passage grave, as well as dry-stone masonry of spandrel type and many boulders for the chamber floor. Burnt granite was produced and used as a second floor layer. At least some postholes are also associated with this phase. The depositional processes within the chamber are difficult to evaluate, as in different subsequent phases most parts of the chamber were cleared.

Phase 4 (depositional processes [3320–3010 BCE])
In the forecourt of the passage grave to the south of the monument, different amounts of ceramics and other items were found. The distribution of the sherds of five different vessels indicates that they had been placed on top of

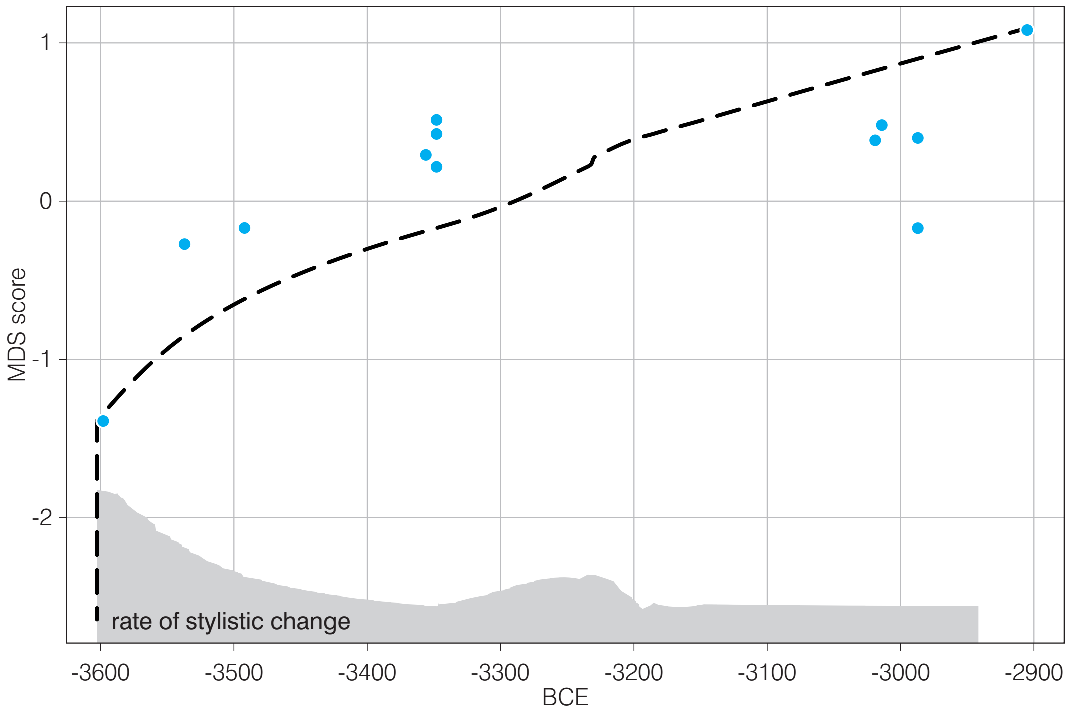

Fig. 11. Visualization of the rate of Tiefstich stylistic change (base: decoration types shapes) plotted according to their NMDS score vs. absolute date (Tiede *et al.* in press). The black dotted line shows a non-linear estimation (LOESS) of the development. The shaded area represents the steepness of the LOESS model, interpreted as speed of change. The low but continuous development is visible (graphic: Holger Dieterich, CAU Kiel).

some boulders and toppled down later (Fig. 10). The destruction of these pots took place already during phase 3. The time span ranges from 3330/3300 to 3030/2930 BCE.

Phase 5 (destruction and reconstruction [2890–2870 BCE])

At a moment in time, which we would like to set around 3000 BCE, the chamber was emptied, burials with Globular Amphorae were probably inserted, the dry-stone masonry was taken out and a third mound layer was constructed on top to raise the height of the monument. Clearly, the design and use of both the monument and the chamber shifted. The mound structure for collective burials with megalithic appearance became a huge mound for single burials and a deconstructed megalithic architecture. While the monument was obviously used in a different way, activities ceased around 2880/2640 BCE and were resumed again with Bronze Age activities not earlier than 1013/835 BCE.

Interpretation

Actually, the depositional processes at the single site of Lüdelsen display a different rhythm of activities than that which is in general terms detectable, e.g. in the overall ceramic development. First of all, mound building started abruptly at some moment before 3700 BCE. Activities on top of the mound lasted for about 5 generations, contemporaneous with the development of the Lüdelsen style. The construction of a second mound, most likely associated with the megalithic phase of the site, probably took place around 3390 BCE. As the megalithic kerb of the long mound follows the old non-megalithic layout of the earthwork, continuity in tradition is visible together with a radical change of the meaning: The passage grave strengthens the collectiveness of the ancestors; the forecourt renews the general worshipping.

The act of worshipping followed a new principle – creating pots and destructing pots; even the number of depositions increased in contrast to former phases. The increase in ritual activities, manifested in moveable items, is contemporary with the overall observed increase in pottery production.

The third important moment of monument development is represented by the destruction of the megalithic meaning: The dry-stone masonry was deliberately destroyed, a further raising with an earthen mound, which did not acknowledge the former megalithic borders, was constructed, the chamber was cleared and burials of single character (?) were obviously introduced. In general, interest in the place was lost after a while.

To summarize: Lüdelsen 6 displays clear-cut events of construction and destruction, megalithic and non-megalithic: (a) >3700 BCE "Earth and the long mound", (b) 3390 BCE "Megalithic boulders and collective burial space", (c) 2880 BCE "Earthen destruction and individuals" might label the radical changes of the concept, visible in the architecture. This is not the story of slight alterations leading to change. It is the story of radically occupying place and time: the time of the ancestors.

Such strong events of change are also visible at other ritual places: the Tiefstich causewayed enclosure of Walmstorf, the megalith of Lüdelsen 3 or even the enclosure of Dieksknöll (Tiede *et al.* in press; Demnick *et al.* in press; Dibbern, 2012)

Occupying time: different institutions at work

The determination of the rate of change in the design of movable material culture, which was produced in households, and the rate of change in the design of a monument display quite different patterns:

1. a flow of continuous stylistic change, which reflects no problems or breaks in the distribution of knowledge between generations of households, describes the basic pattern on which the Tiefstich societies rested.
2. a radical change in architectural efforts associated with monuments, probably indicating ritual/ideological transformations within the monument-building societies.

The differences might demonstrate the different rhythms of Tiefstich households and a ritual institution of the Tiefstich communities. Times changed differently: either embedded in the stabilized household communities or reflecting clear differences in long-lasting ideological and ritual patterns, which changed dramatically on specific occasions. The different institutions at work might reflect dynamics which are also indicated by the change of social space within the landscape.

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Transforming place and architecture through cremation

Cremation traditions at the third millennium BC monument complex at Forteviot, central Scotland

Gordon Noble and Kenneth Brophy

Abstract

This chapter will reflect on one of the key discoveries of the authors' research excavations conducted at Forteviot in lower Strathearn, central Scotland, between 2007 and 2010. Investigations here have revealed an extensive complex of late Neolithic monumentality and burial including a giant late Neolithic palisaded enclosure and a range of associated henges, timber structures and burials dating to the period 3000–2000 cal. BC. The catalysis for the creation of this extensive monument complex on a landscape scale may have been the establishment of a cremation cemetery at Forteviot where a minimum of 18 individuals were placed in the ground accompanied by bone pins and a handful of other grave goods in the early centuries of the 3rd millennium cal. BC. In the centuries following the establishment of the cremation cemetery at Forteviot, the aforementioned timber and earthwork enclosures were constructed, some encircling the cemetery; episodes of monument creation and burial continued into the Chalcolithic and Early Bronze Age. At Forteviot we can perhaps identify these activities as ways in which subsequent generations attempted to control access to an important ancestral shrine and burial ground.

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Introduction

Around the beginnings of the 3rd millennium cal. BC an extensive and unusual Late Neolithic cremation cemetery was established at Forteviot, central Scotland. This place would subsequently emerge as one of the most elaborate monument complexes created in Scotland during the Neolithic (Noble & Brophy 2011a; Noble & Brophy 2011b). This chapter represents a preliminary exploration of the significance of the cremations at Forteviot, examining who was buried at this site, and the ways that the establishment of the cremation cemetery at Forteviot may have both been a catalysis and inspiration for elaborate monument building and prolonged acts of remembrance over a millennium.

The Late Neolithic period in Scotland, between about 3000 and 2500 BC, was a period where large-scale monumentality was relatively commonplace, with the construction of hundreds of circular and sub-circular enclosures of earth, timber and stone. These include timber circles, henge monuments and some early stone circles, but also a small number of so-called palisaded enclosures (Barclay 2005; Noble 2006; Millican 2007). The five timber palisaded enclosures identified thus far

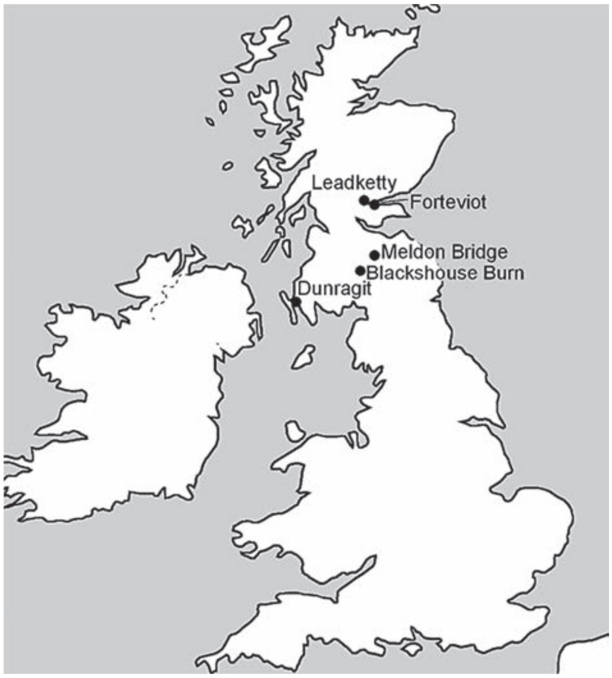

Fig. 1. Location map showing Forteviot and the other palisaded enclosure sites in Scotland.

(Fig. 1) appear to represent the largest construction projects undertaken in Scotland at this time, conspicuous materialisations of Late Neolithic ideology. In terms of scale they are on a par with the "super-henges" of southern England (such as Avebury and Durrington Walls) and have close similarities in scale, date and character with a series of palisaded enclosures found in southern Scandinavia (Svensson 2002; Brink *et al.* 2009; Noble & Brophy 2011b). Radiocarbon dates from excavations at the Scottish and Scandinavian examples suggest that these monuments were constructed in the period *c.* 2800–2500 cal BC, the last centuries of the Neolithic period. It is likely then, that these extravagant monuments were a final flourishing of large-scale monumentality in Scotland's Neolithic (see Needham 2012), and although evidence for the function of these enclosures is limited, they would have been places that could easily have hosted gatherings of large numbers of people and likely served a range of roles.

The Forteviot complex

The Forteviot complex survives only as cropmarks, and was discovered from the air during Cambridge University (CUCAP) reconnaissance flights into Scotland in the early 1970s (St Joseph 1978). These and subsequent sorties have revealed that the site was dominated by a large palisaded enclosure in association with a wide range of pennanular and circular enclosures, large pits, and a range of other features (Fig. 2), none of which had been investigated prior to our work. Our investigations commenced in 2006 as part of the Strathearn Environs and Royal Forteviot (SERF) Project with major excavations in 2007–10 (Driscoll *et al.* 2010). The Forteviot palisaded enclosure measures about 265 m in diameter, with a sub-circular plan defined by an irregular boundary of spaced postholes; other features within and around this massive enclosure include three henges, two timber circles, a series of pennanular enclosures and pit features. Our excavations at Forteviot focused on the entrance avenue of the palisaded enclosure, stretches of the northern and eastern sides of the enclosure perimeter, two of the henge monuments, a timber circle and a double-ditched enclosure (see Noble & Brophy 2011a; Brophy & Noble 2012). These excavations have allowed us to construct one of the most comprehensive dating sequences for a late Neolithic to Early Bronze Age ceremonial landscape in Britain, demonstrating that Forteviot remained a place of ritual and commemoration for over a millennia, with the earliest key component seemingly the crema-

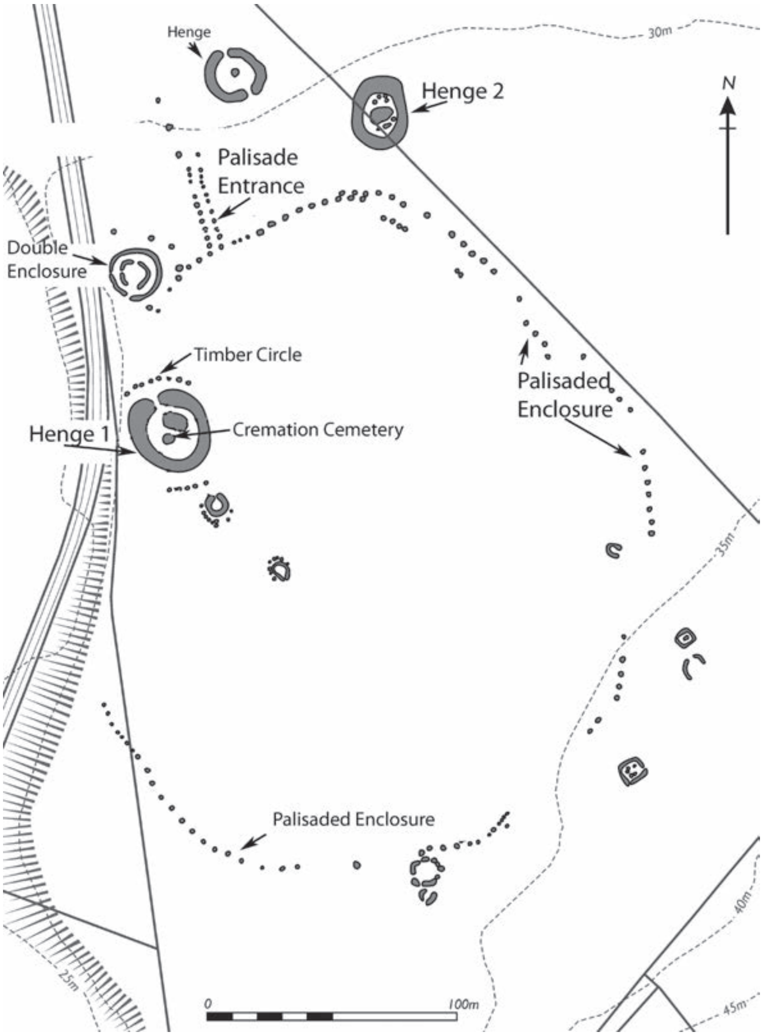

Fig. 2. Transcription of the cropmark complex at Forteviot; the location of the cremation cemetery within henge 1 is marked on the plan (drawing prepared by Lorraine McEwan).

tion cemetery (see Table 1 for a summary of dating of the main monuments).

The late Neolithic cremation cemetery

The earliest major phase of activity that we have identified at Forteviot appears to have been the establishment of a late Neolithic cremation cemetery located at what we could characterize as the heart of the monument complex, within a large henge monument (henge 1) located inside the palisaded enclosure. We excavated nine discrete cremation deposits in 2009, some clustered within cut features, and an extensive spread of dispersed cremated material was found scattered throughout silt spreads that were evident across much of the western henge interior. (The true extent of the cemetery is unclear due to disturbance related to early medieval

Table 1. Outline chronology of the cemetery and subsequent enclosing monuments at Forteviot (the dates are based on Bayesian modelling (at 2 sigma).

Monument	Date	Artefact associations
Cremation Cemetery	2975–2755 cal. BC	Bone pins, leaf shaped arrowhead, accessory vessel
Palisaded Enclosure	2780–2485 cal. BC	n/a
Timber Circle	2620–2475 cal. BC	n/a
Henge 1	2385–2230 cal. BC	Beaker pottery

activity within the henge's eastern half.) The dead were placed into small pits, probably contained within organic vessels or bags given the discrete arrangement of some of the deposits (Fig. 3). Some of the burials were seemingly in association with a stone setting of some kind; in one feature where cremations were concentrated the base of what appears to be a snapped standing stone surviving in its socket was found (Fig. 4), while other cremations may have been placed within an empty stone hole. It seems likely, then, that the cremation cemetery was established soon after the decommissioning of a stone circle or setting, with the empty sockets a particular focus for burials.

Analysis by Stephany Leach (2012) has identified a minimum of 18 individuals amongst the sample of cremation deposits excavated at Forteviot, 11 of them adults and the remainder subadults (the very young and very old were not represented). Both gracile and robust bones are present, suggesting the remains of both males and females were interred. Remarkably, it seems few of the burial deposits represented single individuals: amongst the remains there were recurring finds of mixed adult and child cremations with matching numbers of adults and children identified. The material remains of the dead were also obviously highly important to the mourners. Nearly all the cremations included very small bones indicating the careful and meticulous collection of remains from the pyre site. The pyres had also been well made and maintained – the levels of cremation clearly involved an efficient pyre technology and plentiful firewood was used to ensure burning for an extended period at high temperatures (Leach 2012, pp. 28 ff.).

A few objects were found in association with the cremations. As many as nine bone pins were found, each with a cylindrical pro-

Fig. 3. Excavation of one of the discrete cremation deposits (Photo: SERF).

Fig. 4. Broken standing stone in situ (Photo: SERF).

file and a rounded, bulbous tip where present. These pins have a strong association with the largest, and perhaps earliest, burials and are burnt, so it is likely that the pins formed part of funerary ensemble, placed on the pyre with the deceased (Leach 2012). Sherds of a small pottery vessel were recovered from a cremation deposit found within the possible empty stone socket (Alison Sheridan pers. comm.).

Discussion: Forteviot as a long-term focus for burial and ritual

The cremation cemetery at Forteviot is the earliest dated element of the overall monument complex with the exception of a few scattered pits and other ephemeral features, and it seems likely that this cemetery can help us shed light on the origins of this major late Neolithic monument complex. These founding burials may have allowed a lineage to emerge whose kin subsequently played important roles in the development of the ceremonial complex in the centuries that followed. Certainly the demographic evidence from the analysis of the mortuary population supports this, the mixing of adult and child remains perhaps undertaken to underline a familial closeness in death. The repeated occurrence of mixed adult and child cremations found at Forteviot is unusual. In an analysis of over 4000 prehistoric cremation burials McKinley has found only 5% were of more than one individual (McKinley 1997). In this respect, it seems likely that the mixed cremations at Forteviot were part of a very deliberate statement of *relatedness*. And the nature of these deposits also suggests cremation was very much a public and visceral process, both during and after the event.

In order to allow for repeated deposition of mixed adult and child cremations it seems likely that remains of individuals were curated over time to allow mixing of remains at the time of final deposition. Strategies for this may have varied. Most of the cremated remains had a fresh appearance suggesting that remains had been picked from the cremation pyres soon after burning, but the bone fragments found in one area of the cemetery had a "bleached" or weathered appearance suggesting that in this case the remains may have lain exposed for some time before being collected. Delayed collection may have been one way of ensuring co-burial of different individuals, but the generally fresh remains may also suggest that cremations were kept safe in containers (perhaps those they were eventually buried with) prior to being mixed with another cremated individual's remains at a later date. Whether the individuals at Forteviot were related or not, it is in the very act of co-mingling remains and depositing at the same place in the landscape, that we can witness the ways in which burial may have been used to materialize particular genealogies or histories of the dead, a form of manipulating the dead that earlier in the Neolithic would have been played out with bones in tombs. These histories and genealogies may have helped legitimize particular social and political constitutions at this particular juncture in prehistory (Lewis 1962, p. 35) which in turn established the conditions for a major ceremonial centre to develop and thrive.

The nature of the cremations at Forteviot, the origins of the monument complex as a cemetery, and connections with standing stones and a hengiform enclosure, closely mirror that of Stonehenge. Work by the Stonehenge Riverside Project (Parker Pearson *et al.* 2009; Parker Pearson 2012) suggests that Stonehenge began life as an extensive late Neolithic cremation cemetery associated with a circle of standing stones. Over 50 cremation burials have been recovered from Stonehenge to date leading to estimates that perhaps 150–240 individuals had been buried at the monuments over a period of 500 years or more underlining the role of Stonehenge as a long-term focus for cremation and remembrance. A preliminary study of the demography of the burials at Stonehenge (Parker Pearson *et al.* 2009) has concluded that the cremations were possibly from a single family or lineage, leading to the conclusion that the Stonehenge cemetery may have been founded by a ruling elite whose hereditary hold on power was secured through a monopoly on subsequent monument building at Stonehenge.

There are closer, if less spectacular, parallels in Scotland. A recent National Museums of Scotland programme radiocarbon dating material from historic excavations has suggested that other late Neolithic monument complexes started life as high status cremation cemeteries, albeit on a smaller scale. One is Cairnpapple Hill in west Lothian, where recent dating of a bone pin associated with cremation deposits has suggested that the first phase of this long-lived ceremonial and burial monument was a cremation cemetery perhaps established slightly earlier than Forteviot (4470±35 BP (SUERC-

25561, 3345–3020 cal. BC (95.4%)); Sheridan *et al.* 2009, p. 214). The cremations at Cairnpapple were also found in relation to a stone setting; seven possible stone sockets in a cove-like setting were found during Stuart Piggott's excavations (Piggott 1948). Thirteen cremation deposits in total were found from this early phase of Cairnpapple which, like Forteviot, subsequently became a timber circle, a henge and finally a Bronze Age cemetery.

Recent dating of cremation deposits from an extensive series of monuments at Balfarg/Balbirnie in Fife has resulted in a similar sequence. Here, dating of bone (not possible at the time of the original excavations in the 1970s) from a number of cremation deposits from within the sockets of Balbirnie stone circle suggests that once again that the catalyst for this major 3rd millennium BC monument complex was the establishment of a cremation cemetery in association with standing stones. This is one of the earliest elements of a complex that grew to include a series of timber structures and earthwork enclosures in the 3rd millennium BC. The cremations, like those at Forteviot, consisted of both adults and children, and date to the 31st to 27th centuries cal. BC – broadly contemporary with those at Forteviot (Gibson 2010).

At least 13 other late Neolithic cremation cemeteries of similar character are known across Britain – these include some of the greatest ceremonial complexes of the period – Duggelby Howe in Yorkshire, the Priddy Circles in Somerset and Dorchester-on-Thames in Oxfordshire (Parker Pearson *et al.* 2009). If all of these were cemeteries of particular lineages or families it may indicate the emergence of particular families or groups rising to power and dominating particular key river valleys at the beginnings of the third millennium BC. And there are perhaps direct links between at least some of these sites in the way the dead were displayed and transformed on the funerary pyre suggesting more than just a trend or fashion lies at the origins of these sites. The bone pins at Forteviot for example, find close parallels in bone "skewer" pins found at Stonehenge. Similar pins have also been found at Cairnpapple Hill, Dorchester-on-Thames and Duggleby Howe. The pins suggest the dead were dressed in particular ways for the cremation events and the pins may even have been part of a formal dress worn by key people in the establishment of these special places that became major late Neolithic monument complexes. The careful preparation of the pyres at Forteviot and the meticulous collection of remains may be other indicators of the status of the interred (McKinley 1995, p. 459; McKinley 1997). What is also striking is that much of this may have been happening at the same time – the cremations at Forteviot, Balfarg, Cairnpapple and Stonehenge for example appear to be broadly contemporary – perhaps inaugurated in the 30th century cal. BC, a period when other major transitional events were happening across Britain, including the emergence of the so-called Grooved Ware complex.

Conclusions

Lineage and ancestry are major sources of memory and power in traditional societies, and through acts of building, control over this resource can be materialized and redefined (Lewis 1962). At Forteviot the establishment of a cemetery appears to have played a key role in the creation and evolution of a major monument complex that endured for almost a millennia. And variations on this trajectory are evident at a number of other major monument complexes across Britain. Both Thomas (1999, p. 153) and Jones (2008, p. 186) have linked the establishment of these kinds of cemeteries to the development of new networks of contact between dispersed yet pivotal high status kin groups in the later Neolithic. The monuments that followed on from these cemeteries could be viewed as expressions of power created by a select group of social institutions that were not working in isolation, but shared regularities in terms of political structure and the material orchestration of power (Renfrew 1986, p. 11; Bradley 2007).

At Forteviot, this place, initially used for the placing of cremations in the ground in the 30th century BC, perhaps in association with a stone circle or setting, became increasingly monumentalized through time, with a nested series of monuments built in relation to what would have become an increasingly ancient (and perhaps mythical) burial site. The dragging of giant tree trunks to create the palisaded enclosure may have been undertaken to mark in monumental form the place of the cemetery. This boundary established an arena for large scale gatherings in the vicinity of the ancient burials, but may also have marked a change in the role of the cemetery location, perhaps formally closed to further use, enshrining a place of the ancestors and fixing their identity in time and space. Access to the enclosed ancient burial ground (eventually encased within a henge, timber circle and palisaded enclosure) may have been one of the prime sources of power and competition amongst those who gathered at this site, with the smallest enclosure, the henge, perhaps even acting as as a kind of reliquary. Competition and the desire to tap into the power of the ancestral dead may explain why people undertook these phenomenal feats of monument building, and the memorialization and restriction of access to this ancient cemetery was further developed by the construction of further monuments over time in the vicinity, satellites in the orbit of the founding burials. All of these monuments may have been seen as a means of aggrandizing a place of the ancestors and it is through monument construction that we can perhaps identify the ways in which subsequent generations of late Neolithic communities attempted to control access to an important ancestral shrine and burial ground.

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The proper way of dwelling at the Early Neolithic gathering site of Almhov in Scania, Sweden

Elisabeth Rudebeck and Stella Macheridis

Abstract

The Early Neolithic (*c*. 4000–3500 BC) site of Almhov, located in southwestern Scania, Sweden, is interpreted as a gathering and feasting site, subsequently transformed into a burial site with ancestral monuments. The focus of the article is on the pit pairs and pit clusters at the site, and on the differential distribution of artefacts and animal bones within them, thereby touching upon more general topics such as material culture patterning, structured deposition and the categorization of animals during the Early Neolithic.

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Introduction

The Almhov site in southwestern Scania was excavated by Malmö Heritage in 2001–2002, as part of the City Tunnel Project, which cleared the ground for the new railway around the city of Malmö (Figs. 1 & 2). Ten hectares of topsoil were cleared by excavators, revealing pits and burials from the Early to the Middle Neolithic and longhouses from the Late Neolithic–Early Bronze Age and the Early Iron Age (Gidlöf 2006, 2009; Gidlöf *et al.* 2006; Brink 2009). The features were located on a low hillock, about 14 metres AMSL. From this level the terrain sloped gently towards the west and east. To the east of the site there was once a bog which was artificially drained in modern times. The distance from Almhov to the coast during the Early Neolithic was about 1.5 kilometres.

Of the roughly 320 Early and Middle Neolithic features on the site, the majority were dated to the earliest phase of the Early Neolithic (EN I), *c*. 4000–3500 BC. Among the features were about 200 pits as well as traces of four façade structures with adjacent burials and two dolmens (Gidlöf *et al.* 2006). Of the pits, around 190 were dated to the earliest phase of the Early Neolithic. One façade structure had traces of a ploughed-out long barrow to the west of the façade. The Early Neolithic artefacts, which were mainly found in the pits, include approximately 700 kilos of worked flint and flint tools, 390 kilos of pottery, 160 kilos of used and worked stone and 41 kilos of animal bones.

