Danish Journal of Archaeology, 2013
Vol. 2, No. 2, 146–163, http://dx.doi.org/10.1080/21662282.2013.904127

Routledge
Taylor & Francis Group

RESEARCH REPORT

The introduction of ceramics in the Ertebølle Culture

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(*Received 8 October 2013; accepted 26 March 2014*)

Pottery production has long been viewed as an integrated part of the Neolithic package. Instances of ceramic production in hunter-gatherer contexts have been explained by influences from early farmers. This has also been the case for the ceramics of the Ertebølle Culture. Recently, however, the discussion has become more nuanced and alternative explanations have emerged. This article argues that a focus on the life cycle of the early ceramics as well as an understanding of technology transfer as a process of cultural transmission can potentially broaden the perspective on the uptake of ceramics technology by the hunter-gatherers of northern Europe. The chaîne opératoire of the Ertebølle ceramics is analysed and a model of how a technology moves from one social setting to another is presented. In the light of this work, different approaches to the introduction of ceramics in the western Baltic are discussed. It is argued that important elements of the Ertebølle pottery tradition came from the east via Baltic exchange networks. However, the tradition was not directly transferred, and important elements appear along the way. Whether some of these elements can be ascribed to agro-pastoralist groups in the south is still uncertain.

Keywords: mesolithic; neolithisation; early ceramics; Ertebølle Culture; chaîne opératoire; technological transmission; cultural transmission; Baltic

Introduction

From the onset of the investigation of the Ertebølle Culture (EBK), ceramics have been recognised as part of this culture's inventory. Early on, it was suggested that the subsistence at the Ertebølle-type locations had been based on wild resources (Worsaae 1862, p. 62–63). As the use of ^{14}C dates spread, it was shown that the culture should mainly be placed before the onset of farming (Tauber 1971, p. 126–129, 1972, p. 109–120). Therefore, the Ertebølle ceramics came to represent a challenge to the concept of the so-called 'Neolithic package', i.e. the firm association of domesticates and ceramics.

In spite of great popularity in Western archaeology, the concept of the 'Neolithic package' has not played any major role east of the former iron curtain. Within Soviet archaeology, a radically different definition of the Neolithic developed. Here the presence of ceramics is one of the necessary criteria whilst farming is not (Dolukhanow *et al.* 2009, p. 238, Jordan and Zvelebil 2009b, p. 35, Gronenborn 2011, p. 68). This kind of Neolithic has been termed boreal Neolithic as opposed to agro-pastoral Neolithic (Davison *et al.* 2009, p. 10). For long, the confrontations between the two traditions were sparse because of political and linguistic barriers. However, within the last decade and a half, a number of scholars have suggested that there could be a connection between the hunter-gatherer associated ceramics traditions of Western Europe and the boreal Neolithic of Eastern Europe, bringing ceramics all the way from the Urals and maybe even from the Far East (Timofev 1987, p. 221, 1998, p. 225–228, Van Berg and Cauwe 1998, p. 468–470, Klassen 2004, p. 111–114, Hallgren 2004, p. 139–141, Dolukhanov *et al.* 2005, p. 1453–1456, Davison *et al.* 2009, p. 17, Jordan and Zvelebil 2009b, p. 36, 69–72, Dumpe *et al.* 2011, p. 436).

In recent years three major volumes on the origin and spread of ceramics in the context of hunter-gatherers in northern Europe and Eurasia have been published, making the debate take a major leap forward (Jordan 2009a, Vanmontfort 2010, Hartz 2011). Focussing on the EBK ceramics, a number of different hypotheses on the origin of the craft tradition are now present. They can be summarised as follows:

- The Ertebølle ceramic tradition is, along with the ceramics of the Swifterbant culture of the Netherlands and Belgium, a result of inspiration from Linear Band Keramik Culture (LBK) and post-LBK groups, combined with an indigenous coiled basket tradition and maybe similar functional demands on hunter-gatherer vessels. Though the two ceramics traditions are thought to have originated in roughly the same way, they are not related (Louwe Kooijmans 2010, p. 36).
- The Ertebølle ceramic tradition is a result of a creolisation happening when influences from the

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Boreal Neolithic and from the Agro-pastoral Neolithic met in the north-western-most Europe (e.g. Dumpe *et al.* 2011, p. 435, Hallgren 2004, p. 131–141).

- The Ertebølle ceramic tradition has its primary roots in the eastern forager-related ceramic traditions of the south-eastern Baltic, and thus in the Boreal Neolithic (e.g. Klassen 2004, p. 111–114, Gronenborn 2011, p. 68, Andersen 2011, p. 209).

While disagreement on the nature of the process can hardly be greater, new data on the production and use of the vessels have qualified the basis for addressing the introduction of ceramics in the EBK considerably (e.g. Craig *et al.* 2007, 2011, Philippsen *et al.* 2010, Glykou 2010, Dumpe *et al.* 2011, Saul *et al.* 2012).

In evaluating the introduction of a new technology like ceramics, it must be taken into consideration that pottery is not just an idea or a type of utility. Pots are the result of a process demanding skilled action upon matter, and the resulting product becomes involved with further processes, most commonly the production of food. Furthermore, the movement of the craft and related practices from one group of people to another entails cultural transmission. Therefore, I propose that examining the whole production sequence of the Ertebølle ceramics as well as viewing the process in the light of a model of technology transfer can potentially shed light on the introduction of ceramics in the Ertebølle Culture. In the following, I will review the production sequence of the Ertebølle ceramics. Then I will introduce and discuss a model of technology transfer and finally I will discuss the three viewpoints outlined above as well as new data on the spread of ceramics technology in the Baltic region in light of that model.

The Ertebølle ceramics

The area of the EBK includes present-day Denmark, the Swedish province of Scania and parts of Blekinge as well as parts of the German Schleswig-Holstein and Mecklenburg-Vorpommern, including the island of Rügen. The area of distribution in present-day Germany is still not fully established (Jennbert 1984, p. 142, figure 79, Klassen 2002, p. 306–307, 2004, p. 27 Abb. 4).

It is generally accepted that the first ceramics appeared in the western Danish area as well as in Mecklenburg-Vorpommern around 4800–4600 cal BC, around the middle of the EBK period (Richards *et al.* 2003, p. 288, Hartz and Lübke 2006, p. 64, Andersen 2010, p. 168, 2011, p. 207–208). Based on dates from food crust from vessels from the inland site of Schlarmersdorf LA 5, it has been suggested that EBK ceramics appeared substantially earlier in the inland of Schleswig-Holstein, as early as the last centuries of the sixth millennium cal BC (Hartz *et al.* 2000, p. 140, Klassen 2004, p. 109–110, Hallgren 2004, p. 136). However, a freshwater reservoir effect of significant magnitude has recently been shown to exist at Sclarmersdorf as well as in the Danish Store Åmose. This reservoir effect is called the hardwater effect (Philippsen *et al.* 2010, p. 995). It is due to fossil carbon in the ground slowly being dissolved and flowing with the ground water into the freshwater systems. The hardwater effect is in part determined by local geological and hydrological conditions. It varies through the year and between different organisms in the water, which makes a general estimation of the hardwater effect very difficult, even within a single site (Philippsen and Heinemeier 2013, p. 1091–1098). In Store Åmose, a hardwater effect of between 100 and 500 ^{14}C years has been demonstrated to exist in Mesolithic material. At Schlarmersdorf, the effect seems to be even larger. At both locations, the hardwater effect was examined by comparing dates from fishbone with dates from terrestrial material and dates from food crusts on ceramics (Fischer and Heinemeier 2003, p. 456–457, Philippsen *et al.* 2010, p. 996). The existence of the hardwater effect on the Schlarmersdorf site makes it probable that the dates of the ceramics here fall into the established time range of ceramics use in the rest of the EBK area (Hartz and Lübke 2006, p. 64). Another concern is that there is a lack of dates for the onset of ceramics production in Scania and Zealand. Whether this happens at the same time as in the rest of the area is therefore not known (Andersen 2010, p. 168, 2011, p. 208).

