

CROPS, CATTLE AND HUMAN DNA

The Motala Site and the Mesolithic-Neolithic Transition in Östergötland, Southern Sweden

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Palaeogenetic research has recently questioned the notion that the transition to agriculture in southern Scandinavia was initiated by local groups of hunter-gatherers who adopted the new economy at the onset of the Neolithic. Instead, the transition is claimed to have been brought about by farmers who migrated to the region from the continent. In this paper we examine whether the idea of a migration can be upheld when set against archaeological source materials from Östergötland in southern Sweden. Our findings indicate that the notion of a local adoption is supported by the archaeological sources from the area. We also claim that available palaeogenetic sources do not contradict the interpretation that local groups of hunter-gatherers initiated the transition to agriculture.

Key words: agriculture, DNA, hunter-gatherers, Mesolithic, Motala, Neolithic, Östergötland.

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INTRODUCTION

The transition from hunter-gatherer to farmer is often considered to be one of the decisive events in human history. Not only did farming change the way people lived and their subsistence, it also transformed their way of understanding themselves and their surroundings. In archaeological sources, this transformation is reflected in the emergence of new forms of material culture and social organization, and the establishment of new settlement patterns. It is not clear how farming spread. Consequently, this question has interested archaeological research for a long time.

In recent years, entirely new types of source material have become available for research on the transition to farming in Europe. Access to modern and ancient human DNA has made it possible to present ideas about the transition within the emerging palaeogenetic field. Several studies have been conducted using material from southern Sweden, in which the researchers argue that farming was brought to the region by expanding groups of farmers from the south (Balter 2012; Skoglund *et al.* 2012; Skoglund *et al.* 2014; Malmström *et al.* 2015). Several of these connect the expansion to a migration process. Farmers moved in and brought the new knowledge with them (Balter 2012; Skoglund *et al.* 2012; Malmström *et al.* 2015). Such an idea of migration is remarkable, since it questions the dominating view among many archaeologists, who have argued that the practice of farming was initiated in the area by local hunter-gatherers who actively chose to adopt it (Jennbert 1984; Larsson, M. 1986; P. Nielsen 1986; Madsen 1987; Thomas 1988; Larsson, L. 1992; Tilley 1996; Price 2000).

Recently, a third model has been put forward. Integration has been presented as an alternative explanation. Farmers and local hunter-gatherers are proposed to have mixed with one another, creating new kinds of society (Sørensen 2014:2, 24ff). Interestingly, the notion of integration claims that farmers moved physically from one area to another but also concedes that local hunter-gatherers played an active role in those movements.

In this article, we will examine the establishment of farming in the south Swedish province of Östergötland. Were agricultural practices introduced here due to migration, local adoption or by a process of integration? We maintain that archaeological sources do not support large-scale migration. On the other hand, the available genetic material illustrates that the idea of adoption needs refinement. The genetic information offers new perspectives when studying how farming spread. The first agriculture did not only involve a new economy or a new way of understanding oneself and one's surroundings. The transmission of

the knowledge of farming was a process that involved the formation of social contacts between individuals and families. The results of these alliances can be observed in genetic sources.

The empirical point of departure for this study is a middle and late Mesolithic settlement site in the town of Motala, situated in the western part of the county of Östergötland. The site was archaeologically excavated between the years 2000–2003 and 2009–2013. Traces of complex Mesolithic structures have been found at the site which was located in a key position in the landscape where communication with other areas would have been easy and important resources were abundant (Carlsson 2008; Molin *et al.* 2013; Hallgren in manuscript). Another basis for this study is a number of early Neolithic farms in Östergötland where archaeological excavations have been conducted in recent years (Carlsson 2014b).

We have identified two different characteristics of the introduction of agriculture to Östergötland. On the one hand, the sources point to a rapid change in the pattern of settlement when inland farms were established during a short period of time. On the other hand, a slow process of change is indicated, in which major parts of the early Neolithic lifestyle continued in a similar way to life at the end of the Mesolithic.

In our opinion, it is crucial to include both characteristics when discussing how agriculture transformed the conditions of life in southern Scandinavia. The palaeogenetic studies mentioned above have however not done this as they are only weakly connected to the archaeological source materials. Palaeogenetic information provides favourable prospects of answering specific questions about the past. In order to make it useful in this way, it needs to be related to specific archaeological source materials. To understand how farming was introduced in Östergötland, it is necessary to consider the temporality of the different sources; both the rapid processes and the slow movement of change should be regarded.