The abundance of pits and the large amount of artefacts and animal bones distinguishes Almhov from other known sites from the earliest Early Neolithic (cf. Fig. 3). Most known sites from this period in Scania and adjacent areas appear to have been much smaller (Larsson 1984; Malmer 2002; Andersson 2004;

Fig. 1. Map of Almhov with all features from the Early Neolithic and early Middle Neolithic. The longhouse northeast of the pit concentration was dated to the Early Neolithic II – Middle Neolithic A.

Fig. 2. Aerial photo of Almhov during the excavation in 2001. Photo: Perry Nordeng.

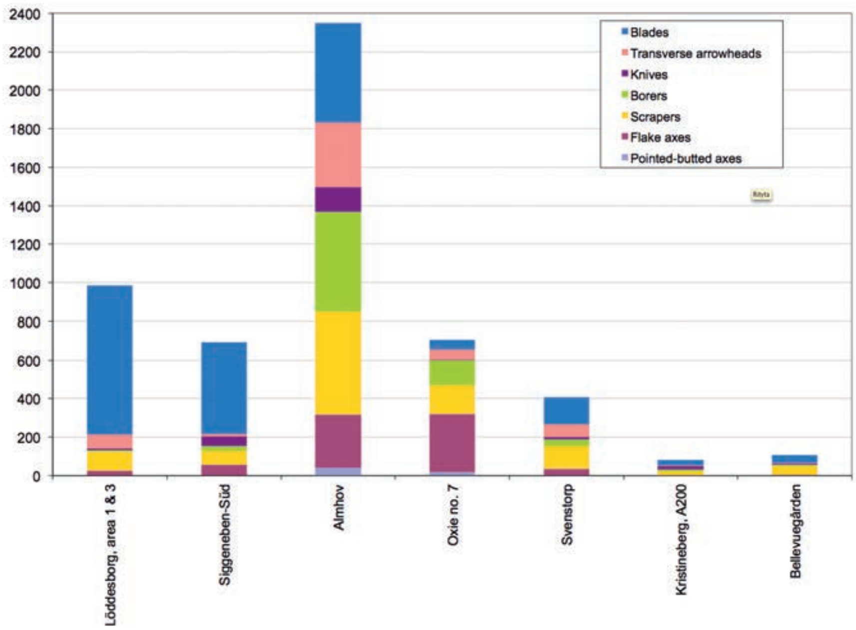

Fig. 3. Diagram showing the amount of various categories of flint tools from Almhov and other well-known sites from the Late Mesolithic (Löddesborg area 1 & 3) and Early Neolithic in western Scania and from the early TRB site Siggenben-Süd in Schleswig-Holstein. Sources: Löddesborg, Jennbert 1984; Oxie no. 7 (surface collection), Svenstorp, Skabersjö 26:20, Stolpalösa and Bellevuegården, Larsson 1984; Siggeneben-Süd, Meuers-Balke 1983; Kristineberg feature A200 (occupation deposit below two long barrows), Rudebeck & Ödman 2000.

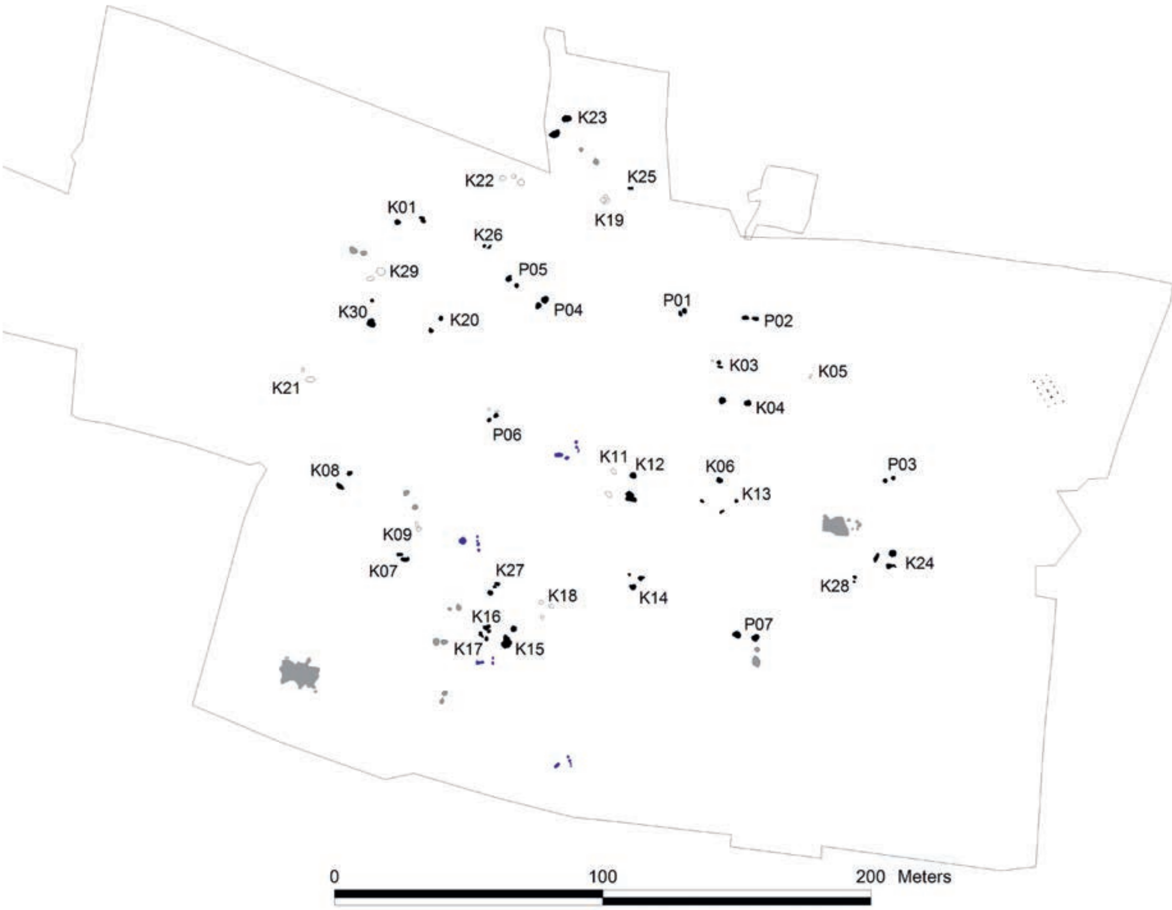

Fig. 4. Pit pairs and pit clusters at Almhov. Black: pits analysed as to contents and shown in fig. 6; grey: probable pit pairs/clusters, not excavated; unfilled: partly excavated pits, not included in the analysis. The façade structures with burials are shown in blue and the two dolmens are shown in grey.

Rudebeck 2006, with cited references). This may partly be due to the delimitation of the excavated areas, and in the case of Oxie no. 7 the finds were collected from the surface, but it is clear that Almhov-type sites were not common. Based on analogies with anthropologically and archaeologically ascertained feasting sites from different parts of the world (Dietler & Hayden 2001; Twiss 2008), Rudebeck (2010) has interpreted Almhov as a gathering and feasting site.

In this paper we discuss the possible significance of patterns in the distribution of artefacts and animal bones in the pit pairs and pit clusters at Almhov. The main purpose is to consider the structure of the dwelling, waste management and possible categorizations of animals and animal body parts during the earliest phase of the Early Neolithic.

Pit patterns

Although not all pits at Almhov were excavated, it was estimated that roughly 190 pits were from the Early Neolithic (Gidlöf *et al.* 2006; Gidlöf 2009). At least 78 were placed in pairs

Fig. 5. Photo of the excavated pit pair P05 (pits 3868 and 3869). Photo: Karina Hammarstrand Dehman, Malmö museer.

and occasionally in clusters with three pits. The pairs and clusters were dispersed across the site, but with a concentration on the perimeter of a roughly circular area, measuring about 200 metres across. The following analysis is based on 58 excavated pits, making up 23 pairs and four clusters with three pits in each (Fig. 4). The remaining 20 pits were either not excavated or only partly excavated, and were therefore not included in the analysis.

The pits varied in size and depth, from one to roughly three metres across, and from 0.15 to 0.70 metres in depth (Fig. 5). Most of them contained two or three layers, and the artefacts and bones were mainly found in the top layer, thus reflecting activities adjacent to the pits. Radiocarbon analyses of organic material from 12 pits and the type of pottery and worked flint from the pits indicate that most of them were backfilled 3900–3700 cal. BC.

The first basic analysis of the 27 pairs and clusters reveals that one pit in each pair/cluster contained the vast majority of pottery, flint flakes, flint tools and animal bones, while the other (or the other two) was either devoid of finds or contained considerably less (Fig. 6). On average, the pit with the majority of artefacts within each pair/cluster contained 72% of the animal bones (weight), 69% of the pottery (weight), 73% of the flint flakes (number) and 73% of the flint tools (number) (Rudebeck 2010).

The amount of pottery in the pits varied between a few grams and almost 30 kilos. The minimum number of pots was estimated for 28 pits and was shown to vary between one and 60. A majority of pits contained sherds from 1–10 vessels. Vessels with a rim diameter of less than 15 centimetres were slightly over-represented at Almhov, possibly indicating a focus on drinking.

Pottery from 56 pits was analysed as to

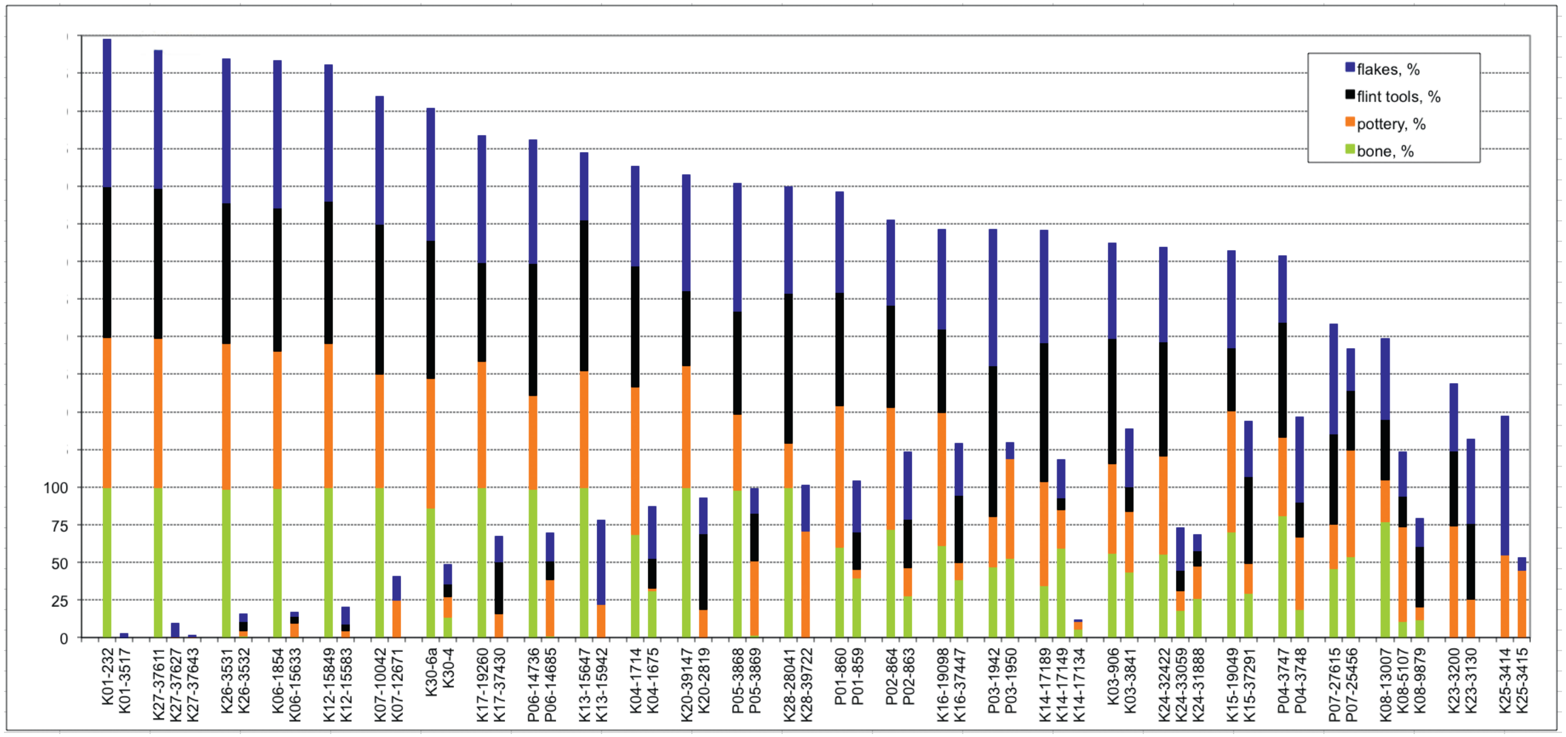

Fig. 6. Diagram of 58 pits in 27 pairs and clusters (P01, K01 etc., cf. fig. 4), grouped together and with each artefact category (number of flint flakes, number of flint tools, pottery weight and weight of animal bones) in per cent for each pit within each pit pair/cluster. In order to facilitate comparison, the bars representing each artefact category have been piled on top of each other, and the pit pairs/clusters have been arranged in the following order: from the most dissimilar pair, to the far left, to increasingly similar pairs/clusters, to the right. Each artefact category is represented by one bar with percentages for each pit. Hence, pit 232 in the pair K01, to the far left, contained 100% of the bones, pottery and flint tools and almost all of the flint flakes from the pit pair K01.

Table I. Dated Early Neolithic and early Middle Neolithic (MN A) features at Almhov with associated pottery styles and presence (x) / absence (-) of red deer bone and antler. Dates based on charcoal are excluded. * = burnt bone from cattle, sheep or pig; ** = this burial was located to the westernmost part of Almhov, outside of the central area shown in fig. 2. FU = pits excavated during the trial excavation.

Feature no & type	Dated material	Lab no.	BP	Cal. BC (2 σ)	Associated pottery style	Red deer bone and antler
A19098, pit	Animal bone*	Ua-21474	5415±110	4460-3980	Oxie	-
A19049, pit	Cereal	Ua-21383	5065±60	3970-3710	Oxie	x
A25594, pit	Hazel nut shell	Ua-21385	5055±70	3980-3690	Oxie	x
A39833, posthole in hut 13	Hazel nut shell	Ua-21384	5045±45	3960-3710	MN A (one sherd)	-
A6b (FU), pit	Cereal	Ua-17156	5000±95	3980-3630	Oxie	x (A6)
A1942, pit	Cereal	Ua-32530	5000±40	3950-3690	Oxie	x
A61 (FU)/A39437, posthole in façade 1	Cereal	Ua-17158	4990±70	3950-3650	-	-
A27048, pit	Pig bone	Ua-22166	4960±50	3940-3640	Oxie?	-
A32422, pit	Cereal	Ua-32532	4940±40	3800-3640	Oxie	x
A3748, pit	Cereal	Ua-23873	4930±45	3800-3640	Oxie	-
A35862, pit below Dolmen 1	Cereal	Ua-32533	4910±45	3790-3630	Oxie	-
A31888, pit	Cereal	Ua-32531	4880±45	3770-3530	Oxie	x
A1854, pit	Cereal	Ua-21382	4780±50	3660-3370	Svenstorp, in top layer	-
A300 (B), façade 5?	Cereal	Ua-33027	4660±40	3630-3350	Svenstorp	-
A437, burial**	Human bone	Ua-18757	4635±70	3650-3100	Svenstorp	-
A13529, a well below Dolmen 2	Cattle bone	Ua-22167	4605±50	3550-3100	Oxie	x
A11772, pit	Cereal	Ua-21380	4575±55	3520-3090	Svenstorp/ Bellevuegård	-
A2210, posthole in house 12	Cereal	Ua-21329	4570±55	3510-3090	Svenstorp – MN A	-
A18958, burial by façade 3	Human bone	Ua-21333	4495±45	3360-3020	Svenstorp?	-

typological traits (pits in K18 and K29 are excluded because they were only partly excavated; cf. Fig. 4). Oxie type pottery, characterized by folded rims with round or simple dragged impressions around the rim, is the most abundant. However, Svenstorp type pottery, characterized by cord impressions, an increasing number of motifs on the rim and vertical decoration on the belly, is also present. The pottery types were distributed in the following way:

- in ten pairs/clusters both/all pits (Σ = 21) contained only Oxie type pottery
- in eight pairs one pit (Σ = 8) contained only Oxie type pottery while the other pit con-

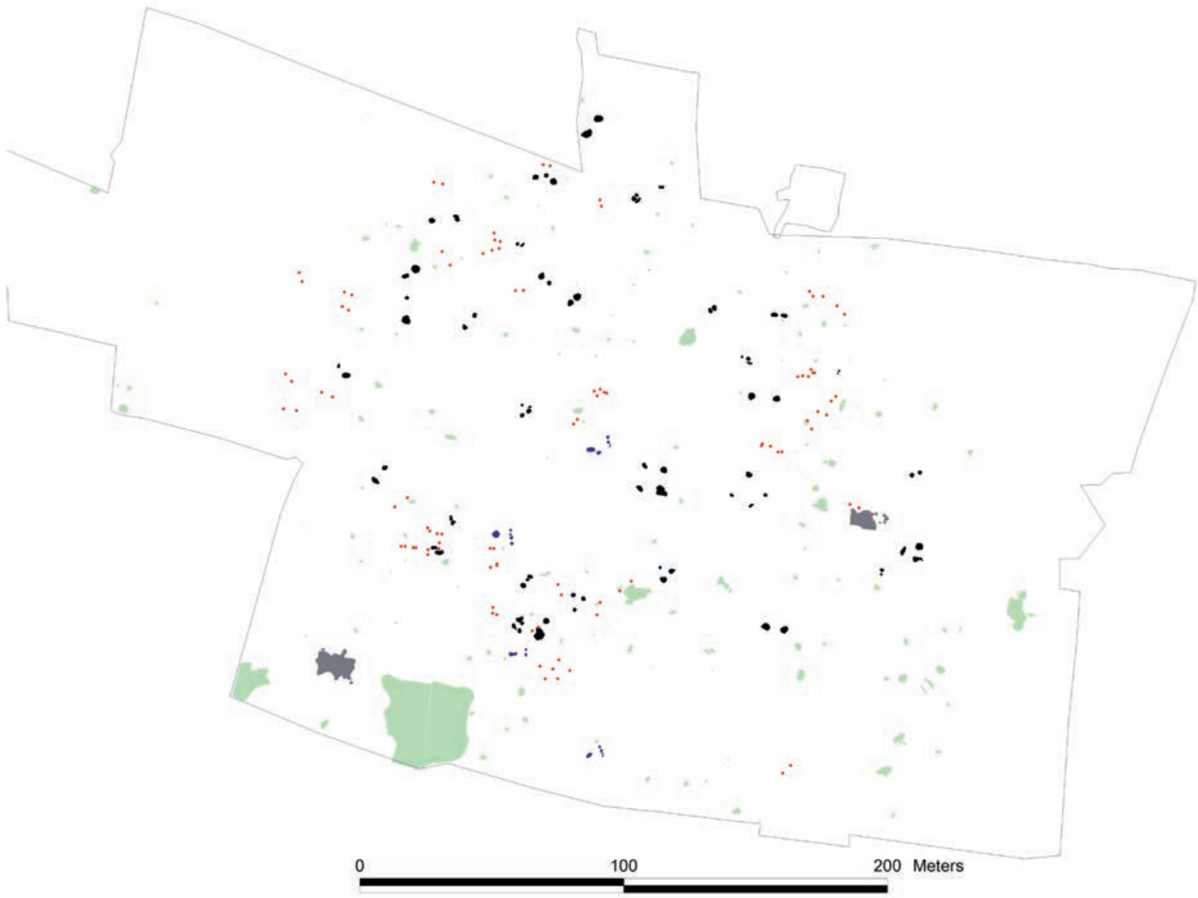

Fig. 7. Map with pit pairs/pit clusters (black), hypothetical post pairs indicating huts or tents (red dots), façade structures with adjacent burials (blue), dolmens (dark grey) and other Early Neolithic or early Middle Neolithic features (light green).

tained pottery that was not typologically identifiable

- in five pairs one pit contained only Oxie type pottery (Σ = 5) and the other only Svenstorp type pottery (Σ = 5)
- in one pair one pit (Σ = 1) contained only Svenstorp type pottery and the other pottery that was not typologically identifiable
- in two pairs, both pits (Σ = 4) contained only Svenstorp type pottery

Traditionally, there are two interpretations concerning the two types of pottery: (1) the two styles signify a possible dual organization during the Early Neolithic, although the Svenstorp type pottery may have been slightly later (Larsson 1984), and (2) both pottery styles were produced by the same group of people, but the Svenstorp type pottery was used in, and possibly produced for, ritual contexts (Koch 1998). The evidence from Almhov supports both interpretations: Svenstorp type pottery seems to have appeared later, *c.* 3700 cal. BC, and it was associated with burials to a larger extent than the Oxie type pottery (Table I).

Moreover, there was a clear association between Oxie type pottery and remains of red deer at the site. Bones and antlers from red deer occurred in 15 of the 34 pits with Oxie type pottery but only in one of the ten pits with Svenstorp type pottery.

The differences in backfill between the pits in each pair and cluster suggest a functional difference between the pits, one being used for refuse and the other for storage. The pits that were backfilled with the bulk of the waste indicate a spatial association with craft production, butchering, cooking and consumption. Based on identifiable rim sherds, these pits on average contained sherds from 20 pots. We interpret these as refuse pits. The pits with less waste contained on average sherds from 11 pots. Moreover, pots with wider rims, 21–36 centimetres across, were more frequent in these pits. The presence of fewer and larger pots and less waste indicates that these pits were used for storage and that they were backfilled at a later stage than the refuse pits, possibly just before the site was abandoned (Rudebeck 2010).

Posthole patterns

Traces of dwellings adjacent to the pits were not systematically searched for during the excavation. However, traces of a longhouse from the Early Neolithic II–Middle Neolithic A were found northeast of the pit concentration (Fig. 1; Table I) (Gidlöf *et al.* 2006). Of the roughly 1740 postholes that were documented at Almhov, some 1350 were excavated. Most of them belonged to longhouses from later periods (Gidlöf *et al.* 2006). During the post-excavation analysis it was discovered that many of the unexcavated postholes appeared in pairs, usually 2–4 metres apart, and sometimes up to 6 metres apart. These hypothetical post pairs, in all about 30 pairs, were located on the periphery of the Early Neolithic activity area, often in proximity to the pit pairs and pit clusters (Fig. 7). Rudebeck (2010) has suggested that these postholes may have been traces of small huts or tents, connected to the pit pairs/clusters. Although it is not possible to verify this interpretation, there is evidence of ten similar posthole pairs at other Early Neolithic sites in the vicinity, and postholes in a pair at the nearby site Elinelund 2B have been dated to the Early–Middle Neolithic (Sarnäs & Nord Paulsson 2001).

Almhov and the flint mines at Södra Sallerup

Evidence from the flint mining site at Södra Sallerup, about 11 kilometres or one hour's walk – northeast of Almhov, reveals various connections between the sites. The earliest flint mines are of the same date as the pits at Almhov, and five excavated posthole pairs adjacent to the mines have been interpreted as traces of huts or tents (Rudebeck 1987; Nielsen & Rudebeck 1991). The association between the sites is evident also from the fact that the majority of the roughly 40 pointed-butted axes from Almhov were made of Senonian flint of the same type as the mined flint. Moreover, blanks for pointed-butted axes were clearly produced in the mining area (Rudebeck 1994, 1998; Jansson 1999; Högberg 2006) and axes of the same type, and of the same type of flint, were also produced at Almhov (Gidlöf *et al.* 2006).

Dispersal patterns of animal bones in pit pairs and pit clusters

The animal bone assemblage dated to the Early Neolithic from Almhov amounts to some 41 kilos, making it the largest bone collection from the Early Neolithic in south Scandinavia (Rudebeck 2010). About one third of the mammal bones have not been possible to identify as to species and body parts. The 58 pits included in the 27 analysed pairs/clusters (cf. Figs. 4 & 6) contained about 30 kilos, 4760 fragments, of animal bones, thus constituting 73% of the animal bones from Early Neolithic features at the site. The animal bone distribu-

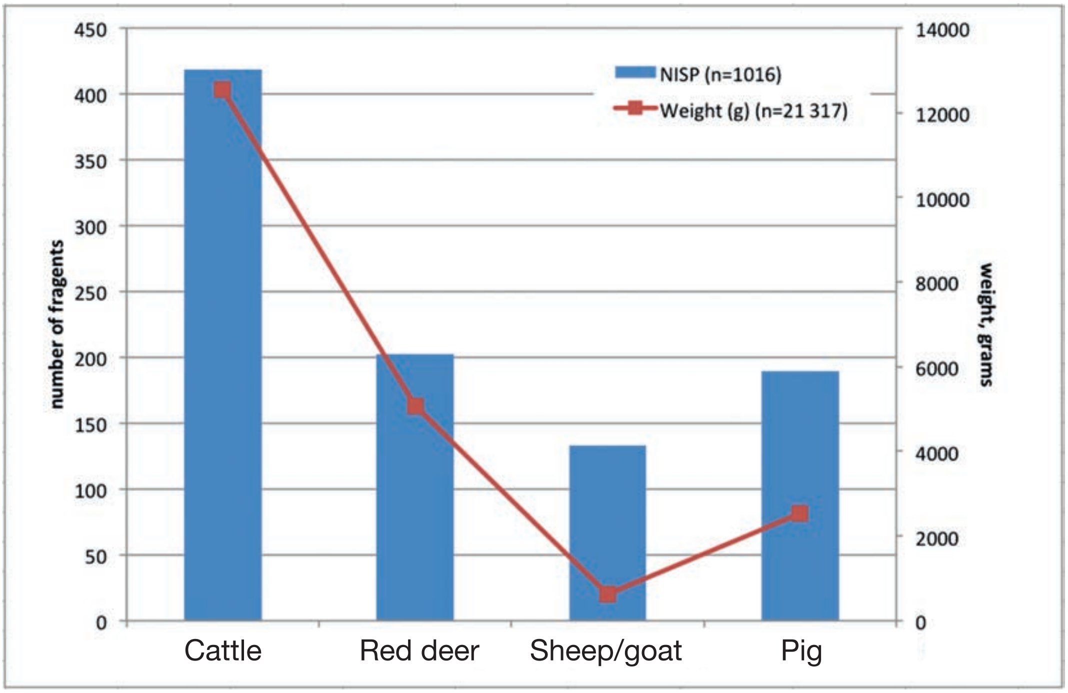

Fig. 8. Distribution of fragments and weight of bones from the most abundant species in 47 pits, making up 22 pit pairs and pit clusters (11 pits in five pairs/clusters shown in fig. 4 are excluded in the diagram, due to the absence of bones or the atypical species representation).

tion in the pit pairs/clusters has been studied in an attempt to discern possible differential treatment of different species and different body parts (Macheridis 2011b).