The EBK ceramics can be divided into two main forms, point-based vessels and low oval bowls (see Figure 1). The point-based vessels have conical lower parts, which end in a point-shaped base. The vessels' wall profiles can vary between cylindrical without any marked transition from neck to body, to distinctly S-shaped. The rim is normally everted, but straight rims are common, and incurving rims have also been found. The bases come in a number of different shapes. Some of them vary regionally whereas others coexist spatially (Prangsgaard 1992, p. 30–32, 2013 p. 283, Glykou 2010, p. 182–183). An example of the latter can be seen at the site of Neustadt LA 156 in Schleswig-Holstein where four different point shapes have been identified (Glykou 2010, p. 182). While the bases in most of the EBK area are variations of a simple conical shape, the bases found in southern Sweden and the island of Bornholm have a cylindrical ending to the cone (Prangsgaard 1992, p. 32).

The point-based vessels vary in size between small cups with a height as small as 8 cm up to very large vessels with heights up to 50 cm. Generally, the small vessels are not as common as the larger ones (Prangsgaard 1992, p. 30–31, Andersen 2011, p. 199). The low oval bowls have rounded bases and the ends can be round or pointy. Their size varies with lengths between 8 cm and

Figure 1. Examples of EBK vessels of various sizes. The upper three are point-based vessels while the lower two are lamps (reproduced from Andersen 2011, figure 2, with permission).

30 cm and widths between 3.5 and 11 cm. There does not seem to be a fixed relationship between length and width. In general, the vessels are shallow with heights up to 5.5 cm (Prangsgaard 1992, p. 37, Glykou 2010, p. 184). The low oval bowls are often interpreted as blubber lamps. This has recently been verified by lipid analysis of crusts from such bowls (Heron *et al.* 2013).

The life-cycle of Ertebølle ceramics

Within technical ceramics studies it has been emphasised that an understanding of the single elements of the ceramics must be based on knowledge of the whole life cycle of the ceramics, including production, use and discarding/disposal (Tite and Kilikoglou 2002, p.4, Tite 2008, p. 228). Here the concept of chaîne opératoire can be helpful. Chaîne opératoire is defined as a sequence of actions transforming one or more materials from their natural form into artefacts (Lemonnier 1992, p. 25–26). Although the process of pottery-making can vary a lot between different traditions, some basic stages are shared, dictated by the physical properties of the clay. In the following, I will go through the basic steps in the pottery chaîne opératoire of low-fired pottery with focus on the EBK ceramics.

Raw materials

The first stage in pottery production is to procure raw materials. These are clay and in some instances tempering material. For the purpose of making pottery, a certain content of non-plastic material in the clay is beneficial.

This can enhance the workability of the clay and help homogenous drying as well as increase resistance to thermal shock under firing and use and toughness of the finished vessel (Kilikoglou *et al.* 1998, p. 261–262, Tite *et al.* 2001, p. 303–315, Rice 2005, p 51–53). Toughness is an expression of how much energy it takes to break a piece of pottery. The ability to dissipate the energy in an emerging crack is an important component in the toughness of a ceramic ware (Kilikoglou *et al.* 1998, p. 261–262, Tite *et al.* 2001, p. 303–315, Rice 2005, p. 51–53).

The EBK potters used non-calciferous fine to coarse clays for the pointed base vessels, while fine calciferous clays often seem to have been used for the lamps (Hulthén 1977, p. 25–45, 1984, p. 201–202, Stilborg and Bergenstråhle 2000, p. 30, Dumpe *et al.* 2011, p. 434, Prangsgaard 2013, p. 288). The preference for non-calciferous clays for the pointed base vessels may be due to avoid spalling and crumbling of the ware caused by decomposed calcite (Rice 2005, p. 98), though this would normally not be a problem because of the low firing temperatures (see below). For the lamps, fine calciferous clays were probably chosen to achieve low permeability (Hulthén 1977, p. 26).

When found in nature, clay is rarely pure; it will normally contain some non-plastic elements such as sand, pebbles, other soil types or even organic material. Therefore, the addition of temper is not always necessary, and some cleaning of the clay will often be performed (Rice 2005, p. 52).

In examination of the temper used in EBK vessels, the presence of crushed granite has been observed in the majority of instances (Prangsgaard 1992, p. 35). The angled shape of the granite particles suggests that the stones were burned before they were crushed (Koch 1987, p. 108, Glykou 2010, p. 179). Burning makes it significantly easier to crush the stone. Also, the use of burned stone may point to a reuse of cooking stones as temper (Prangsgaard 1992, p. 35). Apart from granite, observations of sand, crushed feldspar, crushed quartz, grog, plant material and crushed flint as temper has been reported as well as the absence of added temper (Hulthén 1977, p. 27, table 2b, 42–48, 1984, p. 202, Andersen 2009, p. 147, Glykou 2010, p. 179, Prangsgaard 2013, p. 278). Hulthén has observed instances of grog tempering in EBK ceramics dispersed throughout the EBK area (Hulthén 1977, p. 25–49, 1984, p. 202–206). In order to positively recognise grog as temper, thin section analysis has to be performed (Koch 1987, p. 108) and since such analyses are few in number, it is hard to say how common the use of grog was.

The choice of tempering material can potentially be significant in how the clay body behaves, especially during and after burning, but also in how the process of ceramic production is perceived (Dietler and Herbich 1998, p. 253–254, Gosselain 1999, p. 218–219, Tite *et al.* 2001, p. 316–317, Tite and Kilikoglou 2002, p. 1–2). The tempering materials observed in EBK ceramics have very different characteristics with regard to both physical properties and possible cultural connotations. Experiments have suggested that the crack dissipation abilities of grog-tempered ceramics are not as good as those for ceramics tempered with quartz, sand and marble (West 1992 cited Tite *et al.* 2001, p. 316–317). As quartz makes up a significant proportion of granite, the same could be expected from granite tempering. It must also be mentioned that the concentration of non-plastic particles is an additional important factor for the properties of the ware (Kilikoglou *et al.* 1998, p. 266–276).

With regard to the possible cultural connotations linked to the use of temper, grog is different from other tempering materials in that it involves the recycling of old vessels. The use of burnt stone and plant material may also have contributed with their connotations to the perception of pottery and pottery production. The possible reuse of cooking stones seems interesting in this respect. Burnt stone was a well-known feature in EBK domestic contexts, stemming from cooking stones and stone built hearths, and it is possible that burnt stones had cultural connotations beyond their functional merits.

Preparing the paste

Preparing the clay paste aims at getting a paste with the desired qualities and consistency. Apart from the concern with wanted and unwanted contingents of non-plastics mentioned above, this involves getting the moisture level of the clay paste just right. The latter is often achieved through drying and/or soaking of the clay and subsequently adding water during the kneading, wedging or treading of the paste (Sillar 1996, p. 265, Rice 2005, p. 118–124).

Manufacturing techniques

In manufacturing a point-based vessel, the walls were built by coiling while the base was either coiled or made by pinching one or two lumps of clay into the wanted shape (Koch 1987, p. 109–110, Glykou 2010, p. 179–180). Traces of manufacture clearly show that the vessels were built from the base up (Koch 1987, p. 109–110, figure 6). This is significant as building the vessel starting from the rim would probably provide more stability of the vessel in the process and more freedom for the potter. The fact that the vessels were started from the base probably tells us something about how the vessels were conceptualised. According to Andersen (Andersen 2010, p. 170), the building technique may reflect an association with basketry as a similar procedure is used making coiled basketry. The lamps were made either entirely by pinching or by a combination of pinching and coiling (Glykou 2010, p. 181).

In principle, three different coiling techniques have been recorded for EBK pottery, the so-called H-, U- and

N-techniques (Andersen 1975, p. 57, Hulthén 1977, p. 25–35, figure 15). When using the H-technique, a coil is added to the base or the previous coil by applying pressure with a finger to the coil at even intervals, and smoothing the sides of the coils, normally downwards. The finger pressure will leave imprints of finger-tips, which can be visible when the pot breaks. The U-technique is very similar to the H-technique, with the exception that not as much pressure is added and therefore no finger impressions are present. Despite the fact that thin coils are used, the unidirectional forces exerted when coiling and smoothing will tend to result in vessel walls that are quite thick. Using the N-technique, the coils are smoothed in opposite directions at the two sides of the vessel wall, which forces the coils into an oblique shape (Koch 1987, p. 109–113).