DIFFERENT WAYS OF UNDERSTANDING THE WAY FARMING SPREAD

The development of farming in European societies is a transformation process that has been studied and analysed by many archaeologists (Hodder 1990; Thorpe 1996; Whittle 1996; Fischer & Kristiansen 2002; Sheridan 2010; Sørensen & Karg 2012; Thomas 2013; Hoffman 2015). Research about the initial development of farming across Europe has shifted over the years from explanations based on theories within cultural historical archaeology concerning large-scale migrations, or the

diffusion of ideas, to New Archaeology's thoughts on local adaptation, and later to post-processual approaches with a focus on individual agency. Lately, migration models have again been suggested, this time based on genetic data (Hoffman 2015).

Today, most archaeologists agree that farming was introduced into central and western Europe during the middle of the sixth millennium BC. Many consider the transformation to have involved migration into central Europe from the south-east as well as expansion along the west coast of Europe (Whittle 2003). The migration is presumed to have originated in western Hungary or eastern Austria. However, it is not possible to follow any linear progress towards the north-west and it cannot be described in general terms. Rather, it appears as a series of events with local variations (cf. Thomas 2013; Hoffman 2015). Palaeogenetic analyses of DNA and isotopes have contributed new empirical data to the interpretations. Even so, the picture is far from clear. There are examples of local hunter-gatherers who are thought to have interacted with farmers, but there are also studies showing that people with different lifestyles appear to have lived separately (Arnaud 1989). Even if hunter-gatherers' genes gradually changed as a result of their encounters with farming populations, this fact says nothing about the speed of the development or how these processes took place (Hoffman 2015:465).

Commonly, the development of farming in south Scandinavia is described, first as several hundred years of resistance from the Mesolithic groups, and then as a rapid transformation starting around 3900 BC. For a long time, the interpretation of this course of events focused on the farmers, arguing that a large-scale migration occurred (Stenberger 1964; Brøndsted 1966; Ammerman & Cavalli-Sforza 1973, 1984; Sørensen & Karg 2012:14; Sørensen 2013; 2014). Such migration models have been criticized since they depict the Mesolithic population as passive spectators in the transformation process. Archaeologists who adhere to the adoption theoretical perspective, on the contrary, ascribe the Mesolithic population an active role in spreading the knowledge of farming. Hunter-gatherers are presumed to have influenced their own conditions of life. One reason for people to choose to take up farming is considered to have been a need to adapt their way of living to changes in nature (Dennell 1983; Rowley-Conwy 1984; Zvelebil & Rowley-Conwy 1984; Larsson, L. 2007; Regnell 2012). Other explanations connect the introduction of farming to social circumstances such as trade (Nielsen, E.K. 1986), exchange of gifts (Jennbert 1984; Thomas 1993; Fischer 2002) or prestige and status (Tilley 1996).

Both the migration model and the adoption model have been criticized. The main reason for this is that they are regarded as too general,

which creates an unproductive polarization of the academic discussion of the Neolithization process. The models do not take into account the regional conditions to a great enough extent, nor the problems that arise when they are applied to new regions. The reasons for the introduction of agriculture and the nature of the process should not be understood as the same everywhere (Cummings & Harris 2011; Garcia Rovria 2013; Thomas 2013; Carlsson 2014b).

In a couple of articles about how archaeologists characterize the development of farming in Europe, Peter Rowley-Conwy points to other differences than migration and adoption (2004, 2011). He identifies two general points of view in the research. One way of describing the transition process is to regard it as a rapid revolutionary event. The transition is likened to a Juggernaut, crushing earlier lifestyles and swiftly creating new forms of society. Conversely, the other standpoint emphasizes the transition as a seamless process. Agriculture is considered to have spread relatively slowly and was negotiated at a personal level, which meant that it developed differently in different regions. The difference between life as a hunter-gatherer and as an early farmer is not thought to have been so dramatic. People generally continued to live on wild resources even after they had started to farm. Many researchers emphasize that farming changed people's way of thinking, although this did not have any great significance for the way they made their living initially.

A question that can be more closely studied in the source materials from Östergötland is whether it is possible to discern a rapid process of change in the region or if the sources point to a seamless transition. By first substantiating a picture of the regional conditions, our aim is to establish a clear context in which to analyse the south Scandinavian palaeogenetic information. It is only when the genetic data is treated as an archaeological source material amongst all others that it may be of use in a discussion about how agriculture was spread to Östergötland.