With the exception of K03, K23 and K25, all pit pairs/clusters contained bones that were identified as to species in at least one of the pits, and the distribution of these showed some general characteristics. The pair K15 and the cluster K24 are excluded from the analysis because of their unusual species representation, differing from the average (Macheridis 2011b:34). Fig. 8 illustrates the distribution of the most abundant species from the pits: cattle, red deer, pig and sheep/goat (including loose teeth, horns and antlers). The following analysis focuses on these species. Among cattle and sheep/goat cranial fragments, especially loose teeth, dominate, due to taphonomic factors. Therefore loose teeth are excluded from the anatomical distribution illustrated in fig. 9. Also a few fragments of horn and red deer antler, making up some 35% of the fragments and 50% of the weight of the bones from this species, have been excluded, since antler counts also included tools. With this in mind, cranial fragments can still be considered a majority, together with long bones, metapodials and phalanges. Cranial fragments of cattle are the most abundant amongst the identified specimens. Fragments from the rib cage and the pelvic region and vertebrae are largely underrepresented in all four species. The underrepresentation of spongious elements is most probably a consequence of taphonomic destruction. Unfortunately, a more thorough taphonomic analysis has only been partly done elsewhere (Jonsson 2005; Macheridis 2011b).

Beside these overall characteristics, the distribution of animal species and body parts (simplified here to cranial/postcranial categories)

Table II. Pit pairs/clusters divided into groups, based on the distribution of bone from cattle, red deer, pig and sheep/goat, and body parts (n=941 fragments).

Group	Characteristics	Cattle	Red deer	Sheep/goat	Pig
A (9 pairs; 19 pits)	One bone-free pit.	Cranial fragments exclusively appear in 6 pit pairs.	In 3 pit pairs. Always together with domestic species, in one case with cattle only.	In 5 pit pairs.	In 3 pit pairs. Never the only species.
B (3 pairs; 6 pits)	Both pits contained the same number of species.	In all 3 pit pairs, 4 pits. Cranial fragments appear exclusively in one of the pits in one pair twice.	In 2 pit pairs. Once opposing cattle and once together with cattle. Only represented by antler or postcranial fragments.	In 2 pit pairs, once in both pits of a pair.	In 2 pit pairs. Never the only species.
C (3 pairs; 6 pits)	One pit with one species, the other with three or more species.	The only species in two cases. Cranial and postcranial fragments.	In 2 pit pairs. Only represented by antler or postcranial fragments.	The only species in one pit.	In 2 pit pairs. Never the only species.
D (7 pairs; 16 pits)	Both pits contained the same species, but in one of the pits one of the species was excluded.	Cranial fragments in all pits; exclusively in 5 pits (including antler and loose teeth).	In 4 pit pairs/clusters. Most commonly the "excluded" species in one or more pits of a cluster.	In 5 pit pairs/clusters, in 7 pits. Never the only species.	In all pairs/clusters, in 7 pits. Never the only species.

in and between the pit pairs and pit clusters shows some general patterns. Based on species representation, the features can be divided into four groups (Table II). The most common distribution is pit pairs within which one pit contained all of the bones (group A). Group D is difficult to interpret, since the pattern seems to be more random, and is not discussed further.

The analysis shows that cattle bones were the most common. In pits with only one identified species, it was almost always cattle (Macheridis 2011b:32). That the bone-free pits often also lacked artefacts of flint and pottery implies a practice in which the way waste was managed reflects cultural behaviour (cf. Fig. 6). The filling of pits clearly followed a certain order concerning different types of waste, and animal bones were assessed according to the categorization of species and body parts (cf. Marciniak 2005, p. 216).

Apart from the pattern of one bone-free pit in the pairs (group A), the strongest pattern is the exclusive presence of cranial fragments (also including loose teeth) in many of the pits. This can be seen in group A, where the pit which contained bones almost always contained cranial fragments only. These scattered cranial bones were often very fragmented and few in each pit (Jonsson 2005). A possibility is that these fragments do not represent butchering waste, but swept-down fragments of skulls or crania on display adjacent to the pits, similar to the display of horned cattle skulls on Michelsberg sites in central Europe (Lichter & Weber 2010). That animal skulls had a special significance is supported by other features at Almhov. One example is one pit (A27048; Table I) which contained eleven juvenile pig mandibles (and no other bones), interpreted

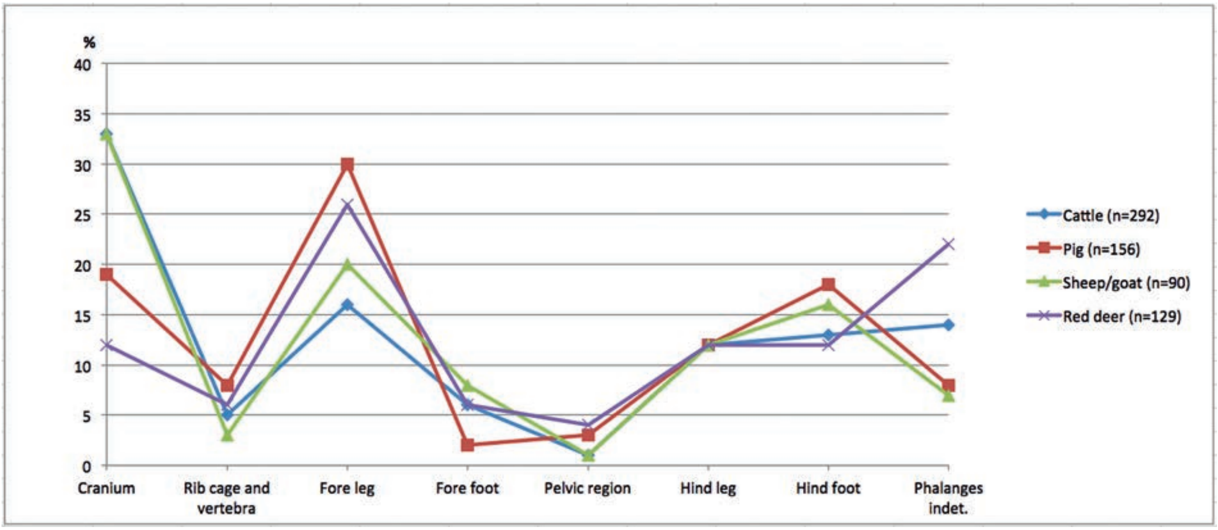

Fig. 9. Anatomical distribution in 52 pits included in 24 pit pairs and pit clusters. Antler and horn fragments as well as loose teeth are excluded. Bones from each body part are shown in percentage of the total number of fragments from the respective species.

as a ritual deposition (Welinder *et al.* 2009, p. 149). Another example is the deposition of a red deer antler in a façade structure below one of the dolmens (Rudebeck 2010; Macheridis 2011a). Both skulls and antlers are regarded as particularly significant and powerful symbols in many cultures (e.g. Larsson 1988; Schulting 1996; Harrod 2000, pp. 113 ff.; Schulting & Richards 2001; Nilsson 2008, p. 88), strengthening these arguments. As mentioned above, a detailed taphonomic analysis with regard to the degree of e.g. weathering and gnawing is lacking. Such an analysis could test this hypothesis further, in terms of handling and exposure of the bones before deposition.

In a correspondence analysis of the distribution of animal species in 83 Early Neolithic pits at Almhov (not only pits in pairs and clusters), one pattern was that bones from red deer did not usually coexist with bones from domestic species (Welinder *et al.* 2009, p. 151). The differential distribution of cattle and red deer in the pits indicates a possible dualism in the categorization of these animals (cf. Welinder *et al.* 2009, p. 151; Marciniak 2005, p. 205). However, a closer look at the species distribution in the pit pairs/clusters does not fully reaffirm the conclusion. Red deer is the second most abundant species. When red deer bone *did* occur with bones of domestic species, it was always together with cattle bone. Therefore, it is problematic to assume a dualism without recognizing the possibility of a more complex categorization concerning large ungulate species (Macheridis 2011b:39; cf. James 1990). Historical evidence reveals that this may have been the case. In Ireland red deer had a special role during the Early Middle Ages. It was designated as *ag allaid*, i.e. wild cattle, which together with iconographical material show that this animal had a liminal status in the sense that it belonged to both the “wild” and the “domestic” sphere. This also meant that the animal had a social significance as it resembles cattle, which is tame, but was also seen as different, as it is a wild species (Soderbergh 2004, p. 168). Ethnographic examples tell of similar perceptions. Among the Ethiopian Konso, it was permitted to eat deer, or rather horned animals, because they resembled cattle, sheep and goats (Hallpike 2008, p. 329). Hence, rather than presupposing a mere wild–domestic dichotomy between red deer and cattle during the Early Neolithic, the evidence from Almhov indicates that the categorization of the species may have been more complex and possibly similar to the ones presented in the examples above.

Concluding remarks concerning pit patterns at Almhov

We interpret Almhov as a gathering and feasting site which was occupied by early farmers who were also exploring the local flint resources. During the gatherings each camping unit raised tents or huts and dug a couple of pits along the fringes of a roughly circular area. One pit was used for dumping waste from butchering, cooking and craft, while the other was used for storage. The camping units probably had animal skulls, preferably skulls of horned animals, on display adjacent to the pits, possibly signifying group identity, available resources, particular skills or other socially significant assets and abilities.

Discussion

Inspired by the discussion of structured deposition and other related concepts initiated by Duncan Garrow (2012), we would like to reflect briefly on material culture patterning at Almhov. The most evident pattern is that the bulk of the artefacts and bones had been deposited in one of the pits in each pair/cluster. The pits were probably backfilled by deliberate actions as well as by natural processes, overall resulting in a pattern with a high level of structure. However, although the actual filling-in of the pits may be regarded as evidence of "highly formalized, repetitive behaviour", which, following Colin Richards and Julian Thomas (1984, p. 191), is a characteristic of ritual activities, the argument here is that the "structured deposition" at Almhov did not derive from actions concerned with the filling-in of pits as a ritual practice, but from cultural norms of dwelling. On the other hand, to the extent that social gatherings and feasting *per se* may be considered as rituals, the site may be characterized as a ritual site. Rituals produce waste and things are used for practical purposes also in connection with rituals (Bradley 2005).

Hence, rather than trying to pinpoint sites, pits and depositions as either ritual or quotidian, based on the level of structure among features and artefacts, it is important to assess possible reasons for the observed patterns in each case. Clearly, the pit pattern and the differential distribution of artefacts and animal bones within the pits at Almhov should be seen as evidence of cultural norms at some level. It is unlikely that the intention was to create pits with rubbish and pits without rubbish as a ritualized practice. It may be argued that the different fillings of the pits were simply a result of the pits having had different functions. However, this does not exclude the normative significance of this difference, but only transfers it to the cultural norm of constructing pits with different functions as a proper way of dwelling.

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The diversity of settings

Ritual and social aspects of tradition and innovation in megalithic landscapes

Almut Schülke

Abstract

This article aims to investigate ritual and social traditions and innovations as reflected in the megalithic monuments. The basis is a case study from Zealand, Denmark, one of the areas in the TRB north group with the highest amount of megalithic tombs. Different aspects of the dolmens and passage graves in northwest Zealand are compared, like their architectural forms and expressions, the work input into the different monument types, the mode of burying the dead, the distribution and the number of the tombs. This analysis shows that the dolmens are manifold in architectural expression and thus must have had different ritual functions. In contrast, the architectural forms of the passage graves are more homogeneous. Aspects of outer expression (mound) and the principle of accessibility resemble traits of the open dolmen chambers, but they also show innovations such as elaborate architecture and more space for many collective burials. A comparison of the number and spatial setting of the tombs shows that the numerous dolmens are widely distributed, while the much fewer passage graves seem to be placed more centralized in somehow regular distances from each other. But there are also marked concentrations of several passage graves close to each other. It is argued that the stone architecture of the dolmens was innovative and that these tombs were built gradually, finally covering vast parts of the study area. By contrast the upcoming of the passage graves seems to reflect an intentional introduction of new ways of burying the dead with innovative architecture, death ritual and spatial setting with a clear element of centralization. The challenges that are connected to a social interpretation of these graves are discussed with regard to the societies building the tombs, the people buried there and the living society using the tombs.

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Introduction

THE QUESTION "WHAT's new in the Neolithic?" can be addressed on different levels. In this article it is understood as asking for innovations that can be observed in the Neolithic period. I will discuss aspects of tradition and innovation on the basis of one of the main cultural expressions of the TRB North group – the megalithic tombs. To explore ritual and social developments, the different main types of the monuments and their spatial setting and distribution will be compared to contribute to a better understanding of TRB burial practice and society in southern Scandinavia.

The main function of the megalithic constructions is, from our modern perspective, as a depository for the dead and a place of burial. Consequently, an analysis of TRB society on the basis of megalithic monuments is in the first part a study of the development of burial practice and the cult and ritual related to it. However, the megalithic graves as assembled and place-bound constructions have countless levels of meaning related to material and non-material aspects, both relating to the spot but also reaching beyond. They are carriers of many different social and ritual aspects.

The megalithic monuments of the northern group of the TRB are unevenly distributed (Fritsch *et al.* 2010). The monument types differ from region to region and different chronological developments are observed (e.g. Schuldt 1972; Sjögren 2003, p. 15 ff.; Paulsson 2010; Mischka 2013). An analysis of regional developments can help in understanding the complicated overall picture. In the following I will present a study of the northwestern part of the island of Zealand, the largest of the Danish islands. Seen in a northern European perspective, this area is amongst those with the biggest covering density of megalithic tombs. However, a closer look shows that the distribution of the monuments is varied and they occur as different megalithic landscapes. With the aim to formulate both challenges and possibilities that lie in the material, the following questions should be pursued: What different types of megalithic monuments exist? How are they distributed? And which aspects of ritual and social life can be discussed on the basis of the material? Which aspects of tradition and innovation can be observed?

Different megalithic monuments – different burial practices: The case-study area northwestern Zealand

The northwestern part of the island of Zealand is geographically varied. It is characterized by moraine ridges, extended coastal areas with both flat beaches and cliffs as well as an inland intersected by watercourses and wetlands. A maximum transgression caused higher sea levels in the Early Neolithic (Hede 2003).

In this roughly 25 x 30 kilometre area more than 400 megalithic tombs are recorded. Thirty-six monuments have been excavated; almost none with modern methods. Consequently, source critical factors like the representation of the known monuments both regarding their number and their form have to be considered. In other parts of southern Scandinavia and northern Germany, modern excavation has brought to light numerous destroyed tombs (e.g. Andersen 2009; Andersson & Wallebom 2013) and has at the same time shown how complex single monuments can be, often containing many tombs (e.g. Steffens 2009; Mischka 2011). Hence, in our case the dating relies mainly on the typology of the structures recorded above ground. However, northwestern Zealand provides an extraordinary basis for a general analysis, with diversified but also classifiable material (for a more comprehensive study see Schülke forthcoming).

The megalithic monuments consist of two main types: dolmens (335 certain, 29 questionable) and passage graves (45 certain, 6 questionable). They show both similarities and differences in their architectonical expression and their use, which challenges a discussion of their relationship to each other. Radiocarbon dating and finds from the tombs confirm that in the study area the passage graves are built later than the dolmens (see below).

The dolmens are characterized by a chamber built of orthostats and one covering stone. However, they show significant varieties. In the study area they can be classified into three main types according to their chamber form and size: the closed rectangular dolmens are stone cists built of four orthostats with a chamber length of up to 1.7 m. The other two types have chambers of up to 2.5 m length (measures for the study area): the open rectangular dolmens (mostly built of three orthostats, plus either a threshold stone or two entrance stones, or both, in one of the narrow ends) and the open polygonal dolmens (with hexagonal chamber form built of five orthostats and a threshold stone or two entrance stones or both in one of the narrow ends) (Schülke forthcoming). The chambers are often surrounded by a long or a round mound, which is lined by kerbstones, or they occur as free-standing dolmens with or without just a small mound. The few remains of burials from the chambers give evidence of both single burials and burials of a few individuals in one chamber. Only a few grave goods are documented, most of which are single ceramic vessels (lugged flasks, dating to EN II). I have discussed elsewhere (Schülke 2014, p. 118 ff.) that the different types of the dolmen chambers illustrate different concepts of burying the dead, either closing the dead off (closed chambers) or, in case of the open monuments, facilitating contact between the living world and the dead individual(s) buried in the chamber. Also the different chamber types might illustrate different types of interment procedures: in a closed rectangular chamber the body of the dead person was most likely buried from above, while in a monument with an opening, the body was supposedly brought in through the side opening (Schülke forthcoming). It must have been a different experience to visit graves with an opening, constituting a sort of façade, compared with those that were completely locked and covered with mounds (Midgley 2011).

The chronological relationship between these different types and concepts is not fully understood thus far (Schülke 2014, p. 115 ff.). There are also signs that this might differ from region to region. For the Danish material it is generally agreed that the dolmens are older than the passage graves, dating mainly to EN II, c. 3500–3300 BC (Schülke 2014, p. 117 with further literature; for the definition of periods see Schülke 2009, p. 218). But there are different opinions on whether the closed rectangular dolmen chambers are older than the rectangular dolmens with openings (Nielsen 1984; Ebbesen 2011, 248 f.; Midgley 2011, p. 126). The polygonal chambers can be dated to EN II and MNA I (Ebbesen 2011, 248 f.) and thus are partly contemporary with the early passage graves, while they seem to belong to the earliest types in other regions (Kaelas 1958, p. 5 ff.; Mischka 2013).

The chambers of the passage graves are bigger than those of the dolmens, with oblong stone chambers of at least 2.7 m in length (for the study area), built of almost human-height orthostats, at least three huge covering stones and a side entrance with a roofed passage. Their mode of building is sophisticated with many constructional details like drystone walling, flint packing and closing stones and is therefore believed to be conducted by specialists (Hansen 1993, 21 ff.). The chambers had a vault-like character and functioned as collective graves, where many individuals or parts of individuals were buried in one chamber, using different deposition practices (Midgley 2008, p. 108 ff.), as the finds from the study area confirm. Together with the bodies, various objects were deposited, like richly ornamented ceramics, amber beads, and tools made of bone and stone. This form of distinct collective burial is of a different character than the burying of a few individuals side by side in a stone cist, which is observed from some of the dolmen chambers. The passage graves were accessible through a door and it was possible for a grown up person to move around in the chamber. The tombs are covered by a mound, their outer expression in many ways resembling the open (polygonal) dolmen chambers with round mounds. In the study area there is found the phenomenon of the double passage graves: two chambers are built side by side, often with one shared orthostat, with passages oriented in the same cardinal direction, covered by one mound (Dehn & Hansen 2000). Radiocarbon dating confirms that the passage graves are built in MNA I/II, c. 3300–3000 BC (Dehn & Hansen 2006, p. 26 ff. with dates from the study area; Paulsson 2010).

Noticeably there can be observed sharp distinctions but also similarities between the dolmens and the passage graves. The dolmens are more diverse in their architectural expression than the passage graves and illustrate several principals of burying and commemorating

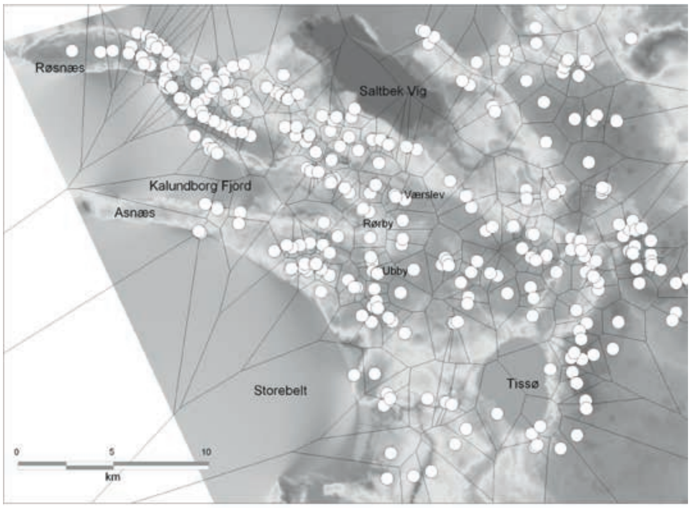

Fig. 1. The distribution of the dolmens in the study area. Voronois (black lines) show statistically calculated regions with a monument at each centre. Højdemodel (DHM), 25 m net: © Kort&Matrikelstyrelsen.

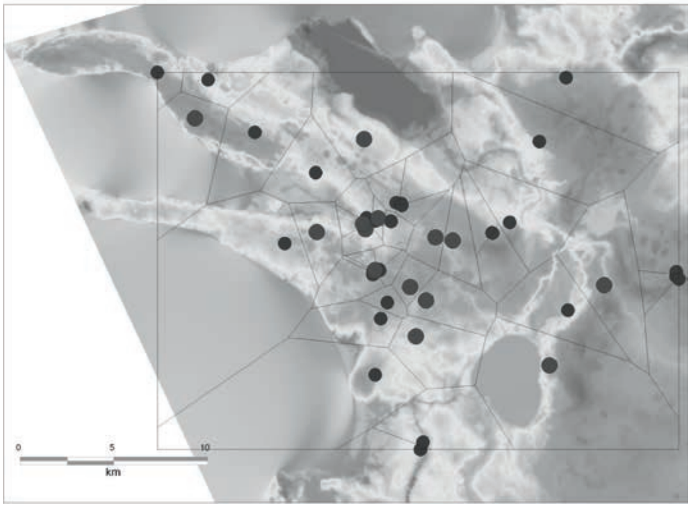

Fig. 2. The distribution of the passage and double passage graves in the study area. Also here Voronoi mapping was used (see Fig. 1). Geographical source: see Fig. 1.

the dead. While the sealing of stone tombs is a special trait for the time of the dolmens (closed rectangular chambers), the aspect of the accessibility of the graves through an opening or door marks similarities in death ritual between the open dolmens (both rectangular and polygonal) and the passage graves. This is amongst other things expressed in the similar outer impression of the open dolmens with mounds and the passage graves (Schülke 2014, p. 118 f.). A clear distinction from the dolmens, and thus an innovation, is the sophisticated architecture of the passage and double passage graves, together with constructional details like the passage and its placement with regard to the chamber. Also, the difference in the number of the tombs is striking, with the number of passage graves being lower than 15% of that of the dolmens.

It can be concluded that the dolmen chambers, most of which are dated to EN II, are heterogeneous in architecture and possibility of use. Much points to a continuous development from closed to open burial monuments, where the open dolmen chambers are an innovative element with regards to their architecture, the burial rituals used, and their outer impression. However, it is not to be entirely ruled out that the closed and open chambers existed side by side from the beginning. In any case the ritual aspect of the accessibility of a grave chamber is at least as old as EN II. Thus for the Middle Neolithic passage graves the most outstanding innovations are the size and the layout of the chamber, the sophisticated way of building the monument, the access through a roofed passage and the lower number of monuments. Also the custom of collective burial is developed further with the passage graves, especially with regard to the higher number of individuals buried in the same tomb.

The spatial distribution of the tombs

In the following, the tombs are mapped in order to distinguish between the dolmens (Fig. 1) and the passage and double passage graves (Fig. 2). The conducting of a Voronoi mapping was chosen for a better illustration of the spatial distances between the different monuments.

The 364 dolmens are distributed almost area-wide (Fig. 1). However, clear concentrations can be observed in the form of alignments or clusters, but also solitary monuments. Some areas, like west of Tissø, appear to be almost monument-free. The longest distance between two dolmens is about 5.5 km, the shortest just a few metres.

The 35 passage graves and 16 double passage graves are evenly distributed across the study area, but are placed further inland than the dolmens (Fig. 2). The longest distance between two graves is about 8 km. However, there can be observed concentrations of graves at the end of the Kalundborg Inner Fjord around Rørby, Værslev, and Ubby.

Most striking are the different numbers of dolmens and passage graves, a phenomenon which also can be observed in other Danish regions. The map of the dolmens, which roughly covers the phase of EN II (Fig. 1), evokes the metaphor of the "explosion", especially considering the non-existence of stone monuments in the preceding EN I (Schülke 2009, 229 ff.). Thus the building of the megalithic dolmen chambers within EN II, a period of about 200 years in length, can be called innovative, with vast parts of the land being marked with monuments for the first time. The distribution of the passage graves, which covers the period MNA I/II (Fig. 2), shows a decrease in stone-building activity.

The question is how the distribution of the different types of tombs should be interpreted. The theory that the tombs reflect a splitting up of land and demarcating areas belonging to one settlement or economic unit has been forwarded (e.g. Renfrew 1973, p. 132 ff., Strömberg 1982, p. 38 ff.). However, this concept of megalithic tombs as a direct reflection of different sized settlement has also been questioned. Arguments that are brought forward to support this critique are that the tombs' topographical and numerical relation to each other might point to a more complex organized society (Sjögren 2003, p. 322 f.) and that the tombs are too unevenly distributed to represent one settlement each (Hinz 2011). Also the probable different social meaning of different graves types with individual burials and more centralized collective graves has been stressed as argument against this theory (Sharples 1985).

In the Danish literature these topics have not been discussed in detail. Instead the megalithic phase has been described as reflecting a segmentary tribal society. However, there is disagreement about the character of this society as either egalitarian or hierarchically organized (e.g. Skaarup 1985, p. 377 f.; Andersen 2000, 56 f.; Jensen 2001, 438 ff.; Ebbesen 2007, 48 ff.). A change from a dispersed to a more centralized settlement pattern at the end of EN II has been observed (Nielsen 2004). It seems contemporary with the change in burial architecture from dolmens to passage graves as also seen in the study area.

In the remaining part of the article I will discuss aspects that are relevant for a social and ritual interpretation of the spatial patterning of megalithic tombs in the study area.

Connected to this is the question whether the number and distribution of the different types of tombs might reflect different settlement patterns from dispersed (one dolmen per settlement unit) to more centralized (one passage graves for one village community).

The dead and the living

The number and distribution of the megalithic tombs in northwestern Zealand points, on a rougher scale, to a regular and marked area-wide erection of the dolmens throughout EN II and to some sort of "centralization" with the passage graves in MNA I/II. To better understand possible social and ritual mechanisms that might have guarded the development of the erection of the tombs, simple statistical analyses were conducted. As will be shown, they should first of all be seen as a thinking tool to better understand both who was buried in the tombs and the living society which used the tombs as burial spaces.

As there are no indications, either from find material from the dolmens or from ^{14}C datings, that there are dolmens that were built at the same time as the passage graves from the study area, it was assumed that the dolmens date to EN II and the passage graves to MNA I/II. To determine the minimum number of monuments erected on average in each period, the number of monuments that can be ascribed each period (EN II: 364 dolmens; MNA I/II: 51 passage graves) was divided with the length of each period (EN II: 200 years, MNA I/II: 300 years). This resulted in the average amount of monuments built per year (1.82 dolmens/year corresponding to 182 dolmens/century; 0.17 passage graves per year, corresponding to 17 passage graves/century, the double passage graves counting as one grave). On average about two dolmens per year were built, while a new passage grave was erected around every sixth year. Thus the social "event" of erecting a dolmen seems to have been much more "ordinary" than that of erecting a passage grave.

While these figures give an impression of the density of events, there are source critical points that have to be taken into consideration. It is rather unlikely that dolmens and passage graves were erected in regular intervals. Regarding the dolmens for example, it can be assumed that they, containing grave chambers for individual burials, were built according to "needs" such as the death of a person. This would naturally result in a more irregular building sequence, slowly aggregating a growing number of monuments in an area. Unlike the dolmens, the erection of the passage graves as collective graves might not be bound to the death of a single person to the same extent. The similar construction of some of the passage graves would speak for a rather contemporaneous "anticipatory" erection aiming at providing future burial space. At least a certain proportion of the tombs might have been constructed at around the same time, marking a deliberate and planned change in burial practice and ritual. It might be presumed that there was an intensive and innovative building phase of passage graves in the beginning of MNA I, with significantly fewer later buildings in the course of MNA I/II.