A number of variations and intermediate forms of the three techniques have been observed. Even within the same vessel, the appearance of the coils can be different according to the part of the vessels that they form. In these cases, it appears to be a combination of non-oblique and oblique coils, the oblique coils occurring where the profile of the vessel changes from rim to belly or from belly to base. The oblique forms of the H- and U-technique may not only be related to transitional parts of the vessels, however (Koch 1987, p. 110, Stilborg and Bergenstråhle 2000, p. 33, Glykou 2010, p. 180, Andersen 2010, p. 170). Because of the more complicated picture emerging, it has been suggested that in evaluating fashioning techniques, not only the individual coil joints must be considered but also what part of the vessel they made up. Additionally, how base and rim are fashioned as well as how variations occur in the vessel wall should ideally be included (Glykou 2010, p. 180, Dumpe *et al.* 2011, p. 429). Very few analyses taking these points into consideration have yet been made. For a want of suitable alternatives, coil-joining techniques will therefore take a prominent position in the discussion of fashioning techniques below.

For the sites where the manufacturing techniques of the ceramics have been analysed, the U-technique appears at all of them, but the occurrence of two or all three techniques at the same site is common (Prangsgaard 1992, p. 34, figure 7, Glykou 2010, p. 181). In the southern Swedish area, the H-technique appears to be more frequent and common within assemblages than is the case in the central and southern parts of Jutland where the U-technique appears dominant. At the site of Neustadt in Schleswig-Holstein, the H-technique was dominant (Prangsgaard 1992, p. 34, Glykou 2010, p. 181, Andersen 2011, figure 10). At the site of Ringkloster in Jutland, a gradual change in the relative frequency of the techniques has been observed: while the U-technique was dominant throughout the sequence, H-technique was more frequent in the lower parts and N-technique in the upper parts of the stratigraphy. It was therefore suggested that the H-technique is an early feature, while the N-technique is late (Andersen 1975, p. 57–64). Yet, it also seems that no technique was absent at Ringkloster at any point in time. As H-technique is dominating the material from the site of Neustadt, which does not cover the earliest centuries of EBK ceramic-making (Hartz 2005, p. 77, Glykou 2010, p. 181), it should be taken into consideration that changes and variation in fashioning techniques could be due to a range of factors other than chronology.

Decoration

After the vessels have been shaped, they need to dry. Decoration can be applied at all stages of the drying process, giving different results and demanding different tools. The most common kind of decoration on EBK pots is ornamentation on top of the rim. This often takes the form of finger or nail impressions in the rim. Glykou has pointed out that this type of decoration follows naturally from coil building a vessel using the H-technique. The last coil is simply treated like all the other coils (Glykou 2010, p. 181).

For the lamps, rim impressions are the only known type of decoration. On the point-based vessels, decoration of the vessel walls and bases can also occur. The most common motif seems to be small pits or stab impressions placed in bands or other patterns (Prangsgaard 1992, p. 36). The band variant seems to be the only vessel wall decoration present at the sites in Schleswig-Holstein and Mecklenburg-Vorpommern (Glykou 2010, p. 183). In the southern Swedish area and the island of Bornholm, a motif consisting of large low pits covering the whole surface in no apparent order has been found. Apart from that, incised lines were also used. These can be sub-parallel or in a cross-hatched pattern (Prangsgaard 1992, p. 36, Casati and Sørensen 2006, figure 27). While decoration of the vessel walls is very sparse or totally absent in most of the area, there are local exceptions where more emphasis on decoration developed. This is the case in the eastern part of the area including the Swedish parts and Bornholm. In Scania, up to 40% of the sherds of a site can be found decorated (Stilborg and Bergenstråhle 2000, p. 34). In eastern Jutland, there is a limited group of sites featuring vessels with decorated walls in certain patterns. Here the ornamented sherds make up only a minor part of the ceramics (Andersen 2011, p. 201, figure 12).

In general, the decoration of EBK vessels suggests that this was executed immediately after the shaping of the vessel. The motifs appear to be embedded in the local art style of the time (Klassen 2004, p. 117, Andersen 2011, p. 204).

Drying

Drying the vessels is important because a rapid heating of water inside the vessel wall during firing will cause the vessel to explode. Also, too quick and uneven drying can cause cracks, and therefore drying the vessels in direct sunlight is often avoided (Rice 2005, p. 152–153). However, Rice suggests that this is not as much an issue for vessels manufactured from coarse paste (Rice 2005, p. 152), which probably means that EBK vessels could be dried in direct sunlight. The frequent rains, which appear at all times of a year in the western Baltic area, would probably pose more of a problem in drying the vessels. The drying of a vessel in temperate climate will normally take weeks (Rice 2005, p. 152), and therefore it seems likely that the vessels were put to dry in some kind of roofed structure that could shelter them from the rain. This could be within the dwelling structures or in a structure built for drying.

Firing

The firing of EBK vessels was probably performed by rapid open firing (Koch 1987, p. 113). Hulthén has observed that the vessels seem to have been fired at a temperature of around 500–600°C (Hulthén 1977, p. 26–45). In general, the temperature control of an open fire is poor, and although this can be alleviated by the way the pots and the fuel are arranged, the temperature range and magnitude vary substantially for different parts of an open fire (Gosselain 1992, p. 248–257, Rice 2005, p. 153–158). This means that there is a relatively high risk of vessel breakage during firing.

Managing the metaphysics

In sum, there are a number of different technological processes that have to be mastered in ceramic production. In addition, most ethnographically observed cases exhibit a range of social practices bound up with the technology that also has to be mastered. Rice (2005), for instance, mentions that raw material procurement in particular and shaping, drying and firing in general are stages of ceramics production, which are often the focus of rituals and taboos. She explains this as a reaction to the fact that many things can go wrong during these stages (Rice 2005, p. 115, 124). According to Gosselain (1999), people in non-Western societies will seek to control the technological process not just through technological means, but also by social means. In his study area of southern Cameroon, an unexpected failure is always explained by the breach of a prohibition, and will in general not be connected to natural causes (Gosselain 1999, p. 209, 217).

The use of point-based vessels

Points from point-based vessels have been found sitting *in situ* in hearths (Becker 1939, p. 263, Andersen and Malmros 1985, p. 81). This indicates that at least one use of the vessels was as cooking pots in direct heat as opposed to indirect heat, or stone boiling. Recent experiments involving cooking with replica vessels in open fire have shown the vessels to be quite effective cooking pots (Philippsen 2009, p. 10).

The occurrence of food crusts on EBK sherds is fairly common. These are typically situated near the bottom on the inside of the vessel and outside the rim, and sometimes contain fish remains like scales or bone fragments (Andersen and Malmros 1985 p. 84–85, Glykou 2011 p. 283). On the basis of recent lipid analysis and carbon isotope analysis of residues from two inland sites and five coastal sites, it was found that the vessels were predominantly used for processing aquatic resources. A smaller number of the residue samples had $\delta^{13}C$ values that fall within the range of ruminant adipose tissue, i.e. fat (Craig *et al.* 2007, p. 142–143, 2011, p. 17, 911–17, 912, figure 4).

Pollen analyses from food crusts may indicate that ribwort plantain and broadleaf plantain were cooked at the site of Ronæs Skov. At the same site, the find of macro remains of mistletoe leaves in food crust showed that this plant was used (Andersen 2009, p. 151-153). Recently a new method of analysing starch extracted from archaeological material has been tested on samples from food crusts on pottery from the submerged site of Neustadt (Saul *et al.* 2012). The authors are cautious in making their conclusions as the method is new and a bigger set of reference material is needed. All the samples analysed contained starches similar to that of acorn. This suggests that the processing of acorn possibly formed a major part of cooking that also involved pottery at Neustadt. In addition, it was found that sedges and reeds might also have been important plant foods. For acorn to be edible, toxic tannins have to be removed. This can be done by repeatedly heating the crushed acorn in water (Saul *et al.* 2012, p. 3489–3490) and pottery could potentially have eased this process significantly compared to other cooking technologies. Furthermore, existence of phytoliths from garlic mustard seed have been proven in food crusts on pots from Neustadt and the Zealandic inland sites of Åkonge and Stenø, indicating a practice of spicing the food in late EBK and early Funnel Beaker contexts (Saul *et al.* 2013).