MESOLITHIC ÖSTERGÖTLAND

Östergötland is a province in the south-eastern part of Sweden, with an area of about 10,000 square kilometres (Figure 1). Plains cover the central parts of the region. South and north of the plains are large forests and rocky uplands. Lake Vättern, 1,900 square kilometres in size, is situated to the west. To the east is the Baltic Sea with an extensive archipelago. Through this countryside, the river Motala Ström runs in an east-westerly direction. The coastline and the archipelago have been affected by land uplift and changing sea levels ever since the end of the



Figure 1. Östergötland in south-eastern Sweden.

latest Ice Age. New islands and rocks have gradually risen out of the sea at the same time as inlets and bays became progressively drier, as the inner parts of the archipelago turned into inland areas.

The state of the sources from the early and late Stone Age is relatively favourable. This is largely due to the considerable number of development-led archaeological excavations that have been conducted in the region during the past decades. There is a larger amount of source material regarding the inland region than there is for coastal areas. How-

ever, surveys have been carried out along the Mesolithic coasts and archipelago in the eastern parts of the region (Åkerlund 1996; Wikell 2005; Molin 2009). A multitude of sites have been discovered, although unfortunately the chronology is unclear. Nevertheless, the surveys show that the archipelago was used during the entire Mesolithic, indicating that fishing and hunting seal were important occupations. One of the few clear patterns that can be seen in the archipelago material is that fewer sites are found on levels believed to date from the beginning of the early Neolithic period. One explanation might be that a transgression occurred when areas were flooded by a rise in the sea level, making it difficult to identify early Neolithic sites (Åkerlund 1996). Another is that there may have been an alteration in the way people frequented the archipelago at the time of the introduction of agriculture. There was less fishing in the sea and hunting seal, at the same time as a new kind of occupation was established in inland areas.

There are a great number of places in the inland where we only find single hearths and pits along with a limited amount of finds, usually worked quartz. On other sites, distinct remains of houses occur with finds consisting of animal bones and thousands of quartz- and flint-flakes (Molin 2000; Carlsson *et al.* 2005; Molin *et al.* 2011). Among the latter, there are several small well-preserved settlement sites from the Boreal climatic stage. They are characterized by traces of two-aisled



Figure 2. The Mesolithic house from Trädgårdstorp, 7000 BC (Menander & Molin 2005).

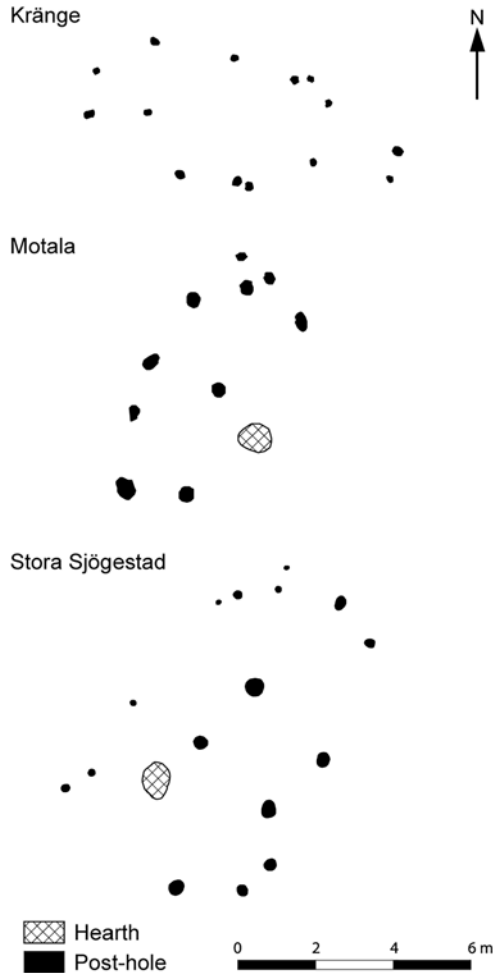


Figure 3. Mesolithic houses from Kränge (Carlsson 2014a), Motala (Carlsson 2008; Molin *et al.* 2011) and Stora Sjögestad (Carlsson 2012).

houses, which were 6–7 metres in length (Figures 2 & 3). The assemblage of finds indicates manufacturing of micro blades, also including small amounts of burnt bones from red deer, beaver, hare and elk, as well as hazelnut shells. Radiocarbon series illustrate how people returned to the same places regularly over a long period of time. However, it is not possible to discern any activities or variations that occurred seasonally (Larsson & Molin 2000; Carlsson *et al.* 2005; Molin 2009; Carlsson 2014b; Carlsson & Hagberg 2014).