Also, some thoughts on the work input into the different monuments should be put forward: the building of a dolmen chamber was surely easier than building the chamber of a passaged tomb. The latter had to be constructed by experts after a clear set of rules (Hansen 1993, 21 ff.). However, the work input for the building of the mounds that were covering the dolmens, and here especially the long mounds that often were surrounded by almost head-high kerbstones, ought not to be underestimated. While the construction of passage graves demanded know-how and the thorough choice of building materials (Dehn & Hansen 2000), the building of dolmens, and especially their long-mounds, demanded access to raw material. It also required the disposition of a bigger spot of land that could be used for building the site, as well as a considerable working force to transport and bring into place the building material. It cannot thus be stated with certainty that the work input for the building of a dolmen actually was lesser than that of a passage grave. Rather it was of a different character and included different tasks. Because the number of dolmens exceeds the number of passage graves, it can be assumed that the total investment in monument building was much higher in the EN II than in the later time of the passage graves.

As a next step, it was calculated how many persons might have been buried in the monuments. This was undertaken with minimum and maximum numbers, based on evidence from the study area. From excavations conducted around the year 1900, there were many bone and skull finds from the chambers reported (Schülke forthcoming). For the dolmens it was estimated that at least one and a maximum of three persons were buried per chamber. For the passage graves it was operated with a minimum of four and a maximum of fifty persons buried per chamber. This resulted in a minimum of 182 and a maximum of 546 buried individuals per century for the dolmens, and in a minimum of 89 and a maximum of 1117 buried individuals for the passage graves per century (Table I).

From this it is difficult to conclude whether the numbers of individuals buried in the graves were higher, lower or almost the same in EN II and MNA I/II. The figures might point to a slight increase in the number of people buried in the passage graves compared to the dolmens. But at the same time, a constant amount or even a decrease of the burials in the passage graves cannot fully be ruled out.

However, these calculations show that the number of burials, even in an area with a dense distribution of tombs, is far too low to represent a whole population buried in dolmens and passage graves. This is even clearer when involving the land area of the study area which consists of approximately 450 square kilometres. Calculating how many persons on average were buried per century per square kilometre, based on the numbers in table I, one comes to the following results: 0.2 persons (passage graves with 4 burials), 0.4 persons (dolmens with one burial), 1.2 persons (dolmens with three burials) or 2.5 persons (passage grave with 50 burials) per square kilometre per century. These numbers might represent a "real" prehistoric situation, with only parts of the society being buried in the megalithic tombs. Other researchers have argued that most of the Funnel Beaker population is not visible in today's archaeological record from the tombs, which would make it most likely that the major part of the dead were buried elsewhere, e.g. in flat-graves without grave goods (Woll 2003, p. 46 ff., Midgley 2011, p. 122 f.). But considering questions of representation and the fact that almost none of the graves were excavated with modern methods, it could also be that the numbers of buried persons from the megalithic tombs would be much higher if we first could know the complete amount of dolmens and passage graves in the study area, and secondly if the megalithic

Table I. Number of dolmens and passage graves with estimated number of buried individuals altogether and with estimated amount of burials per century.

	Dolmens	**Passage graves (p.g.)**
Number	364	35 + 16 double passage graves = altogether 67 p.g. chambers
Length of period	200 years (3500–3300 BC)	300 years (3300–3000 BC)
Estimated number of buried individuals	Minimum 1 burial/dolmen: 364 Maximum 3 burial/dolmen: 1092	Minimum 4 burials/p.g.: 268 Maximum 50 burials/p.g.: 3350
Estimated average number of burials per century	Minimum 1 burial/dolmen: 182 Maximum 3 burial/dolmen: 546	Minimum 4 burials/p.g.: 89 Maximum 50 burials/p.g.: 1117

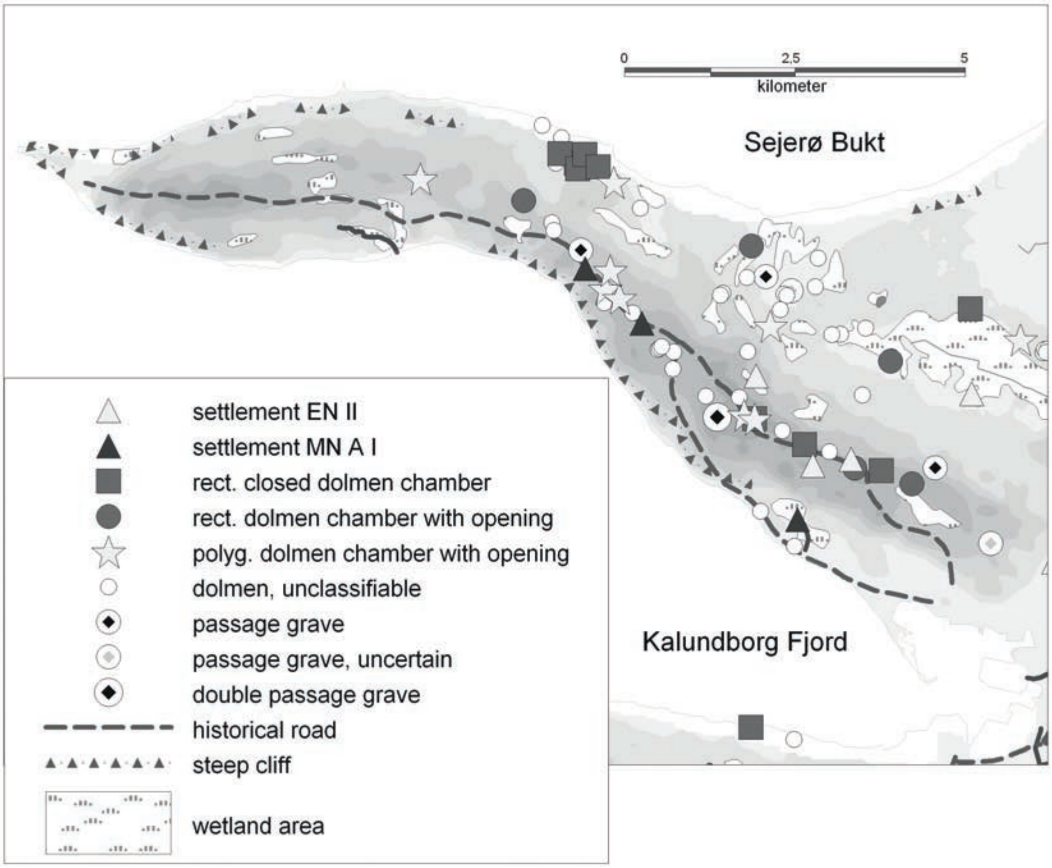

Fig. 3. The Røsnæs peninsula with different types of dolmen chambers, passage graves and settlements that are dated to EN II and MN A I. No settlements from MN A II are known. Geographical sources: Lakes and wetlands: Danmarks jordarter 1999 – © GEUS: Digitalt kort over Danmarks jordarter 1:200,000 (1999); watercourses: AIS – Miljø- og Energiministeriet, Areal Informations System (1996–2000); contour lines: © Kort&Matrikelstyrelsen (Målestok 1:25,000) (2004).

long mounds, which in other areas have been shown to house several graves, were investigated for possible other graves (compare Mischka 2011; Steffens 2009, p. 15 ff.). Thirdly, it might be that more than fifty persons were buried per passaged tomb (Sjøgren this volume). These critical reflections show that the calculations on the number of buried individuals must be taken with caution, and that they only can be a beginning of a discussion on the ritual and social dimensions connected to the tombs.

Lastly, a closer look at the distribution of the megalithic tombs shall illustrate further challenges that we are faced with, when investigating these monuments. They deal with the aspect of "centralization" that is represented in the distribution of the passage graves, in contrast to the broader placement of the dolmens. What is getting centralized? And what do the concentrations of passage graves indicate? To engage with these questions, two different micro-landscapes that serve as good examples for a discussion of distribution patterns in the study area are to be presented.

More than fifty dolmens are situated on the Røsnæs peninsula (Fig. 3). Some settlements

Fig. 4. The area around Rørby, Værslev and Ubby with dolmens and passage graves and settlements from MN A I. No settlements from MN A II are known. Sources: see Fig. 3 and landscape model (Fig. 1).

are known from EN II and are placed in close vicinity of the rectangular dolmens. A huge amount of the settlements and tombs were erected along the watershed on the Røsnæs ridge, which is up to 60 metres high and that still today functions as a road. It is tempting to interpret the distribution of the dolmens as reflecting a continuous development of the monumental landscape, which over time lead to the formation of a distinctive road, with the rectangular closed dolmens being the oldest, followed by the rectangular open and later the polygonal dolmen chambers. Another possibility would be that the different dolmen types were erected side by side through time. In contrast, there are only four certain passage graves (one of them a double passage grave) which lie in rather regular distance from each other (2–3 kilometres apart). The number and distribution of the passage graves compared to the dolmens could support the theory that the passage graves served as "burial centres", and functioned as new, collective burials for bigger more centralized settlements.

The second example shows another pattern: on the hilly ridges around the early Neolithic bay of the Kalundborg Inner Fjord (Fig. 4), megalithic graves occur in clusters and lines. There are more than twenty passage and double passage graves, a number that is much higher than on Røsnæs when seen in relation to the dolmens. A few settlements dating to MNA I are known, two of them in direct vicinity to a passage grave. Furthermore, there are three areas with concentrations of passage graves (Værslev, Rørby, Ubby). At Ubby, for example, a cluster of four passage and two double passage graves forms a ritual landscape with the tombs lying less than a hundred metres from each other. The distribution of several passage graves lying close to each other does not fit with the theory of one passage grave being a centralized burial place for one bigger settlement, at least not when assuming that the tomb was placed close to the settlement. Rather, it should be considered that there might have been other modes of structuring death ritual and monument building, and of burying and being buried in the passage graves. These might be related to the importance of certain areas with religious significance, as for example a place continuity to older graves, as is the case for Ubby, where two nearby dolmens indicate ritual place continuity and tradition, or to other events that are difficult to grasp archaeologically. Still, the question remains who has been buried in the passage graves that lie so close to each other, and from which criteria were the individuals that were buried in one of the graves chosen to be buried there?

Concluding remarks

The following can be concluded about social and ritual tradition and innovation on the basis of the analysis of the megalithic tombs in the study area. It embraces both aspects of life and death.

The impact of the dolmens on the landscape seems to be, at first sight, enormous. However, presuming a gradual emergence of the stone-built tombs within in a two-hundred-year period speaks for a gradual change of the landscape, leading to a marked long-term impact. The dolmen chambers and mounds witness of a strong need to commemorate the dead and to mark their memory in the living landscape. Even though the monuments mark land as static buildings, the aspect of "movement" is an important part of the tombs as they in many cases seem to be built to mark or to give rise to roads or communication corridors. Moving along the graves must have played an important ritual and social role. The questions remain: who built, who buried, and who was interred and commemorated in the dolmens? Did the single monument belong to a household or a family, marking their land and being maintained by them, or were the graves more common places, where individuals that played an important role within society were interred – or both? The fact that many of the graves seem to lie close to roads indicate that the tombs and the individuals buried in them were commemorated by a wider society.

The passage graves give evidence of a deliberate innovative centralization of burial space, breaking with traditional principle for the establishment and the ritual use of burial places as seen in the dolmens. The distribution of the passage graves shows different patterns, which makes their interpretation difficult. First, there are areas where the passage grave seems to be a centralized burial place, perhaps for one bigger more centralized community. Secondly, looking at the areas with clusters of graves, it seems as if their location was not mainly governed by the affiliation to a certain settlement placed close by, but for example, to ritual aspects connected to the area where they were erected and which had to do with ritual continuity, or with other events that we do not grasp yet. As for the dolmens, the question is: who was interred in the grave, which persons were chosen to be buried in the same chamber after which criteria, but also who maintained and had access to the graves?

For a discussion of the "marking of land" through the megalithic monuments, it is important whether only a part of society or whether everybody was buried there, as well as in how far this might have been handled differently for the two types of tombs and at different times. Are we dealing with an equal or a stratified society? Who built the tombs and for whom?

We thus can conclude that the shift in the distribution of the monuments illustrates innovations concerning the ritual use of land, which need not necessarily have been connected to certain settlement units. It will also be a future matter of discussion how the people who erected the megalithic tombs were organized socially and ritually, and how they managed the land both in social and ritual terms.

Acknowledgement

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News from Frälsegården

Aspects of Neolithic burial practices

Karl-Göran Sjögren

Abstract

The passage grave at Frälsegården in Falbygden, western Sweden, was excavated in 1999–2001. In spite of damage and ploughing, this constitutes the most well-documented bone material from a Scandinavian megalithic tomb. In this paper, I summarize the analyses done so far on this bone material, and discuss implications for the interpretation of burial practices in megalithic tombs.

The presence of a number of whole or partially articulated skeletons was one of the most significant results of the excavation. These range from almost complete skeletons to partial articulations. In addition, there is a mass of disarticulated bones but also some bones that seem to have been treated differently, such as a skull group and a couple of bone packages.

It is suggested that most of the bones result from primary burials and subsequent disarticulation, but there are also indications of a change in burial practice, and the occurrence of special treatment could perhaps result from alternative, parallel practices.

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Two models

Since the works by Magnus Bruzelius (1822) and Bror Emil Hildebrand (1864), the dominant view of burial practices in Scandinavian passage graves has been that of secondary burial and deposition of defleshed bones.

This "ossuary hypothesis" was given new life by Christopher Tilley and Michael Shanks (1982). They saw burial practices as ideological, whereby social contradictions could be denied or masked just as well as being demonstrated or emphasized. In this process, a major result was the dissolution of individuality through practices of dismemberment and redeposition of human bones. Mortuary practices thus involved the creation of an anonymous collective of ancestors and concealed real social relations.

In later research, several authors have expressed similar ideas. For instance, Sarup-type enclosures have been suggested to have been localities for primary deposition and defleshing of human bodies (Andersen 1997).

Another view has suggested that burials in megalithic chambers were primary. This was already suggested by Lindgren for the passage grave at Axvalla Hed (Lindgren 1808). In later research such views have been expressed by scholars such as Märta Strömberg (1971), Pia Bennike (1985, 1990) and Torbjörn Ahlström (2004, 2009). In their view, the chaotic appearance of the bones could be explained by factors such as taphonomic loss, disturbance by later activities, and removal of some skeletal parts.

Basic problems in deciding between these hypotheses are the lack of detailed documentation of the bones from older excavations, and the poor preservation in many tombs. The recently excavated passage grave at Frälsegården in Falbygden constitutes an

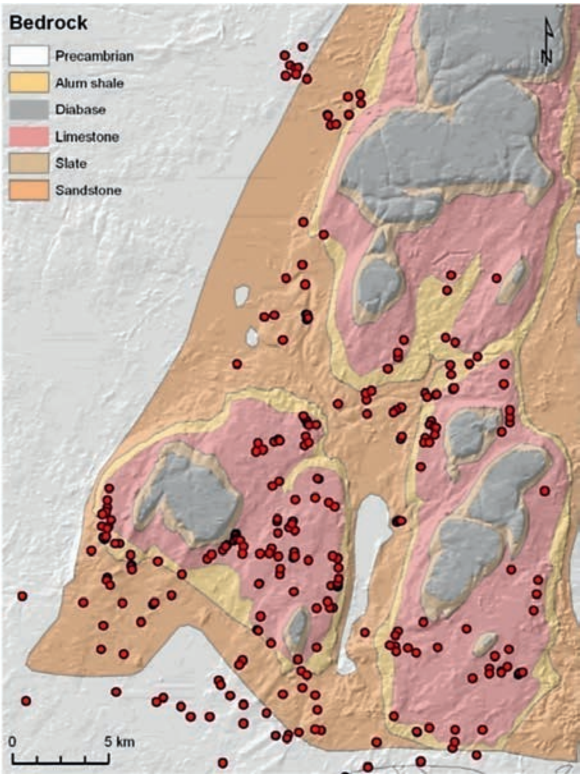

Fig. 1. Map of megalithic tombs in Falbygden.

exception, and I will outline some of the results from the ongoing study of the human bones from this site.

Background

At least 525 dolmens and passage graves are known in Sweden, but especially in the south a large number of tombs have been destroyed during the last two centuries. These tombs were built ca. 3300–3000 BC cal., i.e. the transition between the early and the middle Neolithic periods, in the cultural setting of the Funnel Beaker (TRB) culture. The building of megalithic tombs seems to be virtually simultaneous over a large area including northern Germany, Denmark, Sweden and even southern Norway (Persson & Sjögren 2001; Sjögren 2003; Midgley 2008).

The Swedish tombs occur in two distinct types of landscape. In Scania, Halland and Bohuslän, they are found close to the coast. Especially in Bohuslän they are very close to the Neolithic shoreline and were built in a strongly marine environment.

The second group of tombs is found in the inland area of Falbygden. Here, a concentration of at least 255 tombs coincides with one of the very few areas in the region where the bedrock consists of limestone and slate instead of Precambrian rocks. Therefore, conditions for the preservation of bones are quite good.

Falbygden has several distinctive features. The diabase-capped plateau mountains have characteristic profiles visible over large areas. The flat, limestone plateaus below them are fertile agricultural lands. The vegetation is different from that of the surrounding areas and contains several unusual species. Thus, the Falbygden landscape has a number of properties that set it off from the surroundings. In most directions, it is also clearly bounded.

The Falbygden tombs show a regular pattern in their architecture. The predominant type is the symmetrical, rectangular passage grave (only two dolmens are known). A limited number of tombs have other chamber forms, such as trapezoid, D-shaped, oval or round. In addition to the regularity, they are also large. Mean chamber length is about 9 m, and the largest tombs have chambers up to 17 m in length. Roof block size varies considerably, but some blocks have been estimated at about 20 tons. Chambers are surrounded by stone and earth mounds, usually some 15–20 m in diameter, but examples up to 40 m occur.

In the period 1860–1900, a large number of chambers were excavated by scholars like Bror Emil Hildebrand, Oscar Montelius and

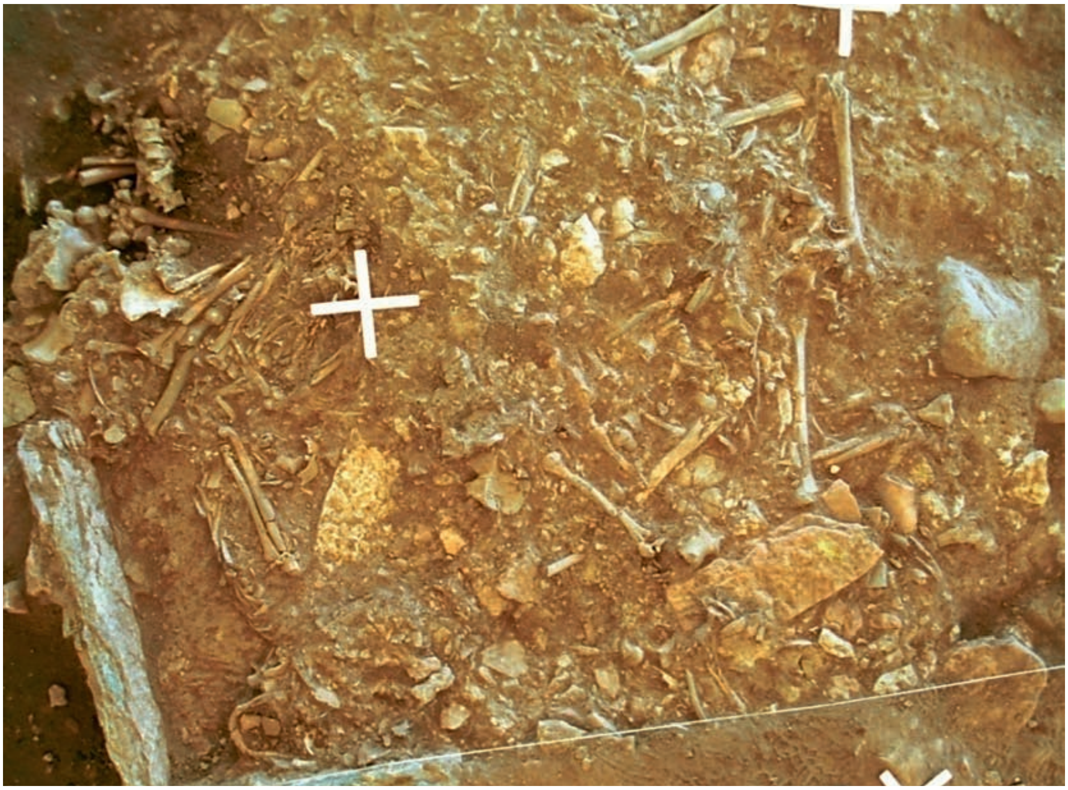

Fig. 2. The Frälsegården tomb during excavation.

Gustaf Retzius. Later, systematic surveys were carried out by Karl-Esaias Sahlström among others. The passage grave at Rössberga was excavated in 1962 (Cullberg 1963), and from the 1980s on further excavations were carried out (Bägerfeldt 1992; Persson & Sjögren 2001; Sjögren 2008).

The Frälsegården passage grave

This tomb was excavated in 1999–2001 (Ahlström 2004, 2009; Sjögren 2008). Most of the chamber stones had been removed *c.* 1900, and the site had been ploughed over since. In spite of this destruction, the construction could be documented and a large amount of bone material collected.

The tomb was found to have been rectangular, approximately 9.1 x 1.8 m large, with a roughly 10 m long passage, and constructed of limestone slabs. Traces of dry walling of slate slabs were found in several places along the walls. Within the chamber a number of sections partitioning the chamber were found. Sections were not found in the central part of the chamber, however, only in the northern and southern parts. If the central part of the chamber was open, the number of sections could have been at most 12–14.

The passage was divided up by thresholds in at least two places, suggesting internal doorways. The chamber had been surrounded by a mound, about 30 m in diameter.

In the chamber a compact, roughly 20 cm thick bone layer with more than 9800 fragments of bone was found. Most of the bones and other finds were measured individually with a total station, and recorded in a GIS database together with the osteological determinations.

Analyses

The human bones from Frälsegården have been subject to a number of analyses. Osteology (species, bone element, sex, age, trauma, tooth morphology) has been analysed by Torbjörn Ahlström (Ahlström 2004, 2009). Ongoing studies concern refitting and pairing of certain bone types, as well as identification of individuals (Sjögren & Ahlström in prep.). Statistical spatial analyses of some bone elements have been published by Ahlström (2009).

A substantial number of bones have been ^{14}C-dated. At present, 34 dates are available, some published in Sjögren (2008) and Ahlström (2009).

A series of $\delta^{13}C$ and $\delta^{15}N$ analyses on collagen in order to study Neolithic subsistence were performed by Hinders (2011). Sjögren and Price (2013) performed $\delta^{13}C$ determinations on tooth enamel.

The mobility of the Neolithic population has been studied by means of strontium and sulphur isotopes (Sjögren, Price & Ahlström 2009; Hinders 2011).

The degree of bacterial breakdown of bone structure (histology) has been studied by Thomas Booth, Sheffield University (unpubl.).

Samples from Frälsegården have also featured in studies of ancient DNA. Three out of four individuals were shown to have the allele for adult lactase tolerance, in contrast to individuals from the Pitted Ware culture on Gotland (Malmström 2007). Six individuals have been classed for mtDNA haplotypes, showing considerable variation on the maternal side (Malmström 2007; Skoglund *et al.* 2012; Skoglund 2013). Nuclear DNA from four individuals has been shown to have greater affinity to modern south Europeans than to north Europeans, again in contrast to PWC individuals from Gotland (Skoglund *et al.* 2012; Skoglund *et al.* 2014).

The human bones

More than 9800 bones and bone fragments have been recorded. Many of these are severely fragmented, so that only 8351 bones could be identified to species and bone element. Most of the bones are from humans, only 268 animal bones have been recorded in contrast to 8408 human bones.

The osteological analysis indicates that a minimum number (MNI) of 51 individuals were deposited in the chamber (Sjögren & Ahlström in prep.; an MNI of 44 was suggested in Ahlström 2009 but has now been revised). As this is fragmented and partly destroyed material, this is most certainly an underestimation. Based on the number of paired and unpaired talus bones, the most likely number of individuals (MLNI) has been calculated, arriving at 78 buried people. Although this is a more realistic estimate, we do not know how many people are not represented by any talus bone at all, so the actual number may be higher.

The overall bone density is shown in fig. 3. A marked concentration of bones is to be seen within a roughly 4 m^2 large area in the centre of the chamber, in front of the passage. The density decreases towards the gable ends, particularly to the south where ploughing has cut though much of the bone layer. No such explanation can be given for the decreasing bone density in the northern part, however, as the remaining fill layer here was thicker than in the middle of the chamber.

The degree of fragmentation was also variable. Bones in the upper parts of the bone layer, and in the southern end, were more fragmented, while those in the bottom of the layer and to the north were surprisingly well preserved.

The dates on human bones are summarized

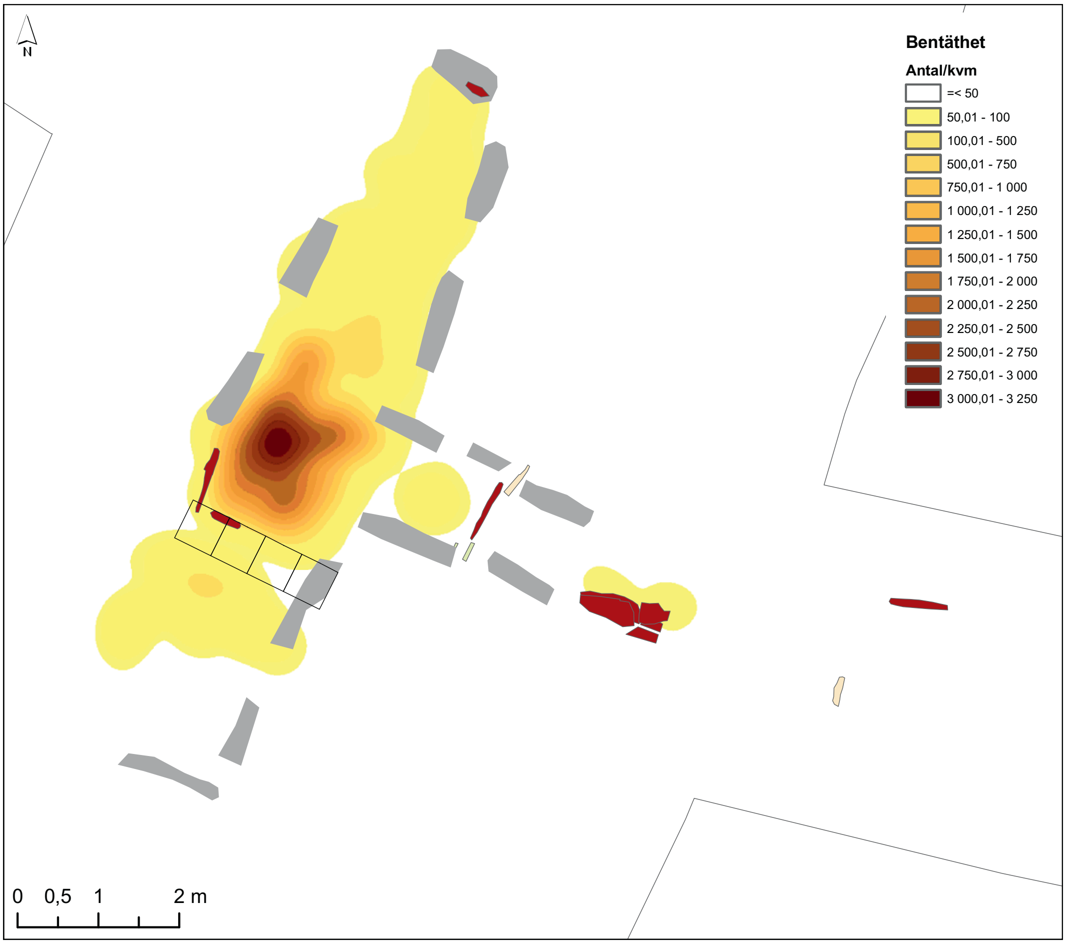

Fig. 3. Frälsegården, tomb plan with bone density.

in fig. 4. Doubles, laboratory errors and samples from other bones than femurs have been excluded, leaving 18 dates representing different individuals. The dates are tightly clustered in the period *c.* 3100–2900 cal. BC. The period of use is thus quite short compared to other dates from Falbygden, as well as to other tombs with several datings, such as Rössberga and Resmo. Perhaps this is part of the explanation for the comparatively well preserved skeletons in this chamber.