The analysis of food crusts on EBK pots show exciting potential for revealing aspects of prehistoric cuisine otherwise hard to investigate archaeologically. At present, the evidence from lipid analyses as well as starch and phytolith analyses suggests that a variety of foodstuffs were processed in the vessels. Analytical challenges remain, however, as the preparation of stews with many ingredients may result in the mixed signals commonly observed, while repeated use of the same vessel for cooking different dishes probably also played a role.

The social dynamics of adopting a new technology

In evaluating the process of adoption of new technologies, it must be realised that technology is fundamentally a social phenomenon, and the cultural transmission involved will likely influence the adopting society in a broader sense (Lemonnier 1986, p. 147–153, 1992, p. 4).

Within the field of Development Studies it was realised early on that the success of the introduction of new technology is highly dependent on social factors and often has unintended social implications (Spicer 1952, p. 13–20). Working with the implications of this insight, it has been suggested that a holistic concept of technology is needed that is ontological universal and takes social factors into consideration. Within development studies, this has been intended to 'decolonise' the concept of technology (Müller 2011, p. 11). Regarding the study of prehistoric and ethnographically observed technologies, a similar concern with the Western-centric notions of the concept of technology has been voiced (Ingold 2000, p. 296–299). Using a well-defined but fairly open definition of technology may offer a productive avenue for seriously taking these concerns into consideration. I therefore focus on one of these attempts to decolonise the concept of technology within development studies. Müller (Müller 2003, p. 29) defines technology as follows:

> *Technology is one of the means by which mankind reproduces and expands its living conditions. Technology embraces a combination of four constituents: Technique, Knowledge, Organisation and Product.*

The first part of the definition is very broad and tells us that we are dealing with something of importance and necessity for all humankind. In addition, it relates technology to living conditions. At face value, the second part of the definition is the more interesting. Here the elements of technology are listed. The first element is technique, which here is perceived as the way the individual steps in the process are carried out and the physical items involved. Knowledge is seen as conscious as well as unconscious. Organisation is how the process is organised, while product signifies the material as well as the immaterial outcome. It is emphasised that the product is an embedded part of the technology. A technology is not only chosen on the basis of the desired qualities of the product but also based on qualities of the other parts of the technology.

The four elements are illustrated as pieces in a jigsaw puzzle. It is argued that a qualitative change in one element will lead to changes in the others. If this does not happen, the initial change will not be sustained. Furthermore, the analogy of the jigsaw puzzle is used to illustrate how the elements of technology are connected to other elements of society, e.g. social capital, economic organisation and ecological conditions. Changes in these external elements will therefore have the potential for changing the technology (Müller 2011, p. 14–15). An important point in Müller's work is that when a technology is moved, the technology as well as the new social context has to be adjusted to fit each other. This is the only way the technology can be successfully integrated. Neither technology nor society can stay the same (Müller 2003, p. 72).

Social carriers of technology

In order to investigate the processes involved in the introduction of new technology, it is essential, according to Müller, to focus on the relationship between actor and structure. To this end, he introduces the concept of 'the social carriers of technology'. A social carrier of technology is an actor in the form of a person or a group of people who engage in promoting the adoption of a new technology. On the basis of this concept, he builds a model of how a technology is integrated in a given society (see Figure 2). The original model is clearly concerned with modern society with access to complex technologies. Nevertheless, the underlying principles make a potentially fruitful tool for understanding the introduction of a new technology also in past societies.

The model prescribes that the introduction of a technology demands more than one social carrier of technology. The carriers form a so-called task network. I will return to this below. Six necessary conditions have to be fulfilled by actors within the task network for them to become social carriers of technology. The six conditions described as applied to a prehistoric context are as follows: (1) interest in the technology; (2) power to pursue this interest; (3) organisation for facilitating adoption of the technology; (4) information about the different technological options; (5) access to the necessary raw materials; and (6) knowledge, here taken to mean mastering the technology. The first three conditions are seen as primarily social, while the latter three are seen as being to a greater extent related to technology (the potential ones and the ones already used by the society). The six conditions are necessary but not sufficient for the adoption of a given technology.

Society or 'structure' is represented in the model by three entities: institutions, social division of labour and infrastructure. The notion of the 'task network', which essentially is what makes the system dynamic, binds these elements together. They are networks of social carriers of technology working together to promote their interests related to the new technology. Unlike the entities

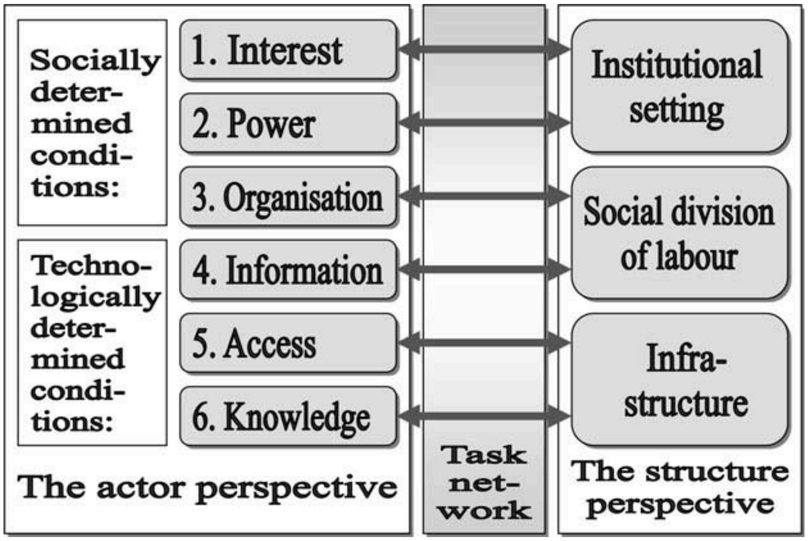

Figure 2. Müller's model for the integration of a technology into a new social setting. J. Müller 2003 © reproduced with permission. Central to the model is the relationship between actor and structure. The actor perspective is represented by six conditions, which have to be fulfilled for a social entity to become a social carrier of technology. The first three conditions are seen primarily as socially determined, while the final three are seen as primarily determined by the relevant technology. The structure perspective is represented by three aspects of society. Social entities form ad hoc task networks in order to introduce new technology into their society. In turn, these changes affect the social entities and the way they fulfil the six conditions, creating a feedback system with technological as well as social repercussions.

representing structure, the task networks have an ad hoc character linked to the new technology. Through the different ways, the six conditions are fulfilled within the task network; the social carriers of technology succeed in affecting the institutions, the social division of labour and the infrastructure. Hereby the new pieces of technology are fitted into the jigsaw puzzle of society, to use Müller's analogy.

An important characteristic of the model is that technology is not present directly but appears indirectly through the engagement of the actors. It is not 'technology meets society' but rather 'society is adjusted to fit in a new technology by the goal-directed interactions of the actors'. The model is a proposition of how the adjustment of society to a new technology can be viewed. However, the question of how technology is adjusted to fit a new social environment is not dealt with. In addition, the only actors in the model are those, which act to the benefit of the new technology. In most cases, a new technology will probably also have opponents trying to keep the social carriers of technology from changing the social structures accordingly.

To clarify how the model may be applied, I will go through in the context of the introduction of the Ertebølle ceramics. I will start with Müller's six necessary conditions.

(1) *Interest in ceramics*. It can be difficult to discern what motivates the actions of the living. Concerning prehistoric people, these difficulties are exacerbated. Obvious motives for having an interest in producing and using ceramics could be that ceramic containers can be used for cooking in direct fire, that food prepared in the vessels is associated with something desirable, or that the process of production in itself opens for something socially propitious.

(2) *Power to pursue the interest in ceramics*. This will probably relate to social position and the ability to persuade others to share the interest, or at least to not work against the adoption of the technology.