The Mesolithic remains occurring in the inland of Östergötland imply a settlement pattern with many small places and an economy that was based on a broad spectrum of resources. It is evident that people

moved around in the entire region, but also that they returned regularly to certain places. No large settlements have as yet been excavated in the region with the exception of the settlement complex at Motala.

THE MOTALA SITE

The settlement site in Motala is situated in the western part of the county of Östergötland by the outlet of lake Vättern into the river Motala Ström (Figure 4). A total of 4,000 square metres of the settlement, on the northern and southern sides of the river, was excavated by hand and wet-sieved. Further, less than a hundred metres north of Motala Ström, a ritual context was excavated in an ancient lake which had become overgrown even in Mesolithic times. The archaeological excavation of the settlement included dry and wet cultural layers, which were wet-sieved. Amongst other things, this resulted in an extensive assemblage

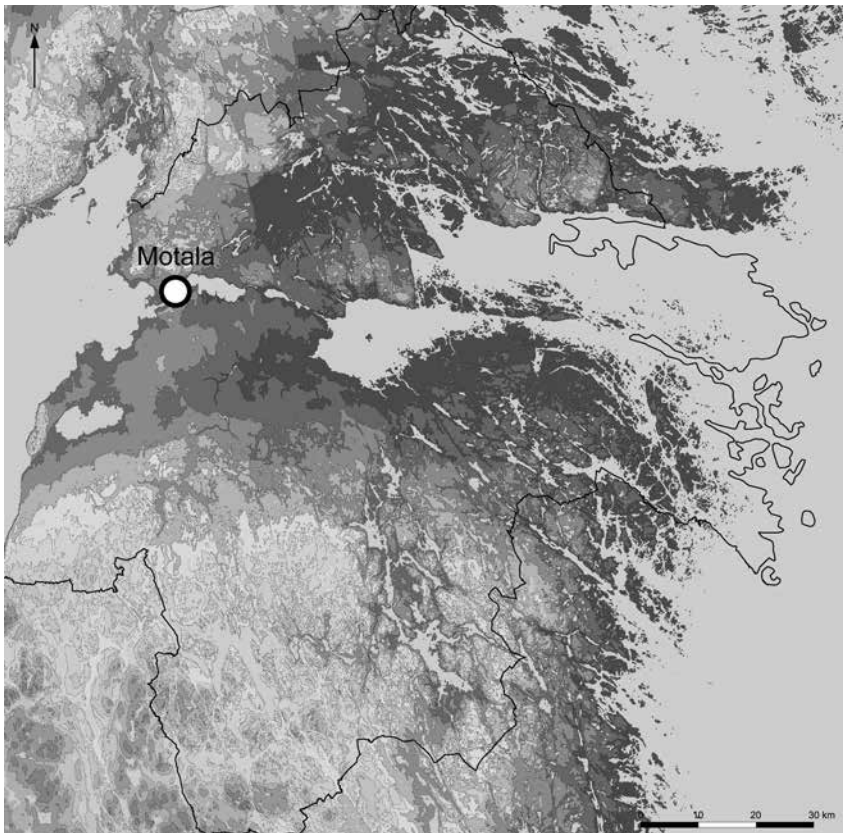


Figure 4. Motala with a Mesolithic shoreline 50 metres higher than today.

of well-preserved organic finds. Currently, there are no other Mesolithic remains in eastern central Sweden to match the finds at Motala (Carlsson *et al.* 2005; Carlsson 2008; Molin *et al.* 2013; Hagberg & Westermark 2015; Gruber & Westermark in manuscript; Hallgren in manuscript).

The preliminary results of the excavation include a well-substantiated chronology based on the analysis of around 200 radiocarbon samples. The earliest traces of human activity on the site are dated to around 9200 cal BC. The most intensive settlement phase of the site occurred during the period 6000–4500 cal BC, whereas radiocarbon dates later than 4500 cal BC are few. Charcoal from a cooking pit dated to sometime between 4000 and 3700 cal BC marks the final events of the settlement complex. One or two potsherds and flint implements of later date have been encountered, which indicates temporary visits during the middle and late Neolithic (Gruber & Westermark in manuscript; ; Hallgren in manuscript).