A rough calculation indicates that on average about 10 persons per generation were buried, if we assume an even frequency during 200 years, a generation length of 25 years and 78 buried people. If half of the bones have been ploughed away, this number will have to be doubled. This could be enough for a small resident population to have buried all or most of their dead.

Articulations and individuals

The presence of a number of whole or partially articulated skeletons is one of the most significant results of the excavation at Frälsegården, as well as a quite unexpected one given the destruction of the chamber. Already during excavation, a number of articulated body parts were noted, such as stretches of vertebrae, rib cages, hands, lower arms, legs and foot bones

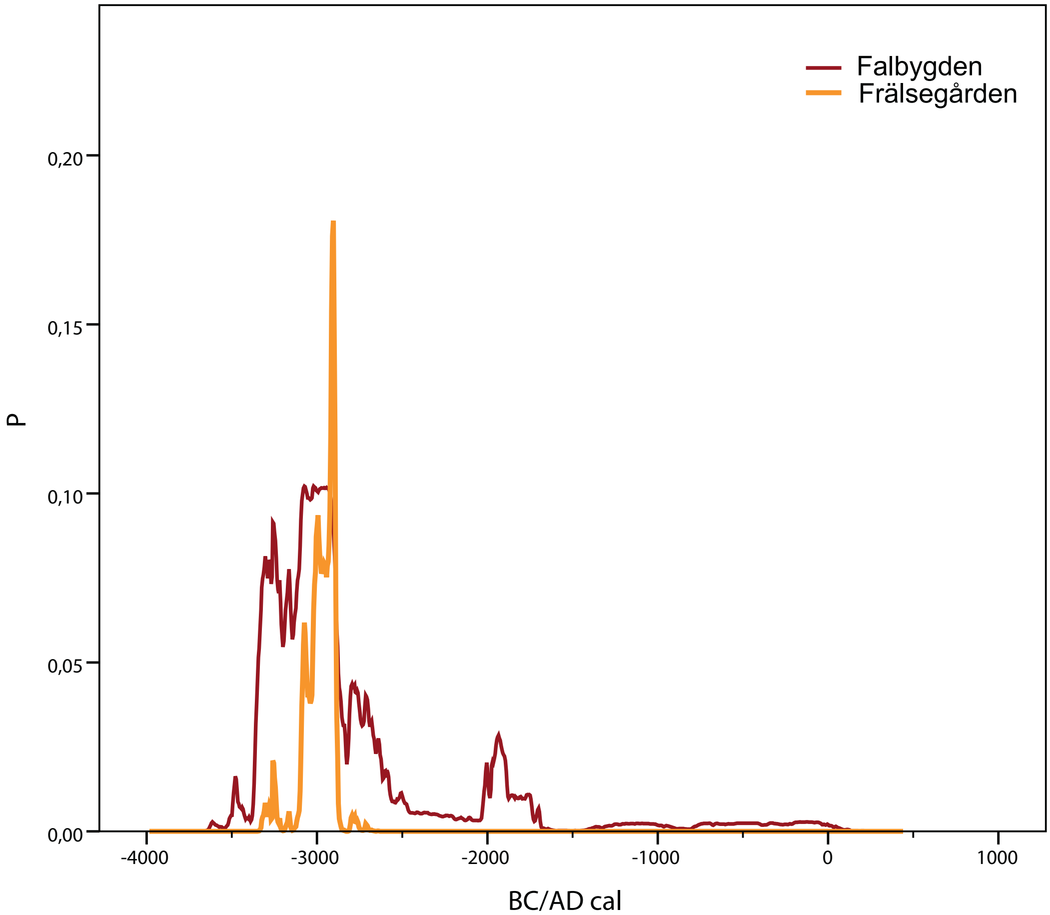

Fig. 4. Summary diagram of ^{14}C dates on 18 femurs from Frälsegården, compared to all dates on human bones from Falbygden.

in connection. Notably, also labile joins were preserved in several cases, for instance phalanges attached to the metatarsals or mandibles attached to skulls. These are the bones most easily detached and therefore most likely to be lost during secondary manipulation of bodies, such as relocation or handling during secondary burial practices. Some of these individuals have been described in preliminary publications (Ahlström 2004, 2009; Sjögren 2008, 2010).

Working on the osteology database together with the GIS database and the geo-referenced photos, it has been possible to extend the number of articulated individuals, and also to revise and complement already identified individuals. A total of 51 sets of articulated bones have been identified.

These range from almost complete skeletons to partial articulations, in some cases with just a few connected bones. It is possible that some of the identified individuals in reality belong to the same skeleton, but when this cannot be demonstrated clearly, we have preferred to keep them apart as separate "individuals". Most probably, further individuals could be discerned by continued analysis.

The articulations are concentrated in the central part of the chamber, especially close to the western chamber wall. This is also where all the well-preserved individuals were found,

Fig. 5. Photo of individual B during excavation. The cranium has already been removed.

with one exception only. Together with the absence of sections in this area, and the distribution of certain artefact types and animal bones, this supports the idea of a functional difference between the central area and the areas towards the gables.

Further, there is some suggestion of order in the positioning of the well-preserved skeletons, as they seem to lie either along the western chamber wall or perpendicular to the chamber axis. As far as body positions can be discerned, contracted positions seem to be predominant, in some cases with strongly flexed limbs. One possibility, suggested by Ahlström (2009), is that the bodies were originally sitting up.

Despite the relatively late datings of the well-preserved skeletons (see below), only very few bones were found underneath them, suggesting either that this area was not used for burial in the earliest phase or that the area was cleared at some point and the bones rearranged.

Individual B

As an example of the well-preserved skeletons I will present individual B in more detail (fig. 5). This almost complete skeleton has been identified as a woman, 30–40 years old. It is the most well-preserved of the individuals found, and also one of the last burials, according to the ^{14}C datings of a femur (3078–2881 cal. BC, 2s, Ua-20946 and 3019–2779 cal. BC, 2s, UBA-14088).

She was found in the centre of the chamber, right in front of the passage. The skeleton was found in the bottom of the bone layer with just a few other bones beneath it, belonging to three different individuals. Under these bones,

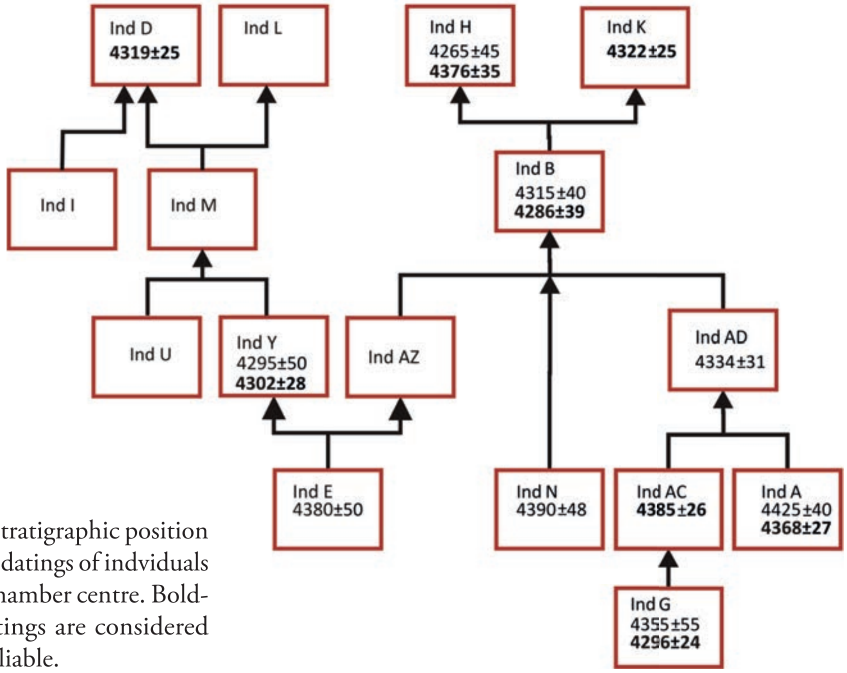

Fig. 6. Stratigraphic position and ^{14}C datings of indviduals in the chamber centre. Boldface datings are considered more reliable.

there was a thin limestone slab, on which the upper body rested. The slab rested directly on the chamber floor; only a single amber bead was found under it.

As found, the skeleton was lying on its back, perpendicular to the chamber axis with the head towards the west. Arms and legs were heavily flexed. Both arms were tightly bound up against the torso, suggesting binding or wrapping. The left leg was similarly tight against the torso, while the right leg was strongly flexed at the knee but pointed perpendicularly to the body and was folded over the left one. The vertebrae and the rib cage were well preserved, but the vertebrae were dislocated at some points. The pelvis was also somewhat disarticulated. Most of the foot bones were in place, but only a few of the hand bones. The skull and the mandible were still in place, as well as the atlas and axis.

Several pathological conditions were noted in her right scapula and clavicle, as well as caries on a number of teeth.

The $^{87}Sr/^{86}Sr$ value on an upper left first molar from this individual is 0.721182, well outside the range for the local geology in Falbygden. She must therefore have spent her early years in an area with an older bedrock. The exact origin cannot be pinpointed, but such values can be found in the Precambrian gneiss areas of western Sweden outside Falbygden.

Stratigraphy and dating

A number of the individuals can be related stratigraphically. This relates to their current position, and does not take into account the possibility of recent or prehistoric disturbance or relocation.

Comparing stratigraphic position with the datings, the overall impression is that these two series are consistent with each other, although with a few contradictions which could indicate relocation of bones (fig. 6). Here, it must be remembered that ^{14}C-dating is relevant to the death of the individual, not necessarily to its placement at the location found. If a consistency between datings and stratigraphical order can be demonstrated, this argues against a significant amount of relocation of these individuals, particularly when the articulations contain labile connections. Relocations would then only be possible very shortly after death. Conversely, lack of consistency suggests that bodies or body parts have been rearranged, within the chamber or coming from the outside.

Refitted bones as well as the study of paired foot bones lend further support to the impression of a low degree of relocation. The great majority of refits and paired foot bones were found within 30 cm distance.

It is possible to use the dated sequences for Bayesian calibration. These calculations suggest that most of the well-preserved individuals died within a quite short time span at about 2900 BC cal. A few individuals could have been buried somewhat earlier, in the period 3000–2900 BC cal.

Articulated and disarticulated bones

If the articulated individuals seem to represent a rather short time interval, the question arises whether this also applies to the large numbers of disarticulated bones. Datings on articulated femurs compared to disarticulated ones do indeed suggest that there is an early phase of use, represented only by disarticulated bones.

While it is difficult to pinpoint exactly the start of the burial sequence, it seems safe to assume that the chamber was in full use at 3100–3000 BC cal., i.e. 100–200 years before the interment of most of the articulated individuals.

There are at least two ways to interpret this pattern. The first is that all burials were performed as primary burials, where complete bodies were put inside the chamber. The disarticulation would then be a result of natural decomposition in combination with disturbance and rearrangement during later use.

The other possibility is that a change in burial practice occurred. For instance, we could envisage a change from secondary burial during an early phase to primary burial in a later phase, but it could also be a question of less dramatic changes such as the introduction of wrappings or other procedures affecting the disarticulation process.

A difference in treatment is supported by the histological analysis performed by Thomas Booth (2012). He studied the degree of breakdown, caused by endogenous bacteria, in thin sections from a series of femurs. A clear pattern was found, in that disarticulated femurs were more severely degraded than femurs from articulated skeletons. In both cases the degree of breakdown was quite strong, however.

This kind of breakdown occurs shortly after death and is dependent on the length of time soft tissues are attached to the bones, so that a low degree of breakdown indicates rapid defleshing (for instance, outdoor exposure) while high degree of breakdown indicates a more drawn-out process.

In the Frälsegården femurs, the results suggest a relatively long period of soft tissue remaining on the disarticulated bones, while the process seems to be halted for the articulated ones. The reason for the difference is not quite clear, but perhaps the best explanation is a change in treatment of the bodies within the chamber.

While most of the bones could have resulted from the deposition and subsequent disarticulation of primary burials, there are some instances that suggest other practices.

In at least two cases tight bundles or packages of disarticulated bones were found. These could be bones redeposited within the chamber, but could also have been introduced into the chamber already in this form.

A similar argument can be made for the group of three skulls found in the northern part of the chamber. Skull groups are recorded from a number of older excavations, but the problem is to date the actual collection into groups, as ^{14}C dating only gives you the date of the death of the individual. So far, it has not been possible to determine whether the skulls belong to any of the skeletons within the chamber or not.

Individual C is the only identified individual from the northern part of the chamber. It has been identified as a woman, 17–25 years old. The 35 bone fragments attributed to this individual belong mainly to the torso, but extremities and cranial parts are also present. Individual C was only partially articulated, with the hip and leg bones packed below and above the torso, suggesting a rearrangement of the bones while the body was still not completely decomposed.

Conclusions

One of the main points to make is the strong taphonomic influence on fragmentation and bone element frequencies in Scandinavian megaliths. The main argument for secondary burial has often been the under-representation of certain categories of bones, for instance small hand and foot bones, supposed to result from loss outside the chambers when the defleshed bones were handled and transported. However, as Bennike (1985, 1990) and Ahlström (2009) have argued, such patterns may also indicate taphonomic loss within the chambers.

In the case of Frälsegården there can be little doubt that several of the bodies were primary burials, and that much of the chaotic appearance of the chamber contents must be due to extended periods of use and later disturbance. In spite of this, traces of ordered depositions in the chamber are still visible.

At least for the later period of use, bodies would have been put in the chambers in a complete state, perhaps wrapped in skins. Rather than intentional fragmentation and de-individualization of humans through mortuary practices, preservation of individual identity within the tombs may have lasted for generations. The use or reuse of bones from these persons would have emphasized specific genealogic linkages, certainly a forceful legitimation tool, and those people in possession of recognized genealogical knowledge would have been in a socially central position.

It is hard to generalize about Neolithic burial practices, partly due to problems of preservation and uneven archaeological study, but also because of the complexity of the practices involving human remains. We have little evidence regarding the variability of burial practices, although as more sites are being studied one would expect the variability to rise considerably, and appear less monolithic than present models suggest.

Even in the case of Frälsegården, there are indications that not all bodies were treated in the same way. At present, the most likely scenario is that of an early phase represented by disarticulated bones and a later phase represented by more complete skeletons. This probably reflects a change in burial practice, perhaps coupled also with a change in how the different parts of the chamber were used. One possibility, supported for instance by the spatial concentration of pig phalanges in the central area, is that wrapping in pig skins was not used in the early phase.

Finally, special treatment of bones is suggested by bone packages and a skull group. Whether these indicate secondary handling of bones or result from alternative, parallel treatment of some bodies remains an open question at the moment.

Acknowledgements

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III. PERSPECTIVES ON MATERIAL CULTURE

An ABC of lithic arrowheads

A case study from southeastern France

Kevan Edinborough, Enrico R. Crema, Tim Kerig and Stephen Shennan

Abstract

If archaeology is to take a leading role in the social sciences, new theoretical and methodological advances emerging from the natural sciences cannot be ignored. This requires considerable retooling for archaeology as a discipline at a population scale of analysis. Such an approach is not easy to carry through, especially owing to historically contingent regional traditions; however, the knowledge gained by directly addressing these problems head-on is well worth the effort. This paper shows how population level processes driving cultural evolution can be better understood if mathematical and computational methods, often with a strong element of simulation, are applied to archaeological datasets. We use computational methods to study patterns and process of temporal variation in the frequency of cultural variants. More specifically, we will explore how lineages of lithic technologies are transmitted over time using a well-analysed and chronologically fine-grained assemblage of central European Neolithic armatures from the French Jura. We look for sharp cultural transitions in the frequency of armature types by trying to detect significant mismatches between predictions dictated by an unbiased transmission model and observed empirical data. A simple armature classification scheme based on morphology is introduced. The results have considerable implications for analysing and understanding cultural transmission pathways not only for Neolithic armatures, but also for the evolution of lithic technology more generally in different spatiotemporal contexts.

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Introduction

Over 40 years ago David Clarke in his seminal work *Models in Archaeology* suggested archaeologists should construct explicit testable models (Clarke ed. 1972), but unfortunately few European researchers do this formally with cultural questions at large regional or supra-regional analytical scales. In contrast, multi-scaled explanatory models supported by highly theorized quantitative methods are the norm in the Natural Sciences. The spectacular success of evolutionary biology is a case in point and can be attributed to two major developments. Firstly, a developed population level theoretical approach emerging last century resulting from biology's "New Synthesis" followed by a staggering series of molecular level discoveries (Gilbert *et al.* 1996). Secondly, the development of complementary analytical tools that harness the exponential growth in computational processing power has expanded the array of tools for investigating increasingly sophisticated research questions.

Our agenda is clear. If archaeology is to assume a lead role in the social sciences as opposed to simply following an agenda set by anthropology, it must undergo its own theoretical "New Synthesis". This is because developed population level thinking (Boyd and Richerson 1985) allows us to systematically analyse site and regionally-scaled consequences of aggregated technological choices which result in the innovation and spread of cultural traits and "variants".

Population thinking combined with computational modelling allows us to infer cumulative consequences of specific individual behaviours, enabling direct comparison between theoretical expectation and empirical observation. Archaeologists can benefit enormously by applying this type of formal analysis to modelling cultural transmission following Boyd and Richerson's theoretical lead (1985), as a testable narrative can be constructed that may be compared with the modelled effects of external environmental drivers of cultural variation, since expected ranges of summary statistics can be obtained and compared with other empirical evidence (Shennan 2011).

Archaeology is now ideally positioned within the social sciences to evaluate and test explanatory models of cultural transmission on a case-by-case basis, as this is the only discipline with direct access to material residues of individual decisions deposited in the cultural record over considerable periods of (sometimes) well-dated time and space. The lithic residue of ancient lithic armatures provides us with a particularly good dataset for testing the predictions of theoretical and experimental quantitative culture transmission work (Bettinger & Eerkens 1999; Edinborough 2008; Mesoudi & O'Brien 2008a & b). Here we develop a paradigmatic classification scheme and apply a simulation-based analysis to infer patterns of cultural change in a very well contextualized case-study area in western Europe. To do this we fit an unbiased transmission model (whereby the probability of adopting a given cultural trait is determined solely by its frequency in the population and the rate of cultural innovation; Boyd & Richerson 1985) to the entire sequence and determine whether specific transitions exhibit strong divergence from our expectations. First, however, we briefly examine the historical reasons why some problematical assumptions are currently made by traditional lithic armature studies.

A brief history of time's arrowheads

The ancient, ubiquitous and persistent nature of stone tools compared to many other lines of archaeological evidence provides us with an excellent opportunity to analyse mode and tempo of technological transmission with a suite of new methodological advances based on populational thinking (Shennan 2011).

In archaeology, directional sequences of technological evolution could only be speculative prior to the development of taxonomic systems-theory, coupled with relative and radiometric dating techniques. Systematic typological classification of lithics formally originated in Scandinavia, perhaps when the Swedish polymath Kilian Stobæus (1690–1742), himself a voracious collector of antiquities including many lithics, outrageously noted in 1738 that stone age axes and daggers were anthropogenic in origin, and not created by lightning as commonly believed (Per Karsten pers. comm.). The influential classification scheme of Stobæus' more famous student at Lund, Linnaeus, subsequently revolutionized the science of taxonomy. The underlying principle of Linnaeus' seminal and influential *Systema Naturae* (1735) was *typological,* he provided an essentialist taxonomy for the natural world, directly related to

Aristotelian concepts of discretely named and categorized *essences (*Hull 1965; 1981). Biology later rejected Linnaeus' immutable categorization of species and static natural ordering, supplanted in 1859 by Darwin's fluid explanatory mechanism of biological "transmutation", more commonly known as descent with modification. As Hull states, the three essentialistic tenets of typology following Aristotle are firstly, the ontological assertion that (Platonic) forms exist; secondly, the methodological assertion that the task of taxonomy as a science is to discern the essences of species; and thirdly the logical assertion concerning a definition, that is to say the classificatory type-name that designates an essence (Hull 1965, p. 317). When constructing a classificatory system archaeologists can benefit from an overt awareness of these tenets, as treating clearly variable tool types consciously or unconsciously as implicit essentialist *species* leads to a mismatch of units of analyses, technical lineages, and thus an erroneous analysis of the lithic data at hand (O'Brien & Lyman 2000).

Armature classification

Our classification scheme for Neolithic armatures explicitly looks at the trait level rather than the whole artefact unit of analysis, avoiding the typologically rooted "species problem" (Hull 1965), in an attempt to avoid the circularity of measuring interdependent technological traits (Edinborough 2008; Buchanan and Collard 2007). We use a *"paradigmatic"* or *materialist* approach, as opposed to a *typological essentialist* approach (Dunnell 1971; O'Brien & Lyman 2000), which sees types not as immutable entities like Linnaean species, but as populations of traits in a constant state of becoming (Hull 1965). It was this revolutionary switch from an essentialist to a materialist philosophy in biology that was the key theoretical advance enabling the intellectual fecundity of the biological New Synthesis (O'Brien & Lyman 2000).

As the only secure way to distinguish an arrow head from a dart head armature is the close association of a wooden shaft with a diagnostic knock end for a bow string (Rausing 1967; Edinborough 2004), armatures are identified as such by each individual lithic analyst. This is done by noting hafting polish, agreed optimal metric ranges, high or low velocity spin off fractures, or more likely a combination of these diagnostic features compared with known ethnographic analogies and experimental work (Edinborough 2008). Arrowhead identifications by different analysts presumably have some degree of error, and issues remain as to correct identification of artefact use-wear, reusage and resharpening (Knarrström 2001); although these issues are not significant in a large enough spatial-temporal sample due to the destructive nature of a relatively high velocity impact (Knarrström 2001). Arrowheads are constrained by size for functional and engineering reasons (Friss-Hansen 1990), and can metrically separate out bimodally as separate distributions from generally larger dart points (Shott 1997), although the precise measurements, methods and results involved are hotly debated among lithic analysts (Edinborough 2004; 2008; Riede & Edinborough 2012). Circumalpine wetland archaeology has its own tool-type classificatory issues that may prove problematic, as ambiguous lithic tools, i.e. potential daggers, knives, or chisels, may possibly be misclassified by a given analyst.

Despite these potentially confounding issues, we do not believe this debate makes it problematical to establish the lineages of technological descent we are interested in here, as the instances where armatures are perhaps misclassified will appear as statistical outliers and can be accounted for. It follows that our classification scheme places a greater emphasis on proximal and basal characteristics, following the work of Bettinger and Eerkens (1999), as the extant archaeological and ethnographic evidence suggests that there is considerably more variety in a projectile point basal element than the distal element, certainly prior to the later innovation of metal arrowhead mouldings (Saintot 1998).

Case study

Some scholars have applied population-level approaches towards understanding cultural transmission processes underlying armature assemblages with some success (e.g., Bettinger & Eerkens 1999; Mesoudi & O'Brien 2008a & b), whilst a general lack of armature sequences obtained from securely stratified sequences remains problematic. Finding deep-time secure temporal sequences with significant numbers of armatures is a rare occurrence. It is difficult to constrain relatively or poorly dated sequences with the necessary temporal precision required to tightly constrain explanatory models (Edinborough 2008). On the other hand, following a tradition over 150 years old, circum-alpine Neolithic lake-dwelling excavations present researchers with unprecedented stratified sequences (Pétrequin & Bailly 2004) especially since the Centre National de la Recherche Scientifique and the Sous-Direction de l'Archéologie made the lakes of Chalain and Clairvaux focused case-studies for French prehistory, with an intensive research programme instigated by Pétrequin (e.g., 1998). In particular, the sites on the shores of these lakes in the Jura region of southeastern France have an excellent chronology associated with a highly detailed study of lithic armatures ideal for testing competing theories of cultural change (Pétrequin 1993; 1998; Saintot 1998).

A series of cultural historical interpretations of these sites have been supported by various analyses of material culture arcing across southeastern France. A dynamic cultural milieu emerges, characterized by variation in technological and stylistic traditions (Pétrequin 1998; Saintot 1998; Shennan 2000). A comparison of the environmental pollen record with breaks in the settlement sequence and variation in different cultural assemblages (Pétrequin 1998) has shown clear support for models of abrupt cultural replacement in the French Jura region, notably in the appearance of the Horgen culture early in the 32nd century BC, followed by the transition to Ferrières cultural assemblage, thought to intrude from the south, in the late 31st century BC. The development of the local Clairvaux culture then follows, down to *c*. 2750 BC. From 2750 to 2400 BC armature morphology diversifies and this is thought to be an indigenous development influenced by greater trade networks in the context of the local Chalain culture. The transition to the Bronze Age is perhaps not so clear-cut, with competing models of cultural replacement and gradual change (Pétrequin 1998; Shennan 2000). The subsequent standardization of arrows on barbed and tanged types indicates Bell Beaker influences from 2400 BC that carry on to the Middle Bronze Age in that particular area (Saintot 1998).