(3) *Organisation for facilitating adoption of ceramics*. This condition is linked to the former but emphasises that the social carriers of technology have to organise in a task network to achieve changes in the way activities are performed in the society. In the case of Ertebølle ceramics, other activities may have had to be rescheduled to fit in with ceramic production and use.

(4) *Information about the different technological options*. In the case of prehistory, the available technological options will often have been quite limited. Nevertheless, a new technology will always have had a precursor in an old technology and the way things used to be done. Furthermore, the Ertebølle people may have been aware of the southern LBK-associated ceramic tradition as well as the ceramic traditions east of the Baltic.

(5) *Access to the necessary raw materials*. Clay, tempering and firewood.

(6) *Mastering the chaîne opératoire of ceramics production*. Alternatively, sufficient knowledge of this process to reinvent it at home. In both cases, knowledge of how to use the vessels is also included in the condition.

The term 'institutions of society' is here taken to mean the ways in which life is organised with regard to economic, social and spiritual activities (which of course cannot be wholly separated). This could, for instance, be seasonal mobility or general worldview. The social division of labour in Ertebølle society was probably based primarily on gender and age. In addition, studies of flint knapping suggest a certain specialisation of demanding crafts (Sternke 2005, p. 158). Infrastructure is in this context viewed as the way information, artefacts and people move between groups. Prestige systems could be an example. Knowledge of the existence of a certain technology has to travel through the existing social infrastructure. The task network would consist of different individuals and groups who directly or indirectly work together to make room in the jigsaw puzzle of Ertebølle society in order to fit in the new pieces: ceramics.

The introduction of ceramics in the Ertebølle Culture could be summarised as follows. Through the pre-existing infrastructure, knowledge of ceramics is available. At some point, a number of actors within the Ertebølle society become interested in this technology. The model does not cover how this interest emerges in the first place. The interested actors will start influencing each other and organise to facilitate the interest. As part of this process, these actions influence and change the social structures. These changes will then influence the strategies of the actors. In this way ceramic production would have influenced a range of aspects of EBK society, including the planning of everyday tasks; the manner in which food was prepared; how information, artefacts and people moved around in the area; and how aspects of the world are perceived.

Technology transfer and learning

The model of social carriers of technology leaves room for various scenarios of how ceramic craft was transferred into the EBK area. To evaluate whether the craft was obtained in the form of skill or the form of inspiration, it would be useful to isolate aspects pertaining specifically to learning relationships. A study of the relations between technology, learning and ethnicity made by Gosselain (1998) amongst non-industrial potters in Southern Cameroon may be of help here. Gosselain found that whereas the techniques of most stages of the chaîne opératoire appeared to vary randomly, fashioning techniques largely followed ethnic boundaries. As the great majority of the potters in the area had learned the craft within their extended family, he ascribed this pattern to the position vessel fashioning techniques have in becoming a skilled potter (Gosselain 1998, p. 92–99). Fashioning a vessel demands the building of specific motor habits and in a sense becomes a part of the physique of the potter once acquired (see Ingold 2000, p. 351–361). Although all stages of the pottery chaîne opératoire demand skill and may be a part of the technical identity of the potter, he or she may choose to change technical behaviour at some point. According to Gosselain, the stages of pottery production most prone to post-learning change are stages that involve public actions and cooperation with others and do not to a significant degree rely on motor habits. This means that where fashioning technique seem to be related to initial learning, the techniques involved in raw material procurement, preparation of paste, firing and post-firing treatment may be related to other factors. These could be linked to the display of some form of affiliation or to the integration of the potter into a new group (Gosselain 1998, p. 100–102). Gosselain emphasises that the distribution of fashioning techniques does not necessarily correspond to ethnic or linguistic groupings, but in reality mirrors learning networks, which can occasionally transgress such boundaries (Gosselain 1998, p. 103–104).

As the training of motor habits is necessary in order to achieve the ability to build a vessel, it can be assumed that the special status associated with the fashioning techniques is common to all pottery traditions. However, Gosselain (2008) later revised this position: potters are able to modify or change their fashioning technique if they find it advantageous. He suggests that the correlation between ethnic boundaries and fashioning techniques in his study area is due to the fact that fashioning techniques are perceived by the potters as something they inherited from their teacher/predecessor. Because techniques are perceived as inheritance, they must be cherished (Gosselain 2008, p. 169–170). This special status of the fashioning techniques can be due to the fact that whereas most stages of pottery production are learned informally as the prospective potter helps out during the process, the fashioning stage is characterised by direct instructions. Often the trained potter will lead the hands of the apprentice to teach the right movements (Gosselain 1998, p. 94–95).

So, does this mean that the fashioning techniques cannot be used to establish learning relationships more generally? In my opinion, this stage of pottery production still holds a special position because of the difficulties that have to be overcome to build appropriate motor habits. However, it is an important point that potters can make changes at all stages of production if they want to. The propensity of making changes at different production stages will likely be related to the organisation of the craft in the relevant society. In the opinion of Dumpe *et al.* (2011), too much emphasis has been put on different coiling techniques in the discussion of the EBK ceramics. Rather they suggest that a wider approach to analysing the building of the vessels would be fruitful (Dumpe *et al.* 2011, p. 429–430). They caution that the H-technique should be seen as "a marker of a specific craft" (Dumpe *et al.* 2011, p. 436). From the present data, it seems that the H-technique is a phenomenon very limited in time and space compared to N- as well as U-technique (Hulthén 1977, p. 46, Koch 1987, p. 109–113, Dumpe *et al.* 2011, p. 436, Raemaekers 2011, p. 495). It must therefore be seen as plausible that potters using this technique were passing it on via detailed instruction. This would not prevent a potter from changing technique later in her or his career. Nor can it be ruled out that potters initially trained in other techniques could change their ways and adopt the H-technique.

Discussion

The three different hypotheses on how the EBK ceramics originated presented in the Introduction have quite different implications when it comes to the process of cultural transmission.

Inspired reinvention hypothesis

In the first scenario – that the EBK ceramic tradition is the result of inspired reinvention instigated by contacts with farmers – the process of cultural transmission is addressed directly. Louwe Koojimans addresses the subject in depth. He is mainly concerned with the ceramic tradition of the Swifterbant but states that he sees the process for the EBK ceramics as similar (Louwe Kooijmans 2010, p. 36).

The Swifterbant ceramic tradition of the Netherlands and the westernmost part of the German province of Niedersachsen appears around 5000 cal BC. When it was first discovered, a relationship with the EBK ceramics was proposed (De Roever 1979, p. 23, Raemaekers 2011, p. 485–486). Recently, however, the nature and closeness of the affiliation has been questioned based on differences in morphology, decoration, tempering and the absence of lamps in the Swifterbant assemblages (Andersen 2010, p. 174, Raemaekers and de Poever 2010, p. 146). Most germane to the reflections on learning relationships above, it has been shown that the assumption of similar coiling techniques appeared to derive from a conflation of terms between the research traditions of southern Scandinavia and the Netherlands. What is termed H-technique within EBK research is not present in Swifterbant ceramics (Raemaekers 2011, p. 493–495).

Louwe Kooijmans's proposes that the adoption of ceramics technology was sparked by the desire for new foods/food preparation modes. The general idea was transferred from farming societies, while the reinvention was partly based on these general ideas and partly based on known container technology, i.e. coiled basketry (Louwe Kooijmans 2010, p. 35–36). Along the same lines, Crombé *et al.* (2011) suggest that the pointed base of the hunter-gatherer ceramics is not a result of affiliation but merely a functional adaption of the vessels to transport and life in temporary camps (Crombé *et al.* 2011, p. 478).

Following this approach, cultural transmission takes on a mixed character as old traditions transmitted from generation to generation are transformed by new ideas transmitted without direct contact between the practitioners of the craft traditions. Loouwe Kooijmans suggest that the males brought home the knowledge of pottery – containers made of fired clay for cooking (in direct heat) – while the females made the transformation of the techniques of coiled basketry into a production sequence for pottery (Louwe Kooijmans 2010, p. 35).