Human skulls and bones along with tools were deposited in the overgrown lake; these date from the beginning of the more intensive settlement phase (Hallgren 2011; Hallgren & Fornander 2014; Hallgren in manuscript). On the southern side of the river, 19 burials were discovered (Gummesson & Molin in manuscript). The settlement area contains the remains of some ten houses and around 500,000 artefacts made of various lithic materials together with debitage from their manufacturing. There were over 400 barbed points, interpreted as leister spears and harpoons; fish traps fixed in place and made of hazel switches; as well as remains of butchering and bone crafts. Bones of red deer, elk and wild boar dominated the osteological material; other identified bones came from bear, roe deer, dog, marten, otter, beaver and various kinds of fish (Carlsson 2004; Gummesson & Storå 2011; Storå *et al.* 2014). Preservation conditions were not particularly good when it came to macrofossils, however. Charred hazelnut shells were predominant. A few pips from wild apple and raspberries were also present. Wood species in charcoal were identified showing that most of the larger types of tree occurred (Carlsson 2008).

The location beside the river in an excellent position for communication over long distances as well as exceptional conditions for fishing are considered to be important reasons for the placement and size of the site (Carlsson 2008; Hallgren 2011; Molin *et al.* 2014; David *et al.* 2015; Hagberg & Westermark 2015). Apart from the fishing that took place on the site, the assemblage of finds indicates regular hunting and gathering forages into the surrounding countryside. People who lived beside the river Motala Ström during this period utilized a broad spectrum of resources for their subsistence.

Material culture from the Motala site indicates a considerable amount of exchange with other regions. This is especially evident in the case of

flint, both the raw material and artefacts; flint is a type of stone that does not occur naturally in Östergötland. Flint discovered at the settlement site comes from west and south Sweden in the form of Cambrian flint, Senon flint and Kristianstad flint.

The archaeological sources thus indicate a local community with a well-functioning economy and limited seasonal mobility at the same time as having a substantial geographic and social network. In the Mesolithic past, the site was probably significant from a variety of perspectives, the good communications, the extensive fishing, houses, burials and ritual depositions. Therefore, the settlement site has been interpreted as a focal point in the Mesolithic landscape (Molin *et al.* 2014).

Through the Mesolithic networks of contacts in Scandinavia, raw materials and most likely also ideas and rituals were exchanged. There is no given model as to how these networks were built up, or who was included, nor do we know how material culture was distributed in practical terms. Distribution might have taken place during short visits between settlements, or may have involved long journeys between the sea and inland. Many people might have been engaged in the exchanges or just single individuals. The encounters may not necessarily have been entirely peaceful. Various degrees of physical violence might have been a part of the contacts (Hallgren in manuscript). Furthermore, in the long-run, it cannot be excluded that networks such as these played an important role in social life, creating the possibility for spreading human DNA.

EARLY NEOLITHIC ÖSTERGÖTLAND

In Östergötland, sites yielding radiocarbon dates from the early Neolithic are much more common than sites of Mesolithic date. Many consist of single hearths, groups of hearths, trenches and pits. Often there are no artefacts at all, although one or two hazelnut shells, juniper berries or other seeds occur in cases where macrofossils have been analysed. Such places are usually situated close to streams or small wetlands (Carlsson 2014a). At the same time, there are a large number of places with stray finds of pointed- and thin-butted axes and polygonal axes, which are typical of the period (Nerman 1911).

Besides the traces of these brief stays, the remains of nine early Neolithic farms are known (Figure 5). They are located in the inland alongside larger waterways. The traces are clearer than they are at equivalent Mesolithic sites, which probably indicates that they were occupied for longer periods of time. The term farm involves the occurrence of remains of houses and finds of cereals, bones from domesticated animals and