The original armature analysis by Saintot (1998) was based on defining 34 elementary morphological types, aggregated into 17 types, from 280 securely identified arrowheads out of a total of 408 armature lithics, whose trajectories through time were characterized on the basis of their changing frequencies (Saintot 1998, Figs. 38–40). Saintot concluded that the patterns of morphological variation she identified in the different types of armatures could be ascribed to a number of cultural processes relating to changes in the direction of the cultural affiliations evidenced in the artefact assemblages from the sites concerned. These resulted from regional scale demographic movements and changing exchange links. Saintot used 9 chronological phases (I: 3700–3600 BCE; II: 3450 BCE; III: 3200 IV: 3100 BC; V: 3050–3010 BCE; VI: 3010–2930 BCE; VII: 2850–2750

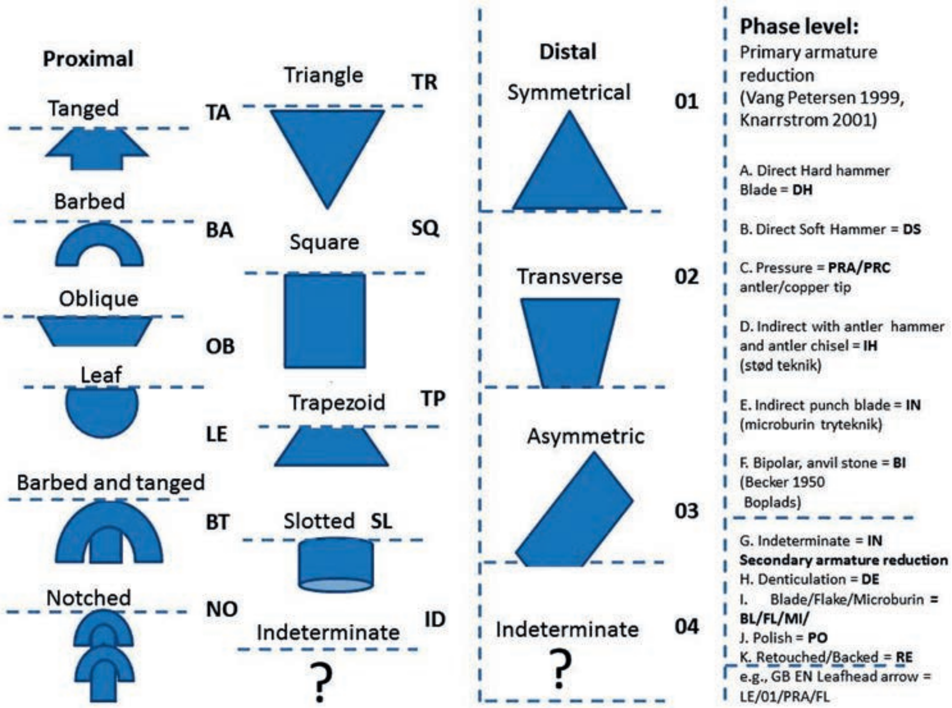

Fig. 1. Attributes used to define the paradigmatic classification for armature traits based on key morphological characteristics. Note the focus on capturing the greater variation present at the proximal end of the armature, which is often hidden when attached to an arrowshaft by mastic and binding technology (cf. Edinborough 2004).

BCE; VIII: 2750–2600; IX: 2600–1650 BCE), following Pétrequin (1998), although the first two were very poorly represented (only 5 arrowheads), and identified two particular periods of change affecting not just armatures but also pottery and ornaments, the first *c.* 3200 BCE, marked by incoming communities from the east entering into contact with areas to the south and the second with the appearance of Bell Beaker material at *c.* 2500 BCE (Saintot 1998, p. 207).

Our study and classification scheme differs from that of Saintot (1998) in two fundamental ways. First, in contrast to her type construction we use as the basic type unit unique combinations of traits identified by our paradigmatic classification. The attributes used to construct the types and the types themselves are shown in fig 1. The attribute values were derived from the armature illustrations in plates 24–43 of Saintot cross referenced against the tables of data therein, and from previous ethno-archaeological research which indicates that the proximal end of lithic arrowheads contains the most variability and is therefore useful for measuring cultural and technological variation (Edinborough 2004; Saintot 1998).

Second, our aim is not to relate the types to the broader cultural context of the sites, the main focus of Saintot's discussion, but to fit evolutionary models of social learning and to address the question of whether any of the phase transitions showed a more marked change than predicted by the model. There are too few armatures present in phase II to investigate the phase II-III transition argued by Saintot to represent the earliest major change in the local sequence. The other predicted significant

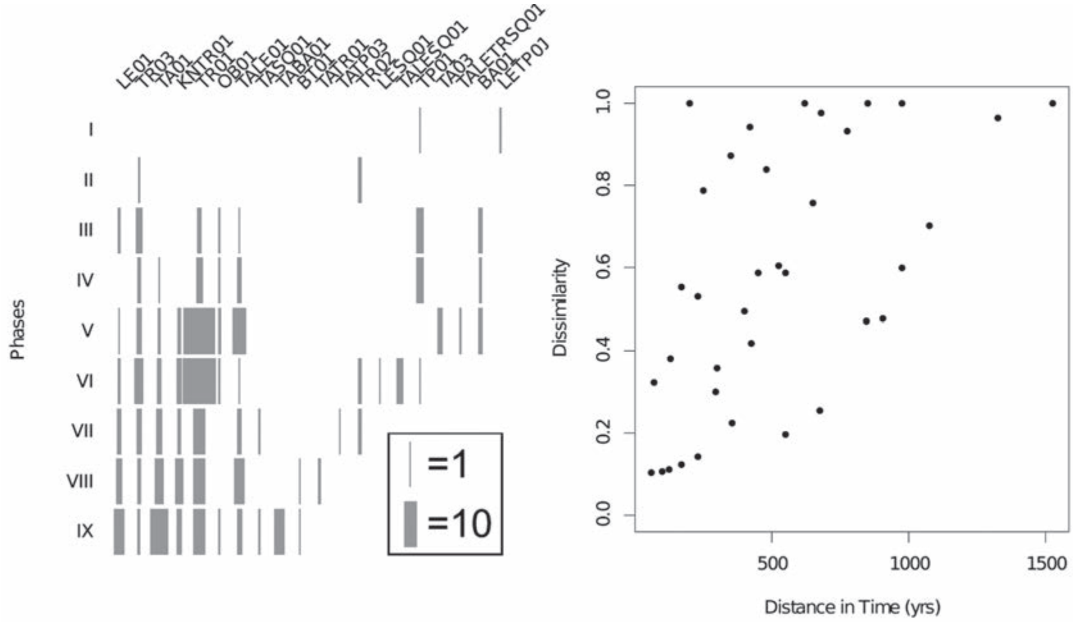

Fig. 2. The relative frequency of our armature types in each archaeological phase (left plot), and Morisita-Horn dissimilarity against temporal distance (right plot) measured between the mid-points of each phase of all pairs of phases identified at the Clairvaux-Chalain sites.

change is that associated with the appearance of Bell Beakers though it is ambiguous from Saintot whether this is represented by the phase VII–VIII or VIII–IX transition.

Temporal changes in the frequency of artefact types offer the possibility for examining, inferring, and testing models of cultural transmission (Neiman 1995; Shennan & Wilkinson 2001; Kandler & Shennan 2013). Mathematical models originally developed in evolutionary biology, and modified to incorporate dynamics intrinsic to cultural transmission (Boyd and Richerson 1985), allow us to make explicit quantitative predictions of population level summary statistics that can be tested against the observed record.

Given that our objective is to examine potential variations in the evolutionary process over time, we chose as a summary statistic of our data the dissimilarity in the frequency of artefact traits between all possible pairs of cultural phases. We use the Morisita-Horn dissimilarity statistic (Morisita 1959; Horn 1966), an ecological index that quantifies the compositional dissimilarity between two vectors of frequency, ranging from 0 (identical composition) to 1 (complete absence of shared types).

The scatterplot in fig. 2 shows a significant correlation between the two measures as expected (R^2 =0.319, p-value= 0.024, Mantel Test with 1,000 permutations), as the longer the temporal distance between two phases, the higher the dissimilarity in the frequencies of different armature types. On the other hand, the scatterplot also shows a variation in the dissimilarity between phases at approximately the same interval. Can we safely state that these differences are resulting from different generative cultural transmission processes, or are these levels of diversity to be expected from the same process? Can we safely ignore the effect of sample size or time-averaging (e.g. Premo 2014)?

Here we use Approximate Bayesian Computation (ABC, Beaumont *et al.* 2002; see Crema

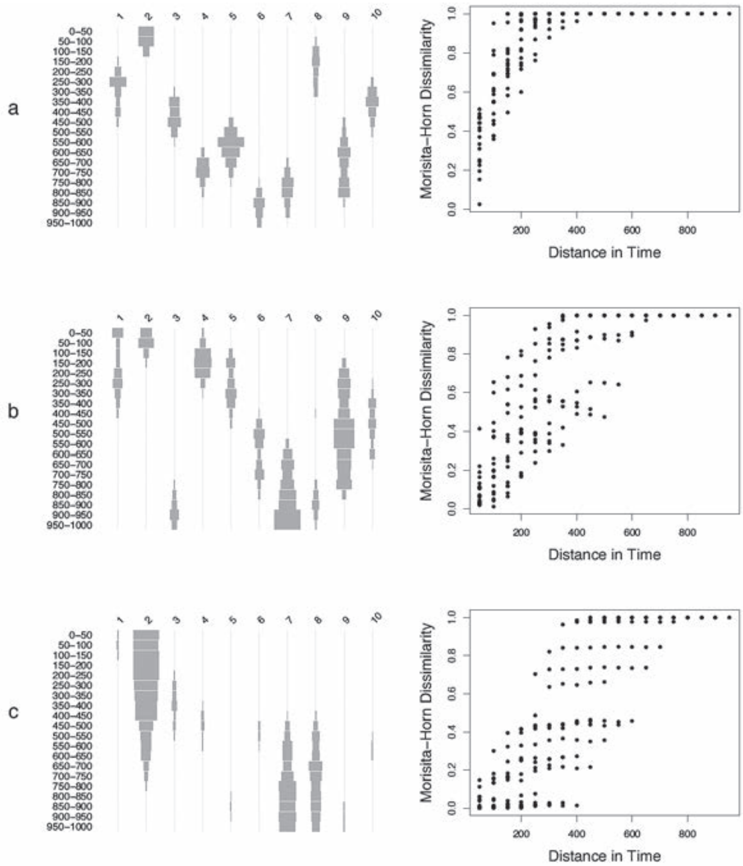

Fig. 3. Simulation output of frequency change in cultural traits (left column) and corresponding scatter plot of Morisita-Horn dissimilarity vs. time distance. Simulation generated from an unbiased transmission model, with a population size of 500 and innovation rates of 0.01 (a), 0.005 (b), and 0.001 (c). The frequencies depicts the 10 most common traits from each simulation.

et al. 2014 for an archaeologically tailored discussion on the method as well as methodological discussion of the present case study), a computational method that enables us to infer, for a given simulation model, the parameter values that will provide the best fit to an observed dataset. This is achieved by iteratively generating artificial summary statistics (comparable to the observed ones) using different parameter values sampled from a prior parameter distribution. The final output of ABC is a probabilistic estimate of the parameters values that is informed both by the hypothesized model and the empirical data.

We used the dissimilarities plotted on fig. 2 as our empirical data-set and assumed that if the generative process behind the empirical record was unchanging, differences in the dissimilarity indices between the observed and simulated data should be small and randomly distributed. Consequently, any changes in the generative process (e.g. an increase in the innovation rate, transmission mechanism, population size) should lead to significant deviations at key transitions (as those expected from phases VII–VIII and/or VIII–IX).

Unbiased Cultural Transmission

One of the most commonly adopted models for exploring the frequency of different artefact types is the unbiased transmission or random drift model (Boyd and Richerson 1985; Bentley *et al.* 2004). The key principle is that the most parsimonious initial assumption in the pattern of cultural transmission is a neutral

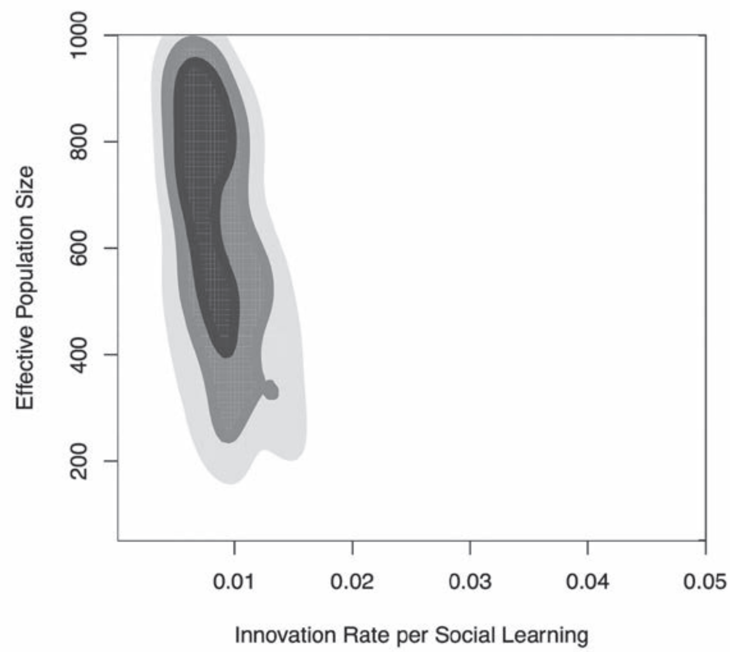

Fig. 4. Posterior density distribution of the two simulation parameters obtained from ABC.

process where selective biases are absent. In other words, the likelihood of copying a cultural trait is purely a function of how frequent this trait is. Under this model, two variables play a pivotal role in defining the dynamics of cultural evolution: the rate of innovation and the effective population size. The former is simply the frequency by which a new cultural trait is invented within defined interval of time *t*. The invention is at the individual level and does not necessarily imply the adoption of the trait by all other individuals. The effective population size can be conceptualized in different ways, from the number of social learners to the observed sample that play a role in the copying process. It is important to stress that the effective population is not equivalent to the actual population size, although a positive correlation between the two can be expected.

Fig. 3 shows how variation in the innovation rate alone can generate different patterns under the same unbiased cultural transmission process, though all of them bear a strong resemblance to classic archaeological "battleship curves". When innovation rate is high (Fig. 3-a), variants have a shorter time-span of existence. Consequently if we plot the dissimilarity against distance in time (as we did in Fig. 2) we have a steep curve, suggesting a fast rate of cultural evolution. When the rate of innovation is low (Fig. 3-c), cultural variants have a longer persistence over time, and the scatter plot exhibits a shallower curve. Thus depending on the rate of innovation we should expect different levels of dissimilarity between two archaeological phases at the same temporal inter-distance. Fig. 3 also highlights how the very same model and parameters can generate, as a consequence of the random nature of the copying process, a range of dissimilarity values for the same temporal distance.

Fitting the model and detecting outliers

The variation observed in fig. 3 indicates that given a temporal distance between archaeological phases we might expect a variety of values in the dissimilarity measure depending on the choice of our model parameters. This leads to the question of how we can evaluate episodes of significant change at Clairvaux-Chalain, if we do not know what exactly we should expect. In other words, if the process generating the

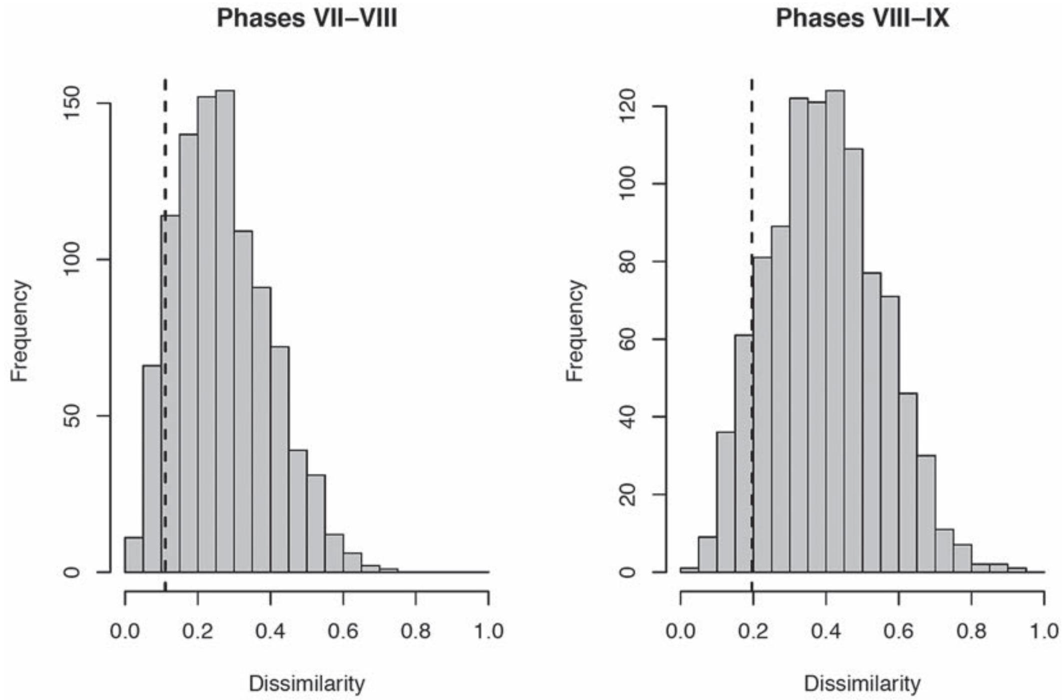

Fig. 5. Dissimilarity ranges expected from the unbiased transmission compared to observed values (dashed line) for phases VII to VIII and VIII to IX.

pattern observed in the frequency changes of arrowhead typology was unbiased transmission, what were the innovation rate and the effective population size?

Fig. 4 shows the parameter estimates of the unbiased transmission model obtained from ABC. Assuming that individuals can socially learn approximately once a decade (for bow-arrow technology see Hill & Hurtado 1996), the simulation shows that the best-fit model has an innovation rate of approximately 0.01 (equivalent to an innovation per 1000 years per person), and an effective population size between 200 and 1000. It is worth noting that these parameter estimates are functions of the assumptions built into the model (i.e. frequency of transmission events), and hence their interpretation should be cautious, and restricted to relative terms, rather than absolute ones. However, a more conservative approach using bootstrapped summary statistics and a probabilistic range (rather than a fixed value) for the frequency of transmission events yielded similar results (see Crema *et al.* 2014), suggesting that the overall conclusion of the study is sufficiently robust.

The posterior estimates of the model parameter obtained from ABC enable us to estimate expected dissimilarity for any given pair of archaeological phases, taking into consideration sample size, time-averaging, temporal distance between the two assemblages, and the inferred innovation rate and effective population size. Fig. 5 shows such expected dissimilarity values for the transitions of our interest (phases VII to VIII and VIII to IX), which can be compared against the observed dissimilarity (shown as a vertical dashed line). This strongly suggests that the observed dissimilarity is lower than that expected by the unbiased transmission model. Such a result is the opposite of what would be expected if there was a major cultural change during this interval, despite the later appearance in phases VII–VIII and VIII–IX of distinctive barbed and tanged arrowhead morphologies, often intuitively associated with the dramatic arrival of Bell Beaker culture or perhaps even Horgen dagger technology (Furestier 2007; Vander Linden 2006).

Conclusions

This paper shows how population level processes driving cultural evolution can be better understood if mathematical and computational methods, often with a strong element of simulation, are applied to archaeological datasets. We navigate through persistent previous taxonomic problems archaeologists inherited from other disciplines long ago by adopting a population-based approach, coupled with a trait-based paradigmatic taxonomic classification scheme for armatures and a statistical method that enabled us to formulate our hypothesis as a simulation model.

We conclude that our population level approach uses new computer-based Bayesian methods that make it possible to generate simulation models integrating theory with archaeological evidence to compare outcomes with observed data. This approach has great utility for studying armature evolution across European research traditions. Our approach is tailor-made for exploring highly specific models of cultural transmission elsewhere in the archaeological record so we believe the implications for better understanding other technological lineages with this methodology are profound. We hope this new approach and others like it will enable archaeology to undergo its own much needed New Synthesis.

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The scent of sandstone – exploring a TRB material

Susan Hydén

Abstract

The aim of this article is to briefly explore how quartz-rich sandstone might have been perceived by TRB societies. Using the senses as a point of departure, it discusses how sandstone was selected for grinding stones and for dry walling in megaliths, emphasizing the significance of the visual as well as the mechanical properties of the material. The article also acknowledges the complexity of the way in which the material was perceived. The significance of sandstone was shaped by context, implying that a changing context altered its significance. Ultimately, this study is a call for taking materials seriously by exploring them in a more nuanced way. Analogies, for example, can be very useful – not as proof, but as a way of raising questions and scenting the diversity of the Neolithic.

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Introduction

When visiting the vicinity of Höör in central Scania in 1819, Professor Sven Nilsson was told that Scanian quarrymen were known for the ability to recognize sandstone by using their sense of smell. In the search for suitable rock material for querns, they thrust thin, pointed levers into the ground. When hitting rock, experienced quarrymen could distinguish between sandstone and gneiss by smelling the tip of the bar. They could also make an estimation of the size of the boulders they came across by listening to the sound the bar made when hitting the stones (Nilsson 1983, p. 65). Scanian sandstone was not only used as raw material for quern stones during medieval and historical times. It was also an important building material, the cathedral in Lund being a renowned example. But the significance of sandstone during another era of monumentality is seldom discussed, despite its frequent uses for grinding stones and as building material. Whether or not the scent of sandstone or the sound of the blocks was significant during the early Neolithic is indeed hard to tell, although senses such as touch, feel, smell, sound and sight are part of any craftsperson's skills (Kuijpers 2012, p. 137). But such analogies open one's mind and encourage us to raise questions that would otherwise not have been asked, due to our unfamiliarity with premodern working skills. Using the senses as a point of departure we can perhaps "scent" something out about how this material was perceived.

Scanian quartz-rich sandstone

Geologically speaking, there is no such thing as Scanian quartz-rich sandstone, but, rather, many different types of sandstone. In some parts of Scania there are still sandstone formations that are quarried. Another source is the vast areas of moraine containing pieces of sandstones brought by the ice sheet and hence not local in a geological sense. One aspect that these quartz-rich sandstones have in common is a reddish colour, although they sometimes show a more greyish or even whitish hue. Geologists refer to one group as arkoses, which is a type of sandstone containing a high degree of the mineral feldspar. The feldspar contributes to the red colour, but some Scanian sandstones are coloured by iron oxide, or a combination of the two (Johansson 2013).

Though not qualifying as such, some sandstones look very much like homogeneous quartzites. There is also a large variation in the size of quartz and feldspars grains. What causes the colour or other geological specifics of the sandstone is not important from an archaeological point of view, however. Irrespective of its composition or formation, many of these quartz-rich sandstones are easily recognizable, mainly due to the combination of their colour and the often homogeneous, sometimes layered matrix of small quartz grains that makes them rather easy to break along their planes (Johansson 2013). To avoid burdening the text in this study, quartz-rich sandstone will be referred to simply as "sandstone" from now on, although it is not a homogeneous group geologically speaking.

A retrospective view

Prehistoric megalith builders used many different types of rock to build their monuments. In the southeastern part of Scania, for example, numerous rock types have been documented, which seem to have been found in the vicinity of the tombs (e.g. Strömberg 1971 pp. 210 ff.). Among these rock types, the selection of red sandstone for dry walling in megaliths has been noted in many cases, although other rock types, especially lamellar or easily cloven stones, were also used (Fig. 1; Strömberg 1971, p. 210; Hårdh & Bergström 1988, pp. 46 ff.; Tilley 1996; Ebbesen 2011, pp. 259, 265). The walls of the chambers, passages and/or kerbstones are often sealed with a dry wall consisting of smaller stones that are stacked on top of each other, although the use of the word dry wall is unfortunate as there is evidence of the use of mortar (Ebbesen 2011, p. 265). Dry walling is often associated with passage graves, but was also used in dolmens (Jacobsson 1986, p. 92; Brink & Hammarstrand Dehman 2013, p. 47). The reason for the selection of sandstone may have been the natural cleavability of this rock type, which was expedient for megalith builders who wanted thin stone plates to use. On the other hand, investigations in Denmark, Sweden, north Germany, northern Netherlands and northwestern France have raised the suggestion that the red colour of the building materials may have been significant (Strömberg 1968, p. 165; Hårdh & Bergström 1988, p. 49; Tilley 1996; Scarre 2004, pp. 199 f.; Midgley 2008, p. 156; van Gijn & Raemaekers 2014).

The geological history of an area is reflected in the choice of stone for building material. Among the passage graves in the megalith-dense region of Västergötland, Sweden, for example, the use of flat pieces of red and grey limestone as construction material has been noted (Axelsson & Jankavs 2013). The red limestone is softer and dissolves more easily than the grey limestone. This means that the red stones stick together more easily, which could have been a desirable property for megalith builders who wanted material that had the ability to seal the chamber and keep it dry. On the other hand, the red stones were often placed in ways that made the red colour stand out (Axelsson & Jankavs 2013, pp. 136 ff.). An investigation of a specific type of red sandstone (Kågeröd sandstone) used for the dry walling in passage graves in western Scania is another example of how both the colour and the mechanical properties of the sandstone seem to have been important (Hårdh & Bergström 1988, p. 49).

If such qualities made sandstone a sought-

Fig. 1. A dry stone wall in the Hallebrøndshøj passage grave on Bornholm, Denmark. Photo: Svend Illum Hansen.

after building material in Scania, the high quartz content made it a useful material for tools as well. According to Rapp (2002, p. 223), quartz was the most common abrasive throughout the ancient world, and rock types with high quartz content are generally suitable for grinding and abrading (e.g. van Gijn & Houkes 2006). In southern Scandinavia, quartz-rich sandstone was often selected for grinding stones (Fig. 2). These tools are easy to recognize, not only because of the rock type itself, but also because of the smooth polish that the worn use surfaces exhibit, which sometimes have striations visible to the naked eye. Flaking is often used to shape the sides of the artefacts but it is often hard to tell whether flaking and/or percussion were applied to shape the use surfaces as well, since they usually are heavily worn. The bottoms of the artefacts are often unaltered but can exhibit a worn appearance, and sometimes the artefacts display two use surfaces, often situated on opposite sides. These grinding stones are most often fragmented which makes it difficult to estimate the original size of these artefacts. They are occasionally found, sometimes in large numbers, on sites from the Mesolithic period and have been associated with ground stone axes (Jensen 2001, p. 112; Schaller-Åhrberg 2006, p. 43). They are a comparatively common find at TRB sites as well, dating from a time when Stone Age people ground axes made of flint as well. The appearance of the heavily worn use surfaces is often interpreted as being caused by the grinding and polishing of, for example, axes (van Gijn & Houkes 2006, p. 178; Johansson 2006, p. 116; Schaller Åhrberg 2006). Experimental archaeology has proven such stones to be suitable for grinding e.g. flint axes with water, sometimes together with sand, as an effective lubricant (Olausson 1983, p. 62; Madsen 1984, p. 52; Hahn 1991, p. 284). These circumstances combined mean that they are often interpreted as axe grinding stones, but it may be mentioned that this assumption is under revaluation and needs to be problematized (Hydén, ongoing PhD project). Although the function of these artefacts is not the topic of this article, it may be noted that the term *grinding stone* is used here in a generic way, i.e. without indicating *what* have been ground using these tools. Nevertheless, this type of artefact has not attracted much attention in archaeological research (Hamon

Fig. 2. Some examples of fragmented grinding stones from the Early Neolithic site of Almhov in southern Sweden. Photo: Susan Hydén.

2006, p. 333; Schaller Åhrberg 2006, p. 44). Thus, an investigation of grinding stones made of sandstone can contribute to an understanding of how this material was perceived, as well as shedding light on a type of tool that is often overlooked or taken for granted.

Thinking material

Despite notable exceptions, much of the last decades' focus on material culture and materiality has been criticized for producing research based on theoretical perspectives, but with surprisingly little attention paid to the *physical material* itself (e.g. Olsen 2003; Hurcombe 2007; Ingold 2007; Conneller 2011). One reason may lie implicit in our modern concept of "raw material", or as Ingold (2007, p. 9) eloquently puts it: "materials appear to vanish, swallowed up by the very objects to which they have given birth. That is why we commonly describe materials as "raw" but never "cooked" – for by the time they have congealed into objects they have already disappeared." Viewed from this perspective, it is better to talk about "material" rather than "raw material".