Creolisation hypothesis

The second hypothesis is that the EBK ceramics tradition is the result of creolisation of eastern and southern ceramics traditions. Dumpe *et al.* 2011 have outlined how this could have played out. They base their proposition on a new and thorough study of Latvian Narva pottery from two sites and compare the results with those of older studies of Scanian EBK ceramics. The onset of the Narva pottery tradition is set to the second half of the sixth millennium cal BC, and the tradition continues into the fourth millennium cal BC (Dumpe *et al.* 2011, p. 412). Similarities between the Narva and the EBK pottery regarding the pointed bottoms and the presence of lamps have earlier been pointed out (e.g. Hallgren 2004, p. 139–141, Timofev 1998, p. 227). As the existence of soot traces on the Narva lamps has recently been verified, an association seemed even more likely. Yet, there are also marked differences in the tempering materials used: While shell and other organic material are dominant tempering agents in Narva ceramics, these are absent (shell) or almost absent (plant material) in EBK ceramics. Also, it is found that the technique of thinning the walls of Narva pots with a comb-like instrument after building and the adjustment of temper particle size to vessel dimensions sets the tradition apart from the EBK, where such thinning and adjustment has not been observed (Dumpe *et al.* 2011, p. 434–436). Therefore, the authors propose that shape and function of the EBK vessels were inspired by the eastern ceramic traditions – ultimately a circumpolar forager related tradition – while the technological knowledge was procured from a Western European ceramics tradition such as the LBK or Swifterbant. Furthermore, they argue that knowledge on choosing temper and clay types along with how to fire the vessels and the principles of coil building was passed on directly from members of an established pottery tradition. In contrast, the detailed knowledge on how to knead the paste into a homogeneous mass and how to join the coils was not passed on. This resulted in a comparably heterogeneous paste in the EBK ceramics along with the H-technique (Dumpe *et al.* 2011, p. 434–436).

Evaluating the potential mix of eastern and southern influences in hunter-gatherer ceramics of the Baltic, data from the Southern Baltic must be taken into consideration. In northern Poland, a few sites featuring point-based vessels and lamps have been uncovered (Nowak 2009, p. 454, Kabaciński and Terberger 2011, p. 372–374). The site of Dąbki 9 north-east of the city of Koszalin in Pomerania is the one most extensively researched and published so far. The site features rich layers of refuse thrown into a former lake. According to dates from worked bone material, occupation at the site appears to have started at around 4900/4850 cal BC and ended more than a millennium later. Ceramics are present from the start of the sequence. Around the middle of the sequence, funnel beaker ceramics begin to appear. No traces of domesticates or cultigens appear before around 3900 cal BC. The early ceramics of the site features weakly S-shaped profiled point-based vessels as well as low oval bowls interpreted as lamps. The tempering agents are mineral, mainly granite (Kabaciński and Terberger 2011, p. 362–371, Czekaj-Zastawny *et al.* 2013a, p. 198–201). Similarities with the EBK have previously been pointed out (Ilkiewicz 1989, p. 31). Of particular interest is the observation that the fashioning techniques (H-, U- and N-coiling) appeared to be similar to those of the EBK ceramics (Kabaciński and Terberger 2011, p. 372).

Yet, a recent in-depth analysis of the pottery reveals a different and more complex picture. The point-based vessels of Dąbki were made using flat, wide coils added at an angle to each other, which makes the cross-section of a vessel wall resemble that of EBK N-technique. The coiling at Dąbki was, however, applied from the inside of the vessel, whereas it is observed that in the EBK the N-coiling was done from the outside of the vessel (see Figure 3). In addition, the coils of the Dąbki vessels in general appear wider than the typical EBK coil (regardless of coil application mode), although the wall thickness of the vessels are about the same or a bit thinner at Dąbki

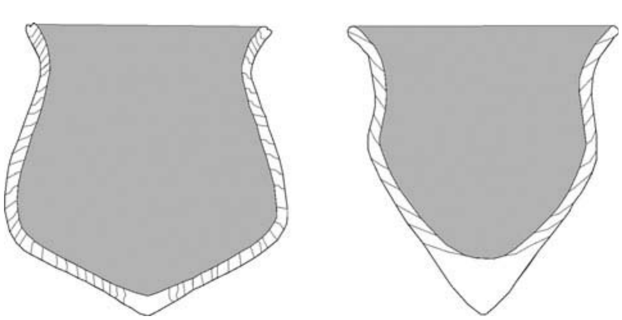

Figure 3. Schematic drawing of the fashioning techniques of the EBK ceramics (left), and Dąbki ceramics (right). After Czekaj-Zastawny *et al.* (2013b, figure 6). Used with permission.

(Prangsgaard 1992, p. 34, Czekaj-Zastawny *et al.* 2013b, p. 414–416). To find out whether or not EBK vessels with N-technique were always built from the outside will require a detailed scrutiny of the EBK assemblages. At any rate, the coiling techniques used at Dąbki and in the EBK ceramics do not appear intimately related.

Interestingly, the differences pointed out by Dumpe *et al.* between Narva and EBK ceramics seem to also differentiate Narva and Dąbki pottery: at Dąbki the vessel walls were apparently not thinned after building. Whether adjustment of tempering particles to vessels dimensions was practiced is uncertain, but the clay paste is described as heterogeneous. The tempering agents are also wholly different (Czekaj-Zastawny *et al.* 2013b, p. 414). Therefore, the same kind of process of technology transfer as suggested between Narva and EBK for ceramics can also be envisioned between Narva and Dąbki. Concerning the relationship between the ceramic tradition of Dąbki and that of the EBK, the form, function and temper appear similar. This could suggest that these elements were transferred from northern Pomerania into the EBK, while fashioning techniques were either reinvented within the EBK or transferred from somewhere else.

Following Dumpe *et al.* the process of transmission demands more intensive interaction between groups of people with different cultural affiliations than is the case for the scenario put forward by Louwe Kooijmans. For the prospective potters of the EBK (or northern Pomerania) to learn how to choose raw materials and fire the vessels, they would need to be in direct contact with the technical donors and witness quite closely the process of pottery production, albeit not necessarily as apprentices.

At Dąbki, contacts with other groups are visible throughout the sequence mainly as sherds of alien pottery. In the late Mesolithic horizon, these derive mainly from the post-LBK group of Brześć Kujawski of the Lengyel Culture, but LBK, Stroke Band Pottery culture and the EBK are also represented by a few sherds. The import ceramics from agro-pastoral groups were all thin-walled ware, and cooking pots do not seem to be represented (Czekaj-Zastawny *et al.* 2011, p. 45–46, 2013a, p. 203–204). It is suggested that people from these respective groups who frequented the site as an important node in the exchange networks of the region brought foreign pottery to the site (Czekaj-Zastawny *et al.* 2013a, p. 207). So how close were the connections between the people at Dąbki and these foreigners? And were they sufficiently close for technical elements of ceramics production to be transmitted?

Within the areas inhabited by early farmers, studies of strontium isotopes indicate that forager women of local descent joined early agro-pastoral societies (e.g. Bentley *et al.* 2003, p. 802). Likewise, a recent genetic study has shown that forager women married into farming communities, while the movement of women the other way was limited (Bollongino *et al.* 2013, p. 480–481). It has been suggested that the socially and economically complex hunter-gatherer societies of the coastal zones may have been able to build more equal intermarriage relationships with farming groups (Zvelebil 2004, p. 50).

For the hunter-gatherers of the Baltic shores, Hallgren (2009) has suggested that far-reaching social networks including the exchange of marriage partners were maintained in order to negotiate access to marine hunting. This is based partly on historical sources underlining the importance of such negotiations in the Baltic, and partly on ethnographically observed marriage structures in tribal societies. Hallgren states that exchange of spouses would probably imply visiting and feasting, increasing the possibility of craft transmission (Hallgren 2009, p. 387–388).

The relationships between foragers and farmers, and between groups of foragers, must have varied across time and space. The distances from Dąbki to the known sites of the cultural groups represented by ceramics there are considerable (<400 km; Czekaj-Zastawny *et al.* 2013a, p. 207). Whether marriage relations or other relations sufficiently intimate to facilitate the transfer of detailed technical information were upheld across these distances is difficult to discern. If such transfer did happen, the absence of agro-pastoral cooking wares at Dąbki may indicate that foragers observed pottery production at the farming villages.