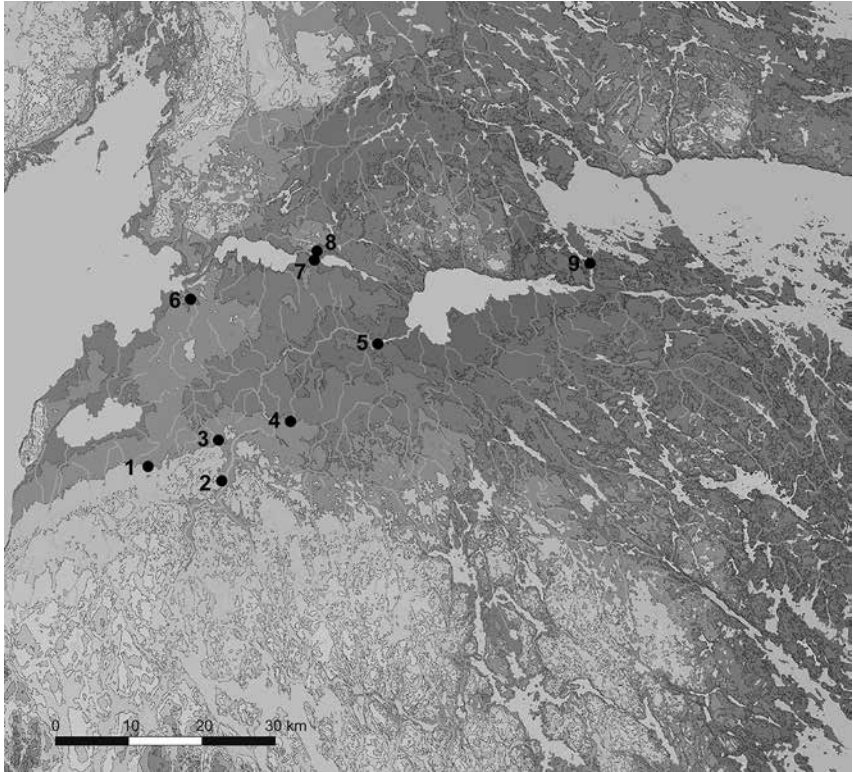


Figure 5. Locations of early Neolithic houses in Östergötland with a shoreline 40 metres higher than today. 1) Bäckaskog, 2) Bleckenstad, 3) Hulje, 4) Veta, 5) Kränge, 6) Nyckelby, 7) Brunneby, 8) Kungs Norrby, 9) Kimstad (Carlsson 2014b).

pottery. The houses are of a type often termed the Mossby type; they are the remains of 10-metre long, two-aisled buildings, 4 metres in width, with rounded ends (M. Larsson 1984). In shape as well as structure, they relate to Mesolithic remains of houses in Östergötland (Figure 6). Seven of the nine farm sites were also used in some capacity during the Mesolithic. As in Skåne, the farms in Östergötland cover extensive areas, sometimes thousands of square metres (Andersson 2003; Helander 2011; Carlsson 2014a; Petersson 2014).

The assemblages of finds are usually sparse, consisting of a few pieces of worked quartz and flint. In some places, the assemblages are more varied and abundant (Browall 1991; Carlsson 2014c). A characteristic of the stone technology in eastern central Sweden is that it did not change at the time of the introduction of agriculture. Local raw materials, quartz and greenstone, were worked with the same techniques in the early Neolithic as at the end of the Mesolithic (Lindgren 2004; Ahlbeck & Gill 2010).

Pottery is only rarely found, usually undecorated, although Funnel Beaker pottery with its typical decoration does occur sometimes (Molin & Stenvall 2010; Carlsson 2014c; Carlsson & Hagberg 2014). No burials have been found, except in one dolmen, which was constructed on the south side of the mountain Omberg in the western part of the county. The tradition of building megalithic graves does not appear to have been continued in the region (Janzon 2009).

The particular and conclusive difference in the economy of the Mesolithic sites and the early Neolithic farms are traces of cultivation and

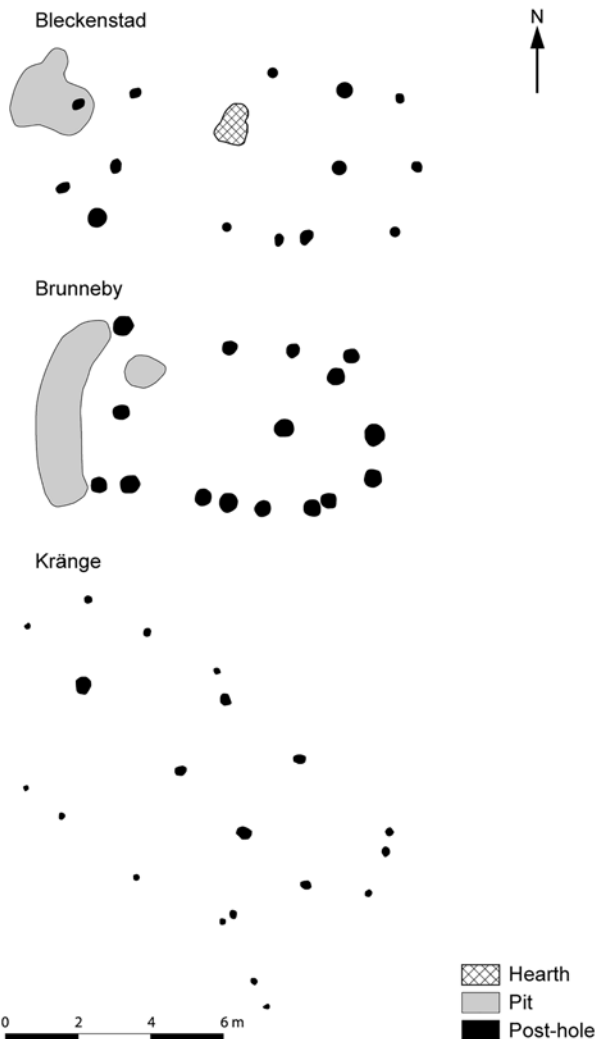


Figure 6. Plans of early Neolithic houses from Bleckenstad, Brunneby and Kränge (Carlsson 2014b).