In recent years, however, research which acknowledges that material is *not* a formless substrate without any significance until it is transformed into a finished artefact form seems to be emerging (e.g. Boivin & Owoc 2004; Conneller 2011). At the same time it is somewhat ironic that archaeological research seldom focuses on stone as a material, despite the fact that a whole period is named after it. Stone as a catchall term in archaeology is rather unwieldy as it conveys the fact that it comprises many rock types with very different properties (Conneller 2011, p, 82). Different rock types may very well have been thought of as different kinds of material in the past, materials that were used to grind, smooth, abrade, polish, saw, bore, crush, shape and sharpen, among other things. It was used for a vast variety of purposes, from making tools, structures and petroglyphs, to tempering of pottery, processing animal and vegetable products, pigments, clays and other materials (Adams 2002). Flint is an exception as it clearly is the most studied material in the rock and mineral group in southern Scandinavia, to such extent that it can be considered the norm (cf. Alexandersson 2007, p. 35). One reason for this research lacuna concerning sandstone grinding stones may be that they do not display any obvious typological features. Moreover, the production and maintenance does not produce much waste material to facilitate technological studies, and the flakes and other by-products that do occur are seldom retrieved from Scanian archaeological excavations. Pecking and grinding techniques may also have been involved in the process, but they do not leave any macroscopically visible by-products, apart from manufacturing tools involved in the process (Olausson 1998, p. 133). All these factors contribute to the tendency to interpret these grinding stones in strictly functional terms. They represent the idea of a ready-made tool used to shape other tools, a fact that does not encourage any further interpretations.

But just as sandstone was deliberately sought out for dry walling, this material was intentionally selected to be used as grinding tools. And quite possibly, there was a similar tension between the mechanical properties and visual qualities, as seems to have been the case when sandstone was selected as a building material. Studying the colours associated with rocks is often forgotten, partly because many rock types sometimes resemble each other after being exposed to the weather and other natural processes (Lynch 1998; Jones 1999). In addition, subtle tonal patterns such as natural differences in shade are not that obvious for us today as they would have been in earlier societies where the palette of colours was restricted (Hurcombe 2007, p. 539 f.). There is a rich flora of research that emphasizes the importance of incorporating colour and other aspects of the sensory realm into the interpretations of prehistoric societies (e.g. Jones & MacGregor 2002; Fahlander & Kjellström 2010; Day 2013). The scope of this article does not allow for an extended discussion of the theoretical background and methodological implications of sensory archaeologies. But by posing the question whether colour or other sensory aspects could be part of the way grinding stones were perceived, new ways of understanding a tool that is often overlooked or taken for granted can be gained. But neither typologies nor function-based terminologies are very helpful when exploring this issue. Focusing on the artefacts' life histories, however, has proven fruitful when studying ground stone artefacts in general (Hydén 2009; 2011; 2014). So what can the life histories of grinding stones tell us about the sensory aspects of sandstone? As a basis for this brief discussion, the grinding stones from the site of Almhov will be used. Almhov was an Early Neolithic burial and gathering place situated outside present-day Malmö, and grinding stones were the most common type of ground stone artefacts found at the site. Almhov is introduced by Rudebeck & Macheridis in this volume and will for that reason not be presented in more detail here (see also Gidlöf 2009; Rudebeck 2010; Hydén 2014).

Visibility

Studying sandstone in relation to the life histories of grinding stones raises a number of questions about procurement strategies and storage. The investigation of the grinding stones from

Almhov showed that they are made of sandstone nodules. Patches of weathered surfaces caused by natural forces can often be identified despite their fragmentary character, which indicates that the material did not originate from solid rock (Hydén 2014, p. 253). The moraine that surrounds Almhov is a possible source, although the stones could have been transported a greater distance. The study made of the Kågeröd sandstone mentioned previously suggests that the material used as dry walling in passage graves was quarried. The large amounts of lamellar stones that were used in combination with their sharp-edged form makes it conceivable that they were brought from an outcrop along a river in the area. The distribution of these red stones in the megaliths points to the existence of a relationship between two areas where megalithic graves were erected in western Scania and the sandstone could have been transported by water (Hårdh & Bergström 1988, pp. 41 ff.). A different procurement strategy must be attributed to the grinding stones found at Almhov. Although the preferred quartz-rich sandstone nodules may originate from the moraine, such stones were hardly lying around everywhere. Firstly, the nodules need to have a certain size. Secondly, many of these stones were to some extent formed by flaking in order to shape the sides, indicating that a certain form was desirable. At the same time, this shaping seems to be done only partly and could also be part in the maintenance of the tools in order to prevent the use surface from becoming too hollow. Nevertheless, the shape of the original, "natural" nodule was utilized to a great extent, thus showing that there was an interest in letting nature act as a designer (cf. Conneller 2011). The question is how the sandstone was collected; if the nodules were actively searched for or if they were picked up for future use when an opportunity presented itself. Both ways are of course possible, and irrespective of procurement strategy, looking at the landscape in southern Scania it is easy to forget how it must have looked like during the Neolithic period. Walking the arable lands of today, it is easy to find stones on the newly ploughed fields. But tilling the soil must also have provided opportunities to gather stones during the Neolithic, although the need for clearance of stones was perhaps not that important in small-scale farming (cf. Olausson 1983, p. 69). Keeping animals is also a way of exposing stones due to trampling and grubbing. In addition, people must also have come across stones during the clearance and digging for pits and megalithic structures at burial and gathering places such as Almhov. There is also the possibility that people brought sandstone nodules or finished grinding stones to Almhov from other places. The pottery found at Almhov, for example, was not made of local clay (Gidlöf 2009, p. 111). The sandstone flakes found at Almhov are negligible, suggesting that the artefacts were formed and curated at another place. This may, on the other hand, be a source-critical problem, as such production waste can be rather scarce and difficult to identify and was not a prioritized aspect in the excavation plan.

Even if the material could have been procured in many different ways, the red colour could very well have been part of it. Red sandstones plates are in fact something that many archaeologists look out for during fieldwork, as they may be an indication of a megalithic environment. This is not to suggest that colour was the only way of recognizing sandstone during prehistory, and other types of red stones were also collected, e.g. red granite, which was used to temper pottery. Also worth noting is the large numbers of pits, which are typically found on TRB sites. Both artefacts and unmodified stones are generally found in these pits, and Almhov is no exception. Investigations of the composition of these stones to see whether they are random or not could provide a basis for a discussion of rock type selection and if there are pits that could have been used for storage (cf. Schneider 1996 p. 306).

Exploring the life histories of the grinding stones from Almhov in relation to context can provide clues as to whether colour was significant at the end of their use lives as well. The fragmented grinding stones were put into the dolmens, at the facades of the long barrows as well as inside the burials. The tools must have been deposited, displayed and arranged in various ways, and their significance was shaped and reshaped by these different and changing contexts. A large corpus of research material with well-preserved and detailed documented contexts would be required for a wider discussion. This is not the case here, but some aspects can briefly be touched upon. The red, flat Kågeröd sandstones used for dry walling contrasted in a conspicuously way than the larger slabs in the passage graves. Due to the bad preservation of the monuments at Almhov, the placement of the grinding stones cannot be discussed in detail. Still, they were put into these monuments, and even if they hardly worked as dry walling material, the colour of these tools would still have had a visual effect. A connection between the overall use of red building stones and the frequent use of red ochre in or close to the megaliths has been suggested (Strömberg 1971, pp. 324 ff.; Hårdh & Bergström 1988, p. 49). An interesting parallel is an investigation of fragmented sandstone tools found on a Neolithic site in the Netherlands. These tools, used as querns, were intentionally broken and rubbed with ochre (Verbaas & van Gijn 2007). Again, the main thread seems to be the red colour, and even if not all sandstone grinding stones from Almhov are distinctly red, there is the possibility that they once were covered with ochre. The almost glossy appearance of the use surfaces is another visual characteristic, not to mention another most striking feature. All grinding stones at Almhov are fragmented and the visibility of these clearly broken tools could represent the social practice of fragmentation (Hydén 2014).

But warnings about concluding too quickly that some sort of colour symbolism or the like was significant, thus privileging vision over the other senses or other aspects, have been made (Scarre 2004, pp. 199 f.). Stone is also seen as a material that embodies the significance of place, an idea that can be interpreted in many ways (e.g. Scarre 2004; Conneller 2011, pp. 77 ff.). Although this kind of interpretation is often connected to monuments it must also be a possibility for nodules used for artefacts and found in a moraine to signify a place. People visiting a large burial and gathering place such as Almhov are likely to have come from different places and may have brought the stones. But the grinding stones could also have gained significance through their use, e.g. representing the communal work of building the monuments at Almhov (Hydén 2014, p. 255). Even materials used in what are considered mundane tasks were bound up with people's understandings of the world (Conneller 2011, p. 77).

To conclude – the significance of sandstone

The aim of this short article was to briefly explore how quartz-rich sandstone might have been perceived by TRB societies, which led to a discussion about colour and visibility. The significance of artefacts is shaped by context, and changing the context alters the significance, which allows for different interpretations in which different material qualities can be part. Both the mechanical properties and the sensory qualities of a material are examples of what can be important in different ways in different situations. The possible tension between stone as something permanent (the monuments) and something that was destroyed and perhaps abandoned (the artefacts) is something that could be explored further. Ultimately, this study is a call for a problematization of different kinds of archaeological methods, concepts and hierarchies. It is concluded, for example, that stone can be many materials, that material is not that "raw" and that the moraine could be looked upon as a harvesting field where colour was important for localizing material of Natures design.

To conclude, modern quarrymen in Scania used scent and sound while quarrying for sandstone, an observation that led to a discussion of the sensory aspects of sandstone during the earlier part of the Neolithic. As such, analogies can be very useful – not as proof, but as a way of raising questions and scent the diversity of the Neolithic.

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Fragmentation during the Neolithic

Transformation and enchainment from a south Swedish perspective

Lars Larsson

Abstract

Studies of the creation of material culture, objects as well as structures, are well represented in research. The ways in which objects and structures go out of use should be as interesting and important an aspect as how they were made.

In recent research fragmentation has been closely connected to enchainment, the relation between objects and humans. The effect of fire represents a special form of fragmentation. Finds indicate that the use of fire on artefacts, especially flint, is well known throughout the Neolithic. Axes are more affected than any other type. In order to achieve the right fragmentation the flint has to be heat-treated. In the second stage the flint can be placed directly on a fire.

At two sites in southeastern Scania mass destruction of flint objects was performed. The evidence from the sites suggests that the process of destruction involved transforming key items of material culture. This means that that the enchainment is not an isolated episode but a process including both separate individuals and a number of members of the society.

The building of earthen long barrows and large palisades involved moving soil and cutting trees, which caused fragmentation of environments, but at the same time had the goal of social unification.

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Introduction

How might we recognize particular worldviews, ideas and values archaeologically? In the case of objects, we can certainly identify evidence for structured forms of treatment, from the conditions in which certain objects were made to the manner in which many were deposited. But we can only begin to make sense of that evidence, once we recognize the close categorical and biographical links that often join people and things. For example, tools have a birth, an active life and a death. How the process of birth and death is dealt with depends, as for people, on how particular tools and materials are evaluated, a process that can vary from one example to another. In other words, the "life" of a tool may take different paths, depending on decisions taken by individuals or collectives. The duration of that "life" may also vary; in some cases no more than days, in others, as with heirlooms, having a life-span that exceeds several human generations (Hakiwai & Smith 2008). In some instances, objects can even be regarded as more valuable than people, possessing names and biographies that are well known to the community.

Studies of the creation of material culture, including objects as well as structures, are well represented in research. But in research the ways objects and structures go out of use is as interesting and important an aspect as how they very made. Studies have been performed (Berggren 2010) but more can be done. There is a need to study the causes of the destruction of objects, intentional as well as unintentional: worn out and discarded, deposited in graves, caches or ritual depositions etc. The same applies to constructions. There can be many different reasons of social importance why an object or construction was taken out of service.

There are several aspects to be considered within the processes of deposition and destruction. Scandinavian archaeologists have long interpreted collections of tools buried in the soil outside occupation sites mainly as the result of ritual acts. Outside Scandinavia, however, it seems to be more difficult to find acceptance for the interpretation of Stone Age depositions as objects not to be recovered (Bradley 1990). A collection of tools is often regarded as a cache for later use. But the large number of finds in wetland environments of southern Scandinavia makes no sense except in terms of ritual purposes (Larsson 2007). Thousands of flint axes have been found in wetlands. In many cases the artefacts were deposited within a delimited area of a bog, even though individual depositions may include artefacts covering a considerable time-span (Karsten 1994).

John Chapman was the archaeologist who was able to make the theme of fragmentation well known and a subject of discussion (Chapman 2000). Research on this theme has developed (Jones 2005; Chapman 2007; Chapman & Gaydarska 2007, 2010; Gamble 2007) and has also been criticized (Brittain & Harris 2014). In the recent debate on fragmentation the term enchainment has been used frequently. The enchainment between humans and the objects marks changes in the social sphere between humans when the object is made, used and fragmented. Enchainment does not have to be linked to fragmentation but it is especially obvious that a change in the enchainment takes place as an object is intentionally fragmented.

Most of the discussion has been aimed at the enchainment before and after the event of intentional fragmentation, which in most cases is a short action. The simple intentional breaking of an object like the figurines from southeastern Europe is the topic of Chapman and Gaydarska. When fire is involved in the process of fragmentation it involves a relation to objects of natural and artificial origin that is needed for just one stage in the process, such as making and maintaining a fire (Hodder 2011)

It might be a considerable process including several hours or days and involving a number of people. This is of special importance when fire is used on objects that do not burn and are not entirely destroyed by high temperature. In addition, the handling of object might involve a deliberate process of changing the quality of the object but simultaneously preserving the shape, as in the treating of flint axes. In these cases the change of enchaining might involve a process of considerable alterations between the objects or features and the members of the society.

Transformation of flint by fire

The effect of fire represents a special form of fragmentation. Finds from settlement sites indicate that the deliberate exposure of flint artefacts to fire was well known throughout the Neolithic. Fire alteration of tools is relatively frequent at sites from the whole of the Neolithic (Karsten 1994; Malmer 2003). The effect of fire on flint axes could be accidental, but at several sites the percentage is too high (often higher than 20%) to be viewed in such mundane terms (Karsten 1994). Most sites show marked differences in terms of the tool types affected by fire. There is also evidence that the exposure of axes to fire was in itself highly structured (Larsson 2000, 2002). The alteration of flint by direct exposure to fire provides different products of fragmentation from those seen on many sites. Simple exposure to high temperatures results in the fragmentation of flint artefacts into very small pieces. This is not what we find with many flint tools affected by fire, which are often recovered as larger-than-expected fragments.

Experiments have been conducted, exposing newly-made flint axes to different forms of fire, including direct as well as indirect heat in large and small fires, in order to find out what happens to flint at different temperatures (Larsson 2006). In order to get large pieces of flint affected by fire, such as are found at the sites, you have to treat it in two evocative stages. First, the flint has to be heat-treated. In the second, more public, stage the flint can be placed directly on a fire. The flint undergoes a colour transformation from natural black or grey to white. This shows that the majority of flint tools were handled carefully, in order to obtain a colour change with a minimum of destruction. The artefact undergoes remarkable change during the act.

The intention was not to destroy the flint objects, but to keep them in parts as large as possible, even after their transformation by fire. At almost every site, axes are more affected than any other type. This phenomenon is independent of chronology, occurring from the earliest Early Neolithic to the latest Late Neolithic. Alteration by fire, however, seems to be most common during the Middle Neolithic, including the late Funnel Beaker culture and the Single Grave culture.

There are several aspects that may be considered within the processes of deposition and destruction – or perhaps we should we say "different means of transformation". Transformation in this connection is viewed as a process in several stages when the enchainment between humans and tools changes and is tied to the interaction with structures such as hearths but also elements such as heat and smoke. The flint object is changed by holding a number of cracks but it has still its original shape. The fragmentation can easily be performed with a slight action as a break. If the action is performed it is through the intention of the members of the society.

Fire-damaged flint axes are found in connection with megalithic tombs (Jørgensen 1977), as well as in pits and trenches associated with causewayed enclosures. The fragmentation of flint axes has been regarded as the result of ritual acts in which fire played an important role (Andersen 1997).

It is of special interest to identify a relationship between the fabrication of axes and the transformation of these same tools. At some causewayed enclosures of the late Early Neolithic and early Middle Neolithic (Andersen 1997) as well as palisades of the "second generation" (Svensson 2002; Brink 2009) from the late Middle Neolithic (MNA–MNB), waste from flint axe fabrication transformed by fire has been documented (Runcis 2008). There seems to be a direct link between the birth and death of axes (Strassburg 1998), related to monumental enclosures.

Mass destruction by fire

A special and so far rare type of site with examples of fire-altered flints, covering an area of approximately 70 × 70 m, has been found on a plateau at Kverrestad, southeastern Scania (Larsson 2000, 2002). Excavation revealed a number of pits of varying size and depth, in which flint and stone artefacts affected by fire had been deposited together with a considerable amount of fragmentary pottery. The largest pit was about 4 m long, the shortest measuring less than 0.5 m. A majority of pits are small and shallow. Finds from the few larger pits were made throughout the fill, which shows that the artefacts had been deposited during the entire process of filling of the pits. Fragments of about a hundred thick-butted, concave-edged axes and chisels have been found, as well as arrowheads and other flint and stone tools (Larsson 2000). A small number of burnt human bones, intentionally cracked into small pieces, were also found, providing another example of a special enchainment between humans and axes. One has to be aware that the colour change of flint exposed to fire is similar to the cremation of a human body.

The finds are dated to the later part of the

Battle Axe culture. As an interesting aspect of the "life cycle", the axes at Kverrestad included rough, unpolished examples, only shaped into form, as well as examples with very well executed polish over the entire body. Some of the latter show traces of use.

The choice of axes in particular for altering by fire, as recorded at settlement sites, is also obvious among the finds at Kverrestad. More than 90% of the axe finds display changes by fire. However, among a number of arrowheads made by pressure-flaking, originating from the Oder area on the other side of the Baltic Sea, just 30% show the same alteration by fire. These marked differences indicate intentional selection – some tools required treatment by fire more than others. If we use enchainment, the explanation might be that the relation between the objects from a group at a far distance was different from the relation of axes that were accessible in an area at a much shorter distance. Similar evidence has also been found at Svartskylle, some 17 km west of Kverrestad (Larsson 1989). Svartskylle is dated to the Early Neolithic/Middle Neolithic transition. At Svartskylle, preforms as well as polished flint axes were found. The same habit is evident despite a time gap of almost one millennium. This phenomenon is independent of chronology, occurring from the earliest Early Neolithic to the latest Late Neolithic.

There is a very marked difference in the attitude towards burning, compared with deposition in water. In the former case, the destruction of the artefact is easily visible at the point when the practical function of the tool disappears. Fire is the destroyer, but also the creator. Slash-and-burn clearance of the forest creates arable land. That flint axes are linked to fire could be explained by a special relationship between fire, flint and people. A common way of making fire was to use flint and iron pyrites. The sparks appear to originate from the flint, and the idea that fire was inherent in this material might have been an accepted element of the worldview.

The sociotope of fire

What is being expressed at Svartskylle and Kverrestad with no connection to settlements or graves, differs from the destruction by fire of single tools or small numbers of tools, as evidenced at settlement sites and megalithic tombs. This type of deposition is found throughout the Neolithic, but on certain occasions the act achieves an impressive effect.

Tools affected by fire that lie outside the megalithic tombs can be regarded as an enchainment to the ancestors or deposits through which the ancestors act as agents for further contacts. Deposits including the element of fire, as at Kverrestad and Svartskylle, might place the actors in direct contact with the metaphysical world without the intermediacy of ancestors.

The cosmology that dictated burning, just like that relating to wetland depositions, was active throughout most of the Neolithic. The fact that the depositions at Svartskylle and Kverrestad are the result of short-term activities indicates that they should be regarded as completed deposits of mass material. These seem to have been of exceptional size and intended to impress humans as well as metaphysical beings. Both sites are located in a way that the action could be attended by a large number of people and in addition were surrounded by wet areas as delimitation. The contact that people intended to be established between the physical and metaphysical worlds was impressive and imposing. The transformation by fire of material culture must have been very obvious and the wealth represented by the number of tools and exotics included must have been considerable.

In view of the high quality and great number of axes, there must have been knappers who spent a considerable amount of time producing axes, i.e. true flint-knapping experts. Blacksmiths were regarded in late prehistory as possessing not only the knowledge to master iron, but also the knowledge required to master forces of the immaterial world (Østigård 2007).

A similar status was accorded to the knowledge and action of the bronze smelter (Goldhahn 2007). One can express it a special enchainment between certain persons and the raw material. The flint-knapping specialist who made the axes may have acquired the same status. The knapper, like the axes, was positioned in a zone between the living society and another world, that of the spirits and deities. Those involved in the birth of particular axes may also have been involved in their death, transforming flint objects as part of the transformation of the deceased and effecting their transfer to the world of the forefathers/foremothers.

The evidence from Kverrestad suggests that, among other things, the process of transforming the body also involved transforming key items of material culture and, in the case of flint axes, this also involved prior heat treatment. This prior treatment was not in most cases a public, pyrotechnical event with a huge fire, the cracking of heated flints and splinters flying out of the fire. The subsequent result, a slow colour change without intense cracking, may thus have been all the more remarkable for those attending the more open and public stages of cremation ceremonies.

Actions of fragmentation

Fire was also used as a means of fragmentation in many other activities. In many cases the final act of use included burning. On stratified sites in different parts of Europe the burning of houses has been interpreted as an intentional act incorporated into a wider ritual sphere (Apel *et al.* 1997; Chapman 2000; Chapman & Gaydarska 2007). Because there are virtually no substantial occupation layers associated with Neolithic houses in southern Scandinavia it is very difficult to obtain a full understanding of the final acts undertaken when houses were abandoned (Larsson & Brink 2013). The charcoal in post-holes has usually been explained in terms of the burning of the post-ends before they were put into the holes in order to improve the resistance of the wood to degradation in the soil. However, it might be reasonable to suspect that charcoal can also originate from the burning of houses. In the absence of well-preserved floor levels, it is impossible to eliminate the possibility of accidental house destruction by fire or burning through hostile action.

The remains of activities within, and especially outside, megalithic tombs reflect a variety of actions causing fragmentation. In same cases, such as the Carlshögen tomb in southeastern Scania, the human remains were separated, probably after some period of decay, particular parts such as the vertebrae being stored together and even placed in a pit inside the tomb (Strömberg 1971).

One example of fragmentation in connection with megalithic tombs is Ramshög in southeastern Scania. Pits were found below the chamber and partially under the orthostats (Strömberg 1971). In these pits burnt and unburnt human bones were found, combined with several hundred flint flakes and fragments of flint axes. The position of the pits indicates that they might have been dug and the items deposited before the tomb was built. Just outside the entrance a small structure built of wood and stone had been burnt. Found within the structure were burnt human skull fragments and some broken pieces of a thin-bladed flint axe, cracked without using fire. Several other features were documented outside the entrance, containing fragments of flint axes affected by fire, chisels or blades, most in association with burnt human bones. At the Trollasten dolmen in the same part of Scania, eleven collections of burnt human bones, along with pieces of axes and chisels affected and not affected by fire were found (Strömberg 1968). In one case almost all pieces of an axe affected by fire had been deposited. Two sets of material included parts of the same axe.

These examples indicate that the change enchainment concerning fragmentation can be related to actions including fire mixed with the remains that were just intentionally broken into pieces.

Breaking into pieces

In addition to fragmentation by fire, some other interesting observations have been made concerning the fragmentation of stone objects. That a battle axe could break at the shaft-hole is no wonder, since this is the weakest part. Malmer's study (1962) of broken battle axes from the Battle Axe culture provides a special insight into the deposition of broken objects. He documented 346 edge parts, but only 151 neck parts. Although 53 of the edge parts have a newly-finished or unfinished shaft-hole, the disparity is remarkable. There has to be an intentional difference in the way these parts were deposited. Malmer's suggestion was that the neck parts were left at the settlement sites, while the edge parts were deposited elsewhere. At the mass destruction site where fire was used, the number of necks of flint axes is higher than the number of edges.

The fragile nature of pottery makes it vulnerable to fragmentation. However, there is strong evidence of deliberate fragmentation as a regular phenomenon during the Neolithic. Some of the Scanian tombs hold the largest quantities of pottery ever found in megalithic tombs in any region of Europe. The number of vessels at the passage grave of Gillhög, close to the west coast, is estimated at almost one thousand. In some cases the vessels were left standing on the entrance stone, and must have fallen down and broken. The question is whether this explanation can be applied to all of the thousand vessels. At some megalithic tombs on the island of Funen, Andersen (2009) has recognized that sherds are of the same size. This would not be the case if fragmentation was accidental. The same could apply to a proportion of the sherds from the Scanian megalithic tombs.

Another action of interest connected with the fragmentation of pottery is intentional sorting of sherds. An example is the material from a cemetery of seventeen children's graves dated to the Early Middle Funnel Beaker culture at Borgeby in western Scania (Runcis 2002). The pottery in the graves is represented by intact vessels, fragments of individual vessels and small fragments of as many as 15 vessels. Parts of pottery vessels may dissolve, which is a common explanation for the absence of some parts of vessels. However, when just one or a few sherds from particular vessels are represented we are dealing with an intentional sample of sherds to be represented in a certain feature. Parts of the same vessel could have been deposited in other circumstances, for example forming part of a deposition or in connection with megalithic tombs. The above-mentioned late Battle Axe culture depositions at Kverrestad present a similar situation. Just a small number of sherds from the same vessel are present.

Fragmented environments

The first major fragmentation of the landscape was introduced when the forest was cut down in the Early Neolithic. Even if the landscape in an ecological sense may have been changed during the Late Mesolithic through intentional reduction of the dense forest by fire in order to improve the feeding for wild animals, it was during the Early Neolithic that clearing of the forest became a regular phenomenon. In this fragmentation of the landscape the death of trees due to elm disease may have facilitated the clearance process (Larsson 2003).

Fragmentation of the forest served several purposes for the societies of that time. The most obvious was to clear areas for agriculture. However, a large number of trees were felled in order to incorporate them into structures, both large and small. One example is the large palisade excavated at Håslöv, dating to the Early Neolithic (Andersson & Wallebom 2013). At least nine thousand posts were used for the arrangement. The construction of large palisades during the later part of the Middle Neolithic required the chopping of thousands of trees. Through fragmentation of the forest, a structure was erected that served the aim of social unification and thereby a marked change of the enchainment both between humans and the environment and also between humans. The trees were transformed from their natural state into an important arrangement in culture.

Another kind of fragmentation of the landscape in order to create social unification is the building of a megalithic tomb. Stones are dragged from localities that may be situated kilometres away. Even if large stones suitable for building material were more common than today, this still required a good knowledge of the landscape. In some cases not only was the size and shape important: the colour also played a decisive role. Stones were sometimes split. One example of such fragmentation is found in Denmark, where two dolmens, two kilometres apart, each have one half of the same large boulder as the capstone (Ebbesen 2011). However, no similar study has been carried out in Scania. The some applies to the studies of the origin of stones or boulders usable for building material, which is complicated by glacial processes during the Ice Age, when stones could be moved a considerable distance from the source by the glaciers. One example indicating that special building material could be transported over a considerable distance is the red sandstone that was split into smaller slabs for use as a filling material between the orthostats at some megalithic tombs, after being quarried some 20 kilometres away (Hårdh & Bergström 1988).