A major concern when evaluating the processes involved in the origin of the earliest indigenous pottery tradition of coastal Pomerania is that it is not certain if we know anything much about the start of this tradition. As ceramics are present from the start of the sequence at Dąbki, the tradition may well be older. How the tradition originated will ultimately have to be decided by further fieldwork and detailed studies of the ceramics of the potential donor cultures. Influences from the farmer contacts incorporated later could potentially have affected the EBK ceramics.

In the EBK area, no site with so massive indications of contacts with agro-pastoral groups as that of Dąbki has been found. The evidence of contact here consists of stone axes and a few ceramic sherds manufactured in post-LBK contexts found in the EBK area, shared bone artefacts and a special flint tool that appears to share wear traces with flint implements of the LBK (Juel Jensen 1994, p. 50–58, 65–67, Klassen 2002, p. 308–313, 2004, p. 119–133). In principle, the relationships here could have been sufficiently close for detailed craft transmission to take place, making a further creolisation between east and south possible.

Eastern origins hypothesis

In the third hypothetical scenario, the EBK pottery has its primary roots in the eastern forager-related ceramic traditions of the south-eastern Baltic, and is therefore more related to the Boreal Neolithic of the east rather than the agro-pastoral Neolithic of the south. The craft travelled from the eastern Baltic via the social networks connecting the coastal areas of the Baltic Sea (Klassen 2004, p. 111–116, Andersen 2011, p. 209). The proponents of this hypothesis have not yet given much attention to the details of the cultural transmissions involved. This leaves room for various different interpretations. Mechanisms of transmission are in principle like those of the two former hypotheses, and can be envisioned alongside a version, where pottery craft travels as a package transferred by detailed instruction on all aspects of ceramics production between individuals. Although there are similarities between the EBK pottery and the slightly earlier and contemporary pottery of the eastern Baltic, there are also marked differences (Dumpe *et al.* 2011, p. 434–435). The latter version of the transfer of pottery technology touches upon one of the long-standing problems with identifying the origins of the EBK pottery: If pottery arrived as a package, why then is it so hard to establish where it came from? Following Müller's thoughts, the explanation could be that a great deal of modification of the technology was necessary for this new element to be fitted into the jigsaw puzzle of the EBK.

Evaluating the hypotheses

As mentioned above, the evaluation of whether inspired reinvention or creolisation was the main process leading to the EBK ceramics basically relies on the nature of the contacts of the involved cultural groups. Hallgren stresses that close contact does not necessarily lead to technological transmission. However, occurrences of ceramics with similar traits in groups, which appear to be connected, suggest that technological transmission between the groups did take place. The EBK sherds from Dąbki show that contacts between people here and those west of the river Oder existed at least around 4500 cal BC (Czekaj-Zastawny *et al.* 2013a, p. 204). It is tempting to assume that such contacts also existed earlier on and could have facilitated craft transmission. Another thing that seems to pose an argument against isolated inspired reinvention of the EBK ceramics is the existence of lamps in the southern and western Baltic from the Narva to the EBK. If the lamps were independently invented, there must have been a predecessor made from organic material. Furthermore, these would have been quite similar across the Baltic – again suggesting contact. All in all, I do not deem an independent inspired reinvention of ceramics likely for the EBK. Whether this model fits the Swifterbant record more aptly is beyond the scope of this article.

At present, the emerging picture indicates that form, function and maybe also temper of the EBK ceramics derived from the east. Yet, the study of fashioning techniques cannot support a notion of unbroken learning from the east. The tradition seems to break between the Narva and that of Dąbki, and again between Dąbki and EBK, though it must be remembered that fashioning techniques can essentially only support an assumption about the nature of learning relationships when sufficient likeness is observed – not the contrary. The H-technique seems almost certainly to originate within the EBK, and if not used by the first EBK potter then it became part of that tradition very early on. The question of whether any of the other coiling techniques observed in the EBK, or other aspects of vessel fashioning, could be derived from the Swifterbant or early post-LBK groups in the south cannot to be excluded at this point. A detailed technological study in line with that suggested by Dumpe *et al*. of the ceramics of different cultural groups in the area would probably have the potential of shedding new light on that particular question. Such studies may also provide new insight into the relationships between groups of the North European Plain, especially how they interacted regarding the transfer of ceramic technology. As present, it is not possible to discern whether the origin of the EBK ceramics is to be seen as a process of creolisation of eastern and southern influences, or rather eastern influences combined with local reinvention against a background of known technology.

In conclusion, I suggest that the EBK ceramics tradition owes important traits to ceramic traditions east of the area. Whether influences from the south or south-west also played a part in the beginning of the tradition is still unclear. I consider it most probable that the tradition took its beginning somewhere at the German Baltic coast, probably in the east. After pottery craft was taken up and consolidated (to a certain degree) in the German area, it spread along the Baltic coast and uplands to the whole of the EBK. During this process, the new technology had to undergo a process of adaption in principle every time it entered into a new social unit. This may in turn account for the variations in vessel morphology and decoration found within the EBK area. How fast this process of ceramisation took place cannot be established from the available dates. ^{14}C dates on the start of the ceramic sequences in Scania and Zealand would be informative to this end, along with more data from Mecklenburg-Vorpommern in general. As ceramics seem to appear simultaneously in Jutland and Funen, the spread of the technology here was probably rather rapid (Andersen 2011, p. 208). A rapid spread of the technology would indicate either that the advantage of producing and using it were obvious or that ceramics in some way got tied up with the prestige systems in the EBK.

It has been suggested that the large coastal sites of the EBK functioned as congregation camps, probably central to the exchange in the area (Johansen 2006, p. 205, Jennbert 2011, p. 101). In this respect, these large sites may have played a key role in the transmission of ceramic technology.

Incorporating ceramics into the seasonal cycle

Traditionally, sedentism along with a certain level of group size have been stressed as being of critical importance for the adoption of pottery (Eerkens *et al.* 2002, p. 200). The degree of sedentism in the EBK has been a matter of debate within the last decade (Carter 2003, Johansen 2006, Brinch Petersen 2006). Whether sedentism amongst coastal EBK groups is accepted or not, it is clear that inland sites and small sites in use only seasonally also contain pottery (Andersen 1979, p. 40–41, Hartz 1997, p. 178–183, Skousen 1998, p. 44, Kramer 2001, p. 157–159). This poses the question of whether the EBK groups that took up pottery had to change their seasonal cycle to accommodate the production of the vessels.

An archaeological study of non-sedentary hunter-gatherers in the Great Basin (USA) found that even comparably mobile groups were able to incorporate ceramic production into their annual movements. Pottery appears mostly to have been made on the spot where it was needed, and to a lesser extent carried during movement from camp to camp (Eerkens *et al.* 2002, p. 219–224). A significant difference between the Great Basin and the western Baltic with regard to pottery production is that the air humidity is considerably higher in the western Baltic (Christiansen 1999, p. 54–55), which would probably make drying of the vessels take longer, thereby prolonging the total production sequence. The faunal data from the smaller EBK sites does not allow an estimate of whether seasonal movements were frequent or only occurred a few times a year (Johansen 2006, p. 204–205).

Two models for how pottery production was incorporated into the seasonal cycle of the EBK can be proposed. The first is that production took place during the summer and enough vessels for the whole year were produced in one or a few larger batches. If the group was sedentary, the vessels were stored. If they had one or more seasonal residence changes, the pottery was transported.

The second possibility is that a few vessels were produced whenever there was a need for new vessels throughout the year.

Moving pottery around may seem inconvenient, but a common feature of EBK settlement is the location near waterways (Mathiassen 1959, p. 19, Pl. XV, Andersen 1977, p. 14–16, Jennbert 1984, p. 102–105, figure 65 and 66, Fischer 1993a, p. 59, 1993b, p. 19–35, 1997, p. 63–65). Camp movement would probably have taken place by boat. The pottery would be put into the boats during moves along with other goods and people. Producing pottery in large batches would potentially leave large amounts of sherds when misfires happened, thereby creating an archaeologically observable trace. However, the taphonomic processes of repeated site use may have obscured such concentrations. A detailed scrutiny of the published and unpublished data on some of the sites with well-stratified living floors may provide the possibility of resolving this specific problem.