animal husbandry. Macrofossil analyses show that seeds from cultivated plants occurred on all the early Neolithic farms. Predominant among the species are various forms of wheat (*Triticum monococcum* and *Triticum dicoccum*). Barley (*Hordeum vulgare*) occurs too. Furthermore, one pea has been found (*Pisum*). Weeds associated with farming are common, for instance cleavers (*Galium* cf. *aparine*) and tufted vetch (*Vicia* cf. *Cracca*). In the same contexts, hazelnuts have been found together with various berries, such as juniper (*Juniperus*), raspberry (*Rubus idaeus*) and crowberry (*Empetrum nigrum*). This shows that gathering was still important (Carlsson 2014a). Preservation conditions for unburnt bones are poor, which means that animal bones are extremely rare, unfortunately. In the few cases where osteological material occurs, we can discern the inclusion of animal husbandry – sheep/goats, cattle and pigs – and hunting – for instance seal (Carlsson 2014c; Carlsson & Hagberg 2014).

Early Neolithic finds and remains are not encountered in all places in Östergötland where people stayed during the Mesolithic. However, there are several places with examples indicating that when a site was occupied during the late Mesolithic, it was also used during the early Neolithic for gathering nuts, seeds and berries, and probably for hunting. The manner of utilizing the landscape during the early Neolithic is in many respects similar to the Mesolithic way; there appears to have been a high degree of mobility. Moreover, the mobility is most likely underestimated since cattle were probably allowed to graze over large areas during the Neolithic (Sjögren *et al.* 2009; Sjögren & Price 2013a; 2013b).

THE MESOLITHIC-NEOLITHIC TRANSITION IN ÖSTERGÖTLAND

The early Neolithic source material has two general characteristics. One part of the material points to a lifestyle that hardly changed; people hunted and gathered and there was a certain amount of fishing during the entire early Neolithic period, in a similar way as during the Mesolithic. The transition to agriculture was a seamless process. Farming appears to have been a supplement to an economy based on hunting, fishing and gathering.

Nonetheless, another part of the source material indicates a sharp and rapid transformation process. Over a short period, farms were established in numerous places in the inland with suitable conditions for cultivation. Domesticated animals started to be kept, and pottery was manufactured and used for the first time. If this change was initiated through migration from the continent, it should be possible to identify

remains from parallel lifestyles in the archaeological source material. Contemporary settlements of hunter-gatherers and farmers ought to be possible to find. Such settlement patterns should be equivalent to settlements that have been found in parts of central Europe where farmers of the Linear Pottery complex and hunter-gatherers are considered to have lived in the same areas but on different sites.

Yet, the archaeological source material from Östergötland does not provide any clear-cut support for such a division into parallel lifestyles. Instead, farming settlements that were established in the region appear to have replaced prominent Mesolithic settlement sites such as the site at Motala. At the same time as the farms appeared, there are signs that there was a change in the intensity of occupation in the archipelago. The hunting of seal and fishing may have lessened in importance when domesticated animals and cultivated plots started to be tended in the inland. These alterations in settlement patterns in Östergötland correspond to changes identified in other parts of south Scandinavia; a shift occurred in the utilization of coastal sites towards the end of the Mesolithic, at the same time as farms were established in the inland (L. Larsson 1987, 1988; M. Larsson 1992; Apel *et al.* 1995; Tilley 1996; Gill 2003; Hallgren 2008).

Even in this sharp transformation, there are signs of continuity. The new farms were often established in environments that had previously been used during the Mesolithic in one way or another. Houses that were constructed in the Neolithic period have an architecture that connects to local traditions from Mesolithic times. The same applies to the stone technology. Even here, there are no clear signs of an extensive change due to the influence of a group of farmers that had recently moved into the area. Rather, the continuity in architecture and stone technology shows that local groups adopted agriculture as a novelty, while other aspects of life continued in a similar way as before.

Altogether, the archaeological sources indicate a transformation process at the beginning of the early Neolithic, in which the Mesolithic lifestyle changed into a new way. This implies that local groups were the people who took up farming at the transition to early Neolithic times, adapting their settlement patterns to the new components of the economy. The hunting-gathering-fishing lifestyle of the late Mesolithic changed into a hunter-gatherer-fisher and farmer's life during the early Neolithic. The transition identified in Östergötland corresponds to changes recognized in parts of central Sweden where the difference between Mesolithic and early Neolithic ways of life also appears to have been minor. Early Neolithic farming was probably not an important aspect of the local economy in these areas, as people continued to utilize wild resources in a similar manner as before (Segerberg 1999; Gill 2003).

PALAEOGENETIC RESEARCH AND THE INTRODUCTION OF AGRICULTURE TO SOUTHERN SCANDINAVIA

An interpretation presented in a couple of palaeogenetic studies published in recent years is that farming spread to southern Scandinavia through migrating farmers who replaced the local hunter-gathering populations (Skoglund *et al.* 2012; Malmström *et al.* 2015). In the study conducted by Skoglund *et al.* in 2012, samples were taken from three Middle Neolithic skeletons from Gotland (an island, 3,200 square kilometres large, situated in the Baltic Sea 85 km to the east of the Swedish mainland). These samples were employed to represent the Mesolithic hunter-gathering population of southern Scandinavia. In addition, samples were collected from a burial in a megalithic grave in Västergötland (a region to the west of Lake Vättern), selected to represent the prehistoric farmers. Amongst a large amount of other samples used in the study, several were recovered from present-day populations in Cyprus and Greece.

The results from the DNA analysis of the individual buried in the megalithic grave turned out to be similar to modern populations around the Mediterranean. The paper argues that agriculture probably spread from southern Europe, implying a westerly route via France and parts of Spain (Skoglund *et al.* 2012: 468, fig 3b). Genetic similarities to Neolithic populations in Central Europe are however also noted (Skoglund *et al.* 2012: 469). Long-range migration is mentioned as a feasible mechanism to explain the distribution in a northerly direction (Skoglund *et al.* 2012:469). In the journal where this study was published, there was a further article based on the same results. Here, it was argued that the first farmers themselves brought the new farming technology with them when they moved from south to north (Balter 2012).

In Malmström *et al.*, 2015, the argument that farming spread to southern Scandinavia through a migration from central Europe is put forward. The analysed genetic material came from more than 40 Middle Neolithic samples from southern and central Sweden. Samples from hunter-gatherers were collected in burial sites on the islands of Öland (a long and narrow island, 1,300 square kilometres in size, situated between the island of Gotland and the mainland) and Gotland. Genetic information from farmers was taken from megalithic graves on Öland and from Västergötland, as well as from an earthen burial in the town of Linköping in Östergötland. A further 124 prehistoric samples from other parts of Europe were included in the study. Samples from farming contexts had similarities to those from the area of the Linear Pottery complex, but differed from those collected in hunting-gathering contexts. This was considered

an indication that agriculture spread to south Scandinavia through migration from Linear Pottery regions (Malmström *et al.* 2015:8).

A third, recently published, palaeogenetic study states that ideas about migration or cultural diffusion constitute two different schools of thought concerning interpretations of how farming spread in Europe (Skoglund *et al.* 2014). According to this study, there are distinct genetic differences between examined groups of farmers and hunter-gatherers. However, the way farming spread was not discussed in terms of Neolithic migration. Instead, expanding groups of farmers are mentioned without any being connected to any kind of social interpretation. The focus of the article concerns the question of what happened to the local hunter-gatherers when they encountered the expanding groups of farmers. Samples from hunter-gatherers were taken from a Mesolithic skeleton found on the island of Stora Karlsö (6.5 km off the coast of Gotland) and from six Middle Neolithic skeletons that came from two different burial sites on Gotland. Samples from prehistoric farmers came from four skeletons from a megalithic grave in Västergötland. Farmers do not appear to have replaced south Scandinavian hunter-gatherers according to this study. Presumably, the populations mixed with each other instead (Skoglund *et al.* 2014:747). The study also states that none of the samples from either of the burial sites from Gotland shows signs of genetic mixing with the farmers of the mainland, despite at least 40 generations of contemporary existence in Scandinavia.

GENETICS AND MIGRATION – PROBLEMS AND CRITICISM

Two of the studies mentioned above question the idea that local hunter-gatherers were the driving force behind the introduction of farming. Instead, migration from the south is advocated