Conclusion

The fragmentation of objects as well as structures is a phenomenon that in some cases just includes a short episode when an object is cracked into pieces or a structure is torn down. As we have seen, however, on a number of occasions the fragmentation includes a process with a duration of several hours or days. As for the fragmentation of flint objects, it includes at least two stages until the desired condition was obtained. This might mean that the enchainment between the objects and humans might have changed focus from individuals to a situation where several of the members of the society were committed. In addition, it signifies a complex enchainment, where in some cases objects that were transformed by fire as an agent could be deposited together with objects that were just broken. The enchainment process seems to include a number of stages that need to be further studied.

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Michelsberg and Oxie in contact next to the Baltic Sea

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Abstract

This article focuses on the cultural contacts between the Michelsberg culture and the Early Neolithic Oxie group of the Funnel Beaker complex in southern Scandinavia and northern Germany by presenting and analysing an assemblage of finds from the site Flintbek LA 48, 8 km southwest of Kiel, Schleswig-Holstein, Germany. There a pit filling contained pots of local early Neolithic funnel beakers of the Oxie group as well as of the middle Michelsberg culture (II/III). The Michelsberg vessels allowed a post-hoc projection into the correspondence analysis of Höhn 2002, for the first time relating quantitative-based relative chronologies of Michelsberg and Funnel Beaker. The decoration techniques at Flintbek are included in a combined correspondence analysis with the earliest Funnel Beaker groups of southern Scandinavia following Madsen 1994. The Flintbek finds connect on one hand two different classification systems of pottery and on the other hand the two main distribution areas of Michelsberg and Early Funnel Beakers of the North group.

The Michelsberg finds are seen as an end point of the expansion phase of this culture in the north.

The article concludes with a hypothesis about the development from pointed or round-based pots to flat-based ceramics, relating this to changes in house furniture and activities connected to a more agrarian economy.

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The site Flintbek LA 48

In 1975 a pit was found underneath a Bronze Age tumulus, containing Early Neolithic pottery. Bernd Zich published important parts of the assemblage in several articles, including a completely reconstructed flat-bottomed funnel beaker with bosses on the inside and several sherds with what are called arcade rims (Zich 1992, pp. 9 f.; Zich 1992/1993, pp. 20 ff.). In his articles, Zich described the similarities to the Michelsberg culture. Later, Lutz Klassen (2004) connected the flat-bottomed funnel beaker with the bosses at the rim of the earliest funnel beakers, type 0 of Koch (1998).

Zich also published a first conventional ^{14}C date (KI-3072, 5280±115 BP) of oak tree charcoal with an age of 4237–3984 cal. BC (1σ), intensifying the discussion of the importance of the Flintbek finds for the origin of the Funnel Beaker North group (Zich 1992/1993, p. 20).

The finds were reanalysed in the work of Mischka (2011b), who was able to refit some of the published sherds and obtained several vessel profiles. A second radiocarbon date using AMS was measured on elm tree (*Ulmus*), by the Leibniz Laboratory at Kiel University (KIA37170, 5387±38 BP) with a calibrated age of 4328–4180 cal. BC (1σ). Apart from old wood effects which have to be taken into account for both dated samples, the short standard deviation of the Kiel AMS dates has to be interpreted with care, because the Kiel laboratory could not reproduce its own measurements of some controlled samples, probably between September 2001 and spring 2012 (http://www.uni-kiel.de/leibniz/ [Accessed October 2012]; Christmas greeting card 2012). Nevertheless, for the discussion of the minimum age of the pit, the youngest date measured (4237–3984 cal. BC (1σ) is seen as a chronological upper boundary for the pit filling.

Finds (Figure 1)

Among the finds, pottery sherds are most frequent. Some 618 sherds weighing 7.6 kg in total have been combined to 67 pottery units (PU). Refittings or similarities in temper and high resemblance in texture and manufacture of the sherds provided the criteria for considering several sherds as one pot. Nineteen pottery units feature only one sherd, PU 13 is refitted from 53 single sherds and PU 1 has completely been reconstructed by the laboratory of the Museum Schloß Gottorf, Schleswig.

The bases of the pots are difficult to identify in the assemblage and to join with the other parts of the vessels. They are often thinner than the wall-sherds.

The Michelsberg pots (Figure 1)

Four pottery units are shaped like Michelsberg Tulpenbecher (tulip-beakers): PU 2, 8, 10 and 37.

The first three can be classified according to the profile shape and dimensions, although no sherds from their bases were classified in the two variants of Tulpenbecher according to Höhn (2002, p. 163 fig. 152). Due to its high degree of fragmentation vessel PU 37 – similar to PU 2 – is not included in the correspondence analysis.

PU 12, classified as a variant 3 of a bowl with a bent wall ("Knickwandschüssel" Kw3 after Höhn 2002, p. 165), shows a steeper and straighter profile of the wall underneath the bend than most of the corresponding Michelsberg bowls. Also, its bend is situated slightly higher.

Based on the rim shapes and rim zone shapes, six pots are classified as storage vessels according to Höhn's typological coding for vessel shapes (2002, pp. 163 f.): PU 3, 4, 5, 35, 41 and 42. PU 5 and 41 become more open at the neck than the maximal rim diameter, which identifies them as belonging to vessel type Vg3 ("Vg" for "Vorratsgefäß"/ storage vessel). In addition PU 3, 4 and 42 are classified as Vg4. Their classification relies mainly on rim sherds. For a classification of pots as Vg1 flat bottoms are needed. Unfortunately, it was not possible to fit base sherds to one of the storage vessels.

The Oxie group pot

Because of numerous concordances in shapes and decoration techniques we propose regarding the terms Wangel's group (Hartz *et al.* 2000) and Oxie group (Larsson 1984; Madsen 1994) as synonymous and prefer to label this phenomenon as Oxie group in future.

Among the vessels there is one beaker of type 0 according to Koch (1998) with a completely flat base: PU 1 on figure 1. It is undecorated apart from one line of small bosses (Lochbuckel) beyond the rim, imprinted from the outside. Type 0 beakers found at Kongemosen and

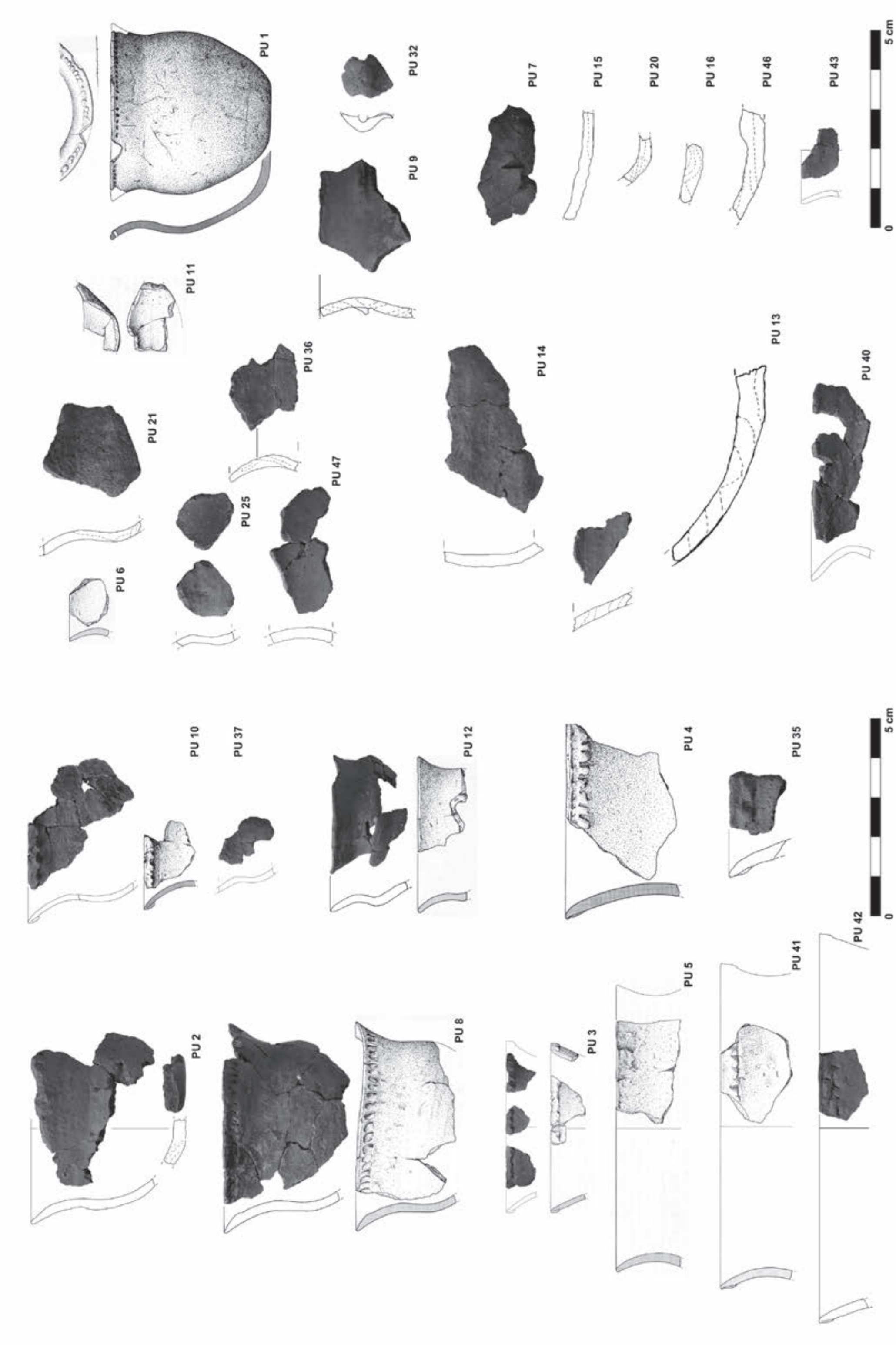

Fig. 1. Flintbek LA 48. Selection of the most important pottery units (PU) from the pit. (Figure A. Heitmann, D. Mischka; PU 8 drawing from Zich 1992/1993 p. 21, fig. 5.1).

Bjornsholm were dated directly to 4070–3800 cal. BC using organic crusts (Koch 1998, pp. 83 ff.).

Pots of ambiguous character (Oxie or Michelsberg) (Figure 1)

Within the Flintbek LA 48 assemblage, less distinct vessel forms also turn up, which cannot (yet) be reliably classified as Oxie or Michelsberg types. Clay spoons like PU 11 are typical for both groups, but rarer in the north (Klassen 2004, pp. 167 ff.). Funnel necks (PU 6, 2, 25, 36 and 47) and subcutaneous knobs (PU 9) are another common feature in Michelsberg and the Oxie group (Lüning 1968, p. 16; Koch 1998, p. 87) – where subcutaneous knobs on type I beakers are preferably placed on the shoulder of the pot or on upper parts of the belly (e.g. 93.2 and 115 in Klassen 2004, p. 174). Broken knobs (PU 31, 32) indicate lugged vessels which are less frequent in the Michelsberg context.

Pots with uncertain classification (Figure 1)

Some pottery units do not fit into existing classifications: e.g. PU 13 resembling a big bowl, PU 14 with a big belly and a conical profile, or PU 40, a very thin-walled, irregular shaped pot with a wide funnel rim, or PU 43 which may resemble a small flask according to its dimensions and profile shape. Several base sherds (PU 7, 15, 16, 20 and 46) could not be fitted to other pottery units and are therefore treated here as distinct units. In the Flintbek inventory both shapes of bases occur, flat as well as rounded bottoms.

Decorations

The decorations are made of simple lines or rows of stitches, with the vast majority orientated horizontally beyond the rim on the vessel's outer surface. Fingernail impressions, finger tricks for the arcade rims, and simple patch strips, bosses or single stitches and simple incisions with rounded profile are present as well.

Other finds

Apart from the pottery, 198 lithics weighing 3.8 kg in total were found. Tools such as laterally retouched blades or flakes, truncations, borers and endscrapers make up for only 10% of the assemblage. Also, tiny bone fragments and pieces of charcoal as well as 141 grams of burnt clay, some with plant imprints, relate the pit to Michelsberg features (cf. e.g. Jeunesse 2010, p. 49 or Jeunesse & Seidel 2010, p. 67).

Archaeometric analysis of the pottery

Archaeometric analyses were carried out within the DFG-Priority programme SPP1400 on "Early Monumentality and Social Differentiation" on a selection of pottery sherds to gain further information on the pottery technology and to distinguish the clay composition of different vessel forms. The study concentrated especially on the type of clay used and the tempering material. A total of 35 sherds from 29 pottery units from Flintbek LA 48 were analysed.

The analysis of the selected fragments was carried out using three methods. First, the open fractures of the fragments were polished to determine, count and measure the temper particles with the help of a digital reflected light microscope. Second, thin sections were prepared on eight selected sherds to characterize the raw material and its natural components of sand and silt or mineral particles with a polarizing microscope. This method helps to describe the artificially added tempering materials as well. And third, sherds whose thin sections showed a similar raw material were analysed chemically by ICP-AES (Inductively Coupled Plasma – Atomic Emission Spectrometry). The measurement of a total of 32 chemical elements made it possible to determine the chemical composition of the clay used for pottery production, and to compare it among the samples. Similar measurement results indicate the use of the same raw material source. The chemical analysis of the ceramics was carried out by OMAC laboratories (Ireland) and analysed by T. Brorsson (2013).

The main tempering material is crushed granite which is characteristic of the Funnel Beaker North group. Nearly 80% of the pottery is tempered additionally with chamotte and some 15% with flint. The latter is very specific and is absent from later Neolithic sherds of the Flintbek region. Chamotte is known from the Single Grave culture wares in other regions (e.g. Hulthén 1977, p. 157; Engberg 1986, p. 240; Madsen 1998, p. 430; Norden 2009, p. 54); Koch Nielsen detected chamotte in Ertebølle pots as tempering material but not in funnel beakers (Koch Nielsen 1987). It is rare in Funnel Beaker inventories of northern Germany examples being a lugged beaker from Siggeneben-Süd (Meurers-Balke 1983, pp. 43 f., figs. 10–11; p. 107, fig. 6) or four sherds from the middle Neolithic site of Bostholm (Meurers-Balke *et al.* 1985, p. 316 tab. 3 and plate 4.3; 7.1,6; 8.15). Furthermore, about 17% are tempered with plant remains. Note that, since several kinds of temper can be present in one specimen, their percentages do not sum up 100%.

The clay itself is fine-grained to medium-grained and belongs to at least four different sources.

Unfortunately it was not possible to analyse the pot PU 1 which was classified as type 0 beaker of the Oxie group after Koch (1998) since this required breaking the specimen. No significant differences were detected between the analysed ceramics of Michelsberg type and the remaining types of Michelsberg or Oxie group.

Correspondence analysis (CA)

CA of the pot shapes (Figure 2)

The Flintbek LA 48 assemblage was projected post hoc as a supplementary row into the correspondence analysis (CA) of Michelsberg inventories produced by Birgit Höhn (2002, listed in annex 3). Software package ca (Nenadic & Greenacre 2007) of the statistical programming environment R (R Core Team 2013) was used for all computations.

Our assemblage – already using Höhn's typological coding (2002, pp. 163–166) – comprises the following vessel types respectively entries in column:

(type code/column)	kw3	t1a	t1b	t2a	vg3	vg4
(number of objects)	1	1	3	2	2	3

All other types of Höhn's table were recorded as zero, i.e. all other columns contain zeroes.

The new line from the Flintbek LA 48 inventory is not used for computing the ordination, because as a new data set it would have changed the ordination result. Instead, the new data line of Flintbek LA 48 was projected into the solution space by means of weighted averages using the numbers of the types present as weights and averaging over their standard coordinates. This approach is known as supplementary row concept (Greenacre 2007, pp. 89 f.). It was chosen to study the position of the Flintbek inventory within the similarity space of the Michelsberg assemblages without influencing the existing relative order – here the relative chronology of Michelsberg.

The biplot of the CA is given in row principal coordinates and scaling 1 and reproduces the published result of Höhn's analysis (2002; for biplots cf. Borcard *et al.* 2011, pp. 132 f.). The projection of the Flintbek assemblage fits well in between early Michelsberg assemblages. The nearest neighbours in the biplot along the parable gradient are the assemblages of Ehrenstein 1 and 2 in Germany – dated to

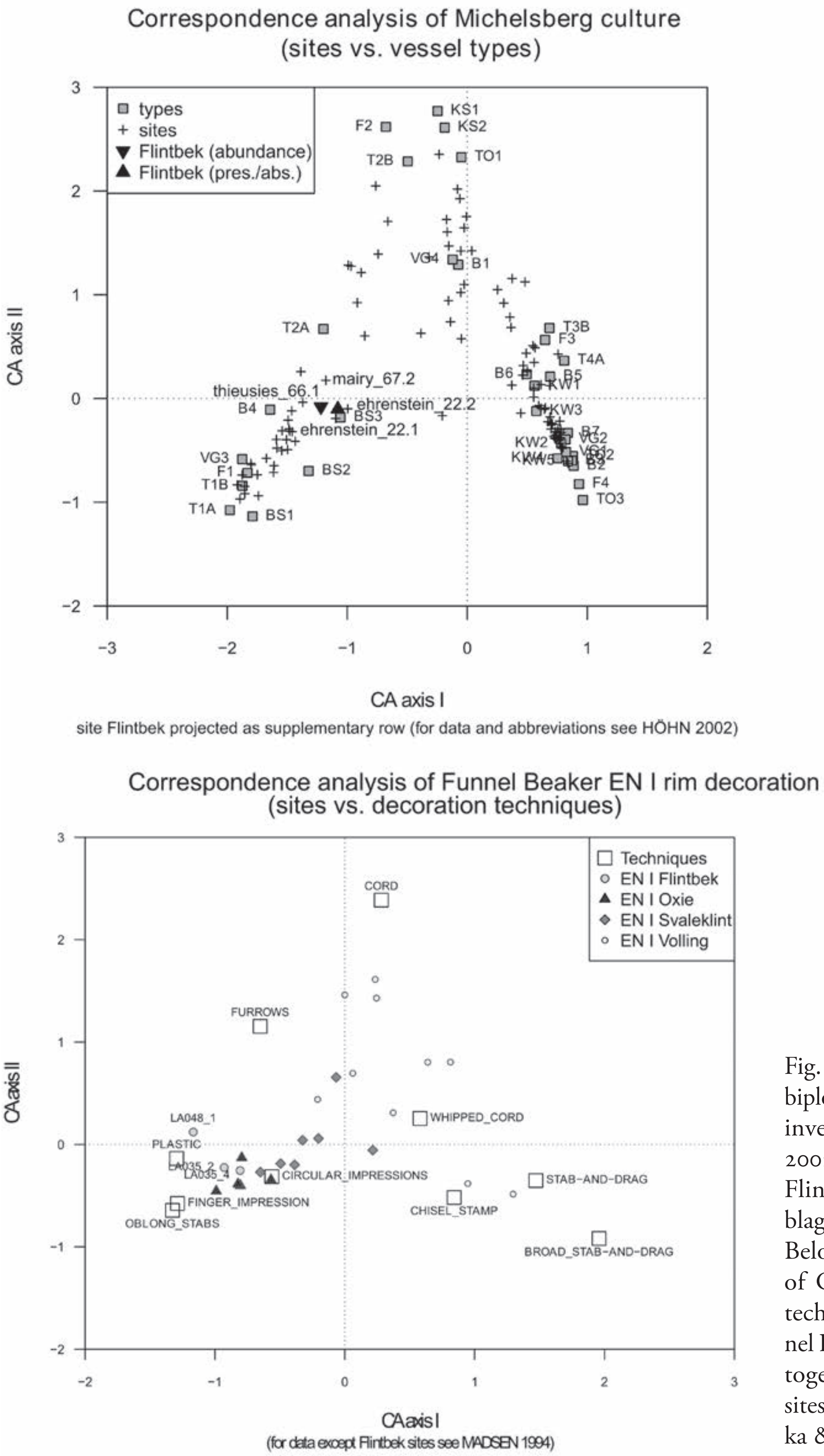

Fig. 2. Above: Scaling 1 biplot of CA Michelsberg inventories after Höhn 2002 with projection of Flintbek LA 48 assemblage (Figure G. Roth). Below: scaling 1 biplot of CA rim decoration techniques of the Funnel Beaker North Group together with Flintbek sites (Figure: D. Mischka & G. Roth).

Michelsberg phase II as well as II and III and the two Belgium sites Thieusies "Ferme de l'Hoste", dated to Michelsberg phases II and III and Mairy "Les Hautes Chanvieres", dated to the transition Michelsberg phases II to III (Höhn 2002, annex 2, nos. 22.1; 22.2; 66.1 and 67.2). So Flintbek fits nicely in the transition from Michelsberg phase II to III. Höhn dates this transition in the early 41st century BC (Höhn 2002, fig. 176). This is – within the limits of both methods: CA and radiocarbon dates – in congruence with the Flintbek dates which probably are older than 4000 cal. BC.

A problem is connected to the pottery unit PU 1, which is classified as a flat-based Oxie beaker type 0 and which is therefore not included in the CA of the Michelsberg pottery. Because of its S-shaped profile and flat base it should be classified as a Michelsberg vessel type B7 (flat-based beaker; Höhn 2002). But flat bases are late within the Michelsberg chronology. Taking into account that the general idea of flat bases for the Early Funnel beaker groups could derive from Lengyel via Gatersleben at some time before (!) late Michelsberg, it seemed reasonable to exclude PU 1 from the inventory of Flintbek LA 48 projected into the Michelsberg CA. In fact test runs (not presented here) with PU 1 present showed that only a presence/absence approach changes LA 48 position significantly while a projection of the abundance vector is nearly unaffected by PU 1.

CA of the decoration techniques (Figure 2)

In the mid-1980s Madsen and Petersen divided early Funnel Beaker ceramics into several groups based on decoration techniques (Madsen and Petersen 1984; Madsen 1994; see also Madsen 2007, pp. 25 ff.). They developed codes for the different techniques and counted the frequencies for each site. Consequently 34 sites from Jutland and the Danish isles were submitted to a correspondence analysis. The observed Early Neolithic I (EN I) groups were designated Oxie, Volling and Svaleklint. The first CA axis already represented chronological as well as spatial information. We used these EN I sites and recoded decorations according to the NoNeK recording system (Mischka 2011a; Mischka 2011b; www.nonek.uni-kiel.de [accessed 30 October 2013]). Additionally three EN sites from the Flintbek region were included in Madsen's data set.

The result of our new correspondence analysis confirms the results of Madsen and Petersen (cf. Madsen and Petersen 1984, Figs. 19–20).

The Flintbek sites LA 35-2, LA 35-4 and LA 48-1, the site discussed here, lay within the range of the Oxie sites. To the right assemblages from the Svaleklint and Volling period follow. The small offset of our Flintbek LA 48-1 is probably due to the absence of two techniques (oblong stamps "Dreikantstich" and fingertip impressions) combined with the dominant presence of furrows, a technique more frequent in Svaleklint and Volling sites.

Although the sites are grouped on the basis of decoration techniques, an interpretation has to be carried out with care considering the possible presence of two causal factors (chronology and geographic distribution). At the moment their relationship and their combined effects cannot be evaluated or singled out. So the impact of the chronology as well as that of the spatial distribution on the CA result (sites scatter) is not clear. Here more accurate absolute dates are needed for the different groups to better understand the analysis. Without them even further canonical analyses using the spatial distribution as a constraint may not be able to separate the factors time and space given the possibility of a diffusion process, i.e. a spreading of the decoration techniques over time and space.

Interpretation and discussion

The role of the Michelsberg culture in the Neolithization process of southern Scandinavia has been discussed for a long time, as well as the influence of the northern traditions on Michelsberg (e.g. for contrasting opinions (Lichardus 1998, pp. 263 f.; Klassen 2004, p. 172, p. 223; or Schier 2009, p. 35; Schier 1993). Especially the chronological order of the Michelsberg culture and the Funnel Beaker culture, in particular the Funnel Beaker North group, is of decisive importance for this discussion. Only a sound chronology allows for further considerations regarding spatial processes and interactions. Additionally, the function of the pottery has to be evaluated against the background of a changing subsistence, with the people of the Funnel Beaker culture being the first inhabitants of the north European plain relying primarily on agriculture (Midgley 1992). The state of research places the origin of the early Michelsberg culture with its characteristic vessel shapes, such as Tulpenbecher (tulip beakers), clay disks and clay spoons (in German "Schöpfer") in the Paris Basin (e.g. Schier 1993; cf. Höhn 2002).

The assemblage of Flintbek LA 48 may be seen as one instance of the eastward-bound expansion of Michelsberg beginning in MBK II (Höhn 2002, p. 187, fig. 174).

The CA results represent the first time that a relative chronology based on quantitative analysis, i.e. a reproducible approach, for one of the two culture historical entities Michelsberg or Funnel Beaker allows us to directly place a characteristic assemblage of the other one into a single relative system thereby directly relating both sequences. According to our result we propose Early Funnel Beaker (Oxie group) to be contemporaneous with or to slightly younger than late MBK II.

Changing from the abstract level of culture history to that of concrete human interactions, basically we would like to discuss three aspects of the genesis of the Flintbek assemblage:

1. Early Michelsberg settlers bringing their typical pots and the concepts for producing them with them to live among or between late Ertebølle communities.

Their subsistence strategy, based mainly on farming and less on hunting, fishing and gathering, may have been quite a surprise to their neighbours. But other aspects of daily life such as commonalities in material culture and in particular in vessel forms like Tulpenbecher which resemble traditional Ertebølle beakers (or starting with the Oxie or Volling group becoming old-fashioned), may have facilitated intercultural contact and exchange with the inhabitants of the region. If vessel functions were related to their shapes, other similarities between the Oxie group and Michelsberg apart from the Tulpenbecher may have been recognized by both sides.

2. We rule out the possibility of the pit filling Flintbek LA 48 representing the remains of a raid, because its deposition structure resembles typical Michelsberg features (Jeunesse 2010, p. 49; Jeunesse & Seidel 2010, p. 67), so no abnormal deposition process such as a destruction layer can be postulated.

3. We cannot exclude that some of the Michelsberg pots may have been imported from other settlements further south by the people living in the Flintbek region. But the treatment of the objects in the deposition process is typical of a Michelsberg environment.

Summing up all evidence speaks – in our view – for a movement of at least some people and not only an exchange of commodities.

Our occupation with the pottery resulted in a little hypothesis concerning one of its functional aspects that we would like to present here before ending our paper: the shaping of the vessel bases. An interesting aspect of the Flintbek LA 48 assemblage is indeed the presence of flat vessel bases. Strictly speaking, this is the only non-genuine Michelsberg element and a non-genuine Ertebølle element within this inventory, which only becomes typical for Michelsberg in the later phases of this culture (MBK IV/V, 3750–3500 cal. BC; cf. Höhn 2002). We do not want to further investigate the cultural history of flat vessel bases, but instead would like to draw attention to their functional aspects. What are the differences or potential advances of pots with flat bases versus roundish-pointed bases? Symbolic or ritual significance is hard to assess. Here a simple aspect of the differences in practical everyday use is emphasized: with flat bases one does not need a string mounting or stands made of stone or organic materials; also, one can transport pots easily and without the help of other people carrying (or constructing) the stands or preparing string mountings. Especially intriguing is the connection of flat bases to flat surfaces, i.e. house floors of or furniture in solid permanent buildings – in particular shelves and tables to put the pots on.

Finally, we propose that Flintbek stands for the presence of Michelsberg settlers who came to southern Jutland during the expansion phase of the Michelsberg culture at the transition of MBK II/III (41st century BC) to live among the local indigenous people. We are aware that this view is simplistic but still see it as the most economical explanation for the Flintbek assemblage.

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