It is possible that the heterogeneous paste observed by some scholars (Dumpe *et al.* 2011, p. 434) was due to pottery production being undertaken on an ad hoc basis. On the one hand, if only a few vessels were made at the time, a few times a year, it may conceivably have been harder for the potter to achieve a high level of skill. On the other hand, the fashioning of the large vessels would have been quite demanding, showing that the craft was taken to a certain level.

Whether the pottery production was worked into annual rounds of movement according to the first or the second model, it would have demanded planning in accordance with other activities. If the pottery was made on the spot of its use, the movements may have had to be scheduled so that the production sequence could be completed before it was needed for a specific task. Whatever the seasonal cycle looked like before pottery was incorporated and regardless of how the production was organised, it would probably have caused the new users to reschedule in some ways and thus to change their attendant habits.

Why go through all the trouble?

One of the explanations put forward for the invention and adoption of pottery in general is that it could have constituted a prestige technology primarily associated with ritual use. The vessels would then be used for displaying food during feasting, or otherwise forming parts of rituals (Hoopes and Barnett 1995, p. 3, Rice 1999, p. 12–14). However, it has also been suggested that such ritual pottery would be likely to receive embellishments (Rice 1999, p. 13). Although some parts of the EBK area show a higher occurrence of decorated vessels, the general impression is that decoration was not very important (Prangsgaard 1992, p. 35–36, Stilborg and Bergenstråhle 2000, p. 34–35, Glykou 2010, p.183–184). A related prestige hypothesis, which is not as dependent on the appearance of the vessels, is that they were used to prepare or store prestige foods (Hayden 1995, p. 261).

It has been pointed out that one of the advantages of pottery relative to other non-industrial container technologies is that it can be produced in large batches at a time, thus reducing the cost of the single container (Eerkens *et al.* 2002, p. 201). This virtue could be an advantage in scenarios where abundant resources were exploited in a short window of time (Jordan and Zvelebil 2009b, p. 58). At some EBK sites, this seems to have been the case. For instance, 63% of the fish bone material found at the shell midden of Bjørnsholm was from migratory species, some of which would occur in large quantities within very limited time periods (Andersen 1993, p. 88–89). Pottery would then be convenient in that a large number of vessels could relatively easily be produced immediately before the migration was expected to occur (Jordan and Zvelebil 2009b, p. 58).

Another advantage of ceramic vessels is that they are well suited for detoxification and for preparation of small food items, thereby having the potential to broaden the diet of the people obtaining pottery craft (Rice 1999, p. 8). It has been suggested that the late Mesolithic saw a broadening of the diet to include more plant foods (Andersen 2010, p. 174–175, Prangsgaard 2013, p. 287). Cooking in ceramic vessels would be an effective way to break down starches to make plant foods more nutritional. In this context, the finds of Saul *et al.* of what appears to be starch from acorn in all of the analysed food crusts from Neustadt is particularly interesting. On the basis of ethnographic observations, Saul *et al.* suggest that acorns were ground, heated in several changes of water and dried to make a storable, non-toxic food source rich in starch and fat. A population of the relevant species of oak produces a large amount of acorns at two- to four-year intervals but virtually nothing in intermittent years (Saul *et al.* 2012, p. 3490). In that way, the processing of acorn would have the same purpose as suggested for the storage of migratory marine resources – to get the most out of a periodically abundant food source.

Whether or not the utilisation of migratory marine species or acorns was part of the reason for taking up ceramics in the EBK, this new technology for preparing food would have introduced new cuisine, new ways of making and consuming foodstuffs. Cross-culturally, what you eat and how you prepare your food inevitably play a role in how identity and group affiliation are signified (Belasco 2008, p. 15–33). This aspect of the new technology must have played a part in the motivation for taking it up and in the negotiations associated with making it fit with other aspects of EBK society.

Unlike the point-based vessels, the lamps were probably not directly associated with food preparation. Cooking would formerly have been undertaken using different technologies such as boiling in soft containers and roasting. Likewise, there could have been organic predecessors of the lamps, which have left no archaeological trace. If such lamps did exist, a new version made in a hard and durable material seems to be quite an improvement. On many sites, lamp sherds are very few compared with sherds of point-based vessels, while at some sites the lamp sherds are totally absent (Andersen 2010, p. 173, 2011, p. 206). In comparing these vessel types, it should be taken into consideration that the lamps are considerably smaller than the point-based vessels and sometimes a careful examination is necessary to identify the lamp sherds. Therefore, it cannot be ruled out that the wish for this new light source could have been a major or important additional incentive for taking up ceramic production.

The rise and introduction of the EBK ceramics

In summary, I propose that important aspects of ceramic technology were carried by and through the networks of the Baltic coast from the south-eastern Baltic, over the southern Baltic and into the western Baltic. Along the way, aspects of the technology appear to have changed at least twice, which indicates that traditions were not only changed to fit into new contexts, but also that a direct learning chain was not upheld. Whether elements of agro-pastoral ceramics were worked in along the way remains unclear.

Adopting ceramics technology would probably have played out as numerous negotiations between individuals advocating the new craft and individuals in favour of keeping things as they used to be. Through these negotiations, aspects of the EBK way of life were changed so that the new element could fit into the routines, dietary customs and metaphysics.

Concerning cuisine, it would be very interesting to examine if the high frequency of acorn starch in the Neustadt food crusts represents a general trend within the EBK. Further analysis of food crusts from the southern and eastern Baltic would be very interesting, potentially shedding light on the degree to which the cuisine followed the containers. The content of the vessels is an important aspect of pottery, which potentially could further qualify the discussion of the spread of ceramics along with the physical properties. Considerations of the latter have hitherto made up the foundation of the evaluations of the topic.

Can the adoption of ceramics in the EBK be viewed as part of a neolithisation process? From the present evidence, it seems clear that the EBK people were not ‘trying out’ a part of an agro-pastoral Neolithic package before ‘buying the whole thing’. The concepts of the agro-pastoral Neolithic and the boreal Neolithic carry within them notions of increased social complexity and sometimes also sedentism (Davison *et al.* 2009, p. 10, Dolukhanow *et al.* 2009, p. 237–238). The matter of sedentism is a contested one. Different use patterns may have existed in different types of landscapes in the late EBK (Johansen 2006, p. 207–208). The general picture of the EBK indicates an overall stability throughout the time period in question. Yet, during the late EBK, the numbers and sizes of the settlements seem to increase (Andersen 1995, p. 48, Johansen 2006, p. 218). Increased evidence of contact with farming communities in the south in the form of imports and shared material culture characterise the late EBK (Klassen 2004, p. 109). It has also been suggested that exchange networks in the Baltic became of increased importance during this time (Timofev 1998, p. 228–234, Zvelebil 2006, p. 180–184). If population density increased, it is likely that social complexity did alongside. The increasing evidence of exchange with other cultural groups may be connected to the mediation of such increased complexity. If the adoption of pottery is seen as connected to these processes, we are left with a picture of neolithisation in the boreal sense.

Some have suggested that in the fifth millennium cal BC, the northern fringes of the North European Plain was characterised by agro-pastoralists and foragers mutually advancing their material cultures to each other, eventually amongst others resulting in an agro-pastoral life style suitable to large parts of the hunter-gatherers of northern Europe (Louwe Kooijmans 2005, p. 269, Bogucki 2008, p. 62–63, Czerniak and Pyzel 2011, p. 350–356). If ceramic traditions of agro-pastoral origin contributed to the ceramic traditions along the Baltic coast, such contributions must be viewed as one element within a wider framework of technology transfer processes that, when taken together, led to the eventual agro-pastoral neolithisation of the northern fringes of the North European Plain.

Acknowledgements

This article is based on my MA thesis from The University of Sheffield and my MA thesis from Aarhus University. I would like to thank the late Prof. Marek Zvelebil and Associate Prof. Helle Juel Jensen for inspiration and encouragement. I would also like to extend my gratitude to Nordjyllands Historiske Museum for providing funding for the preparation of this article.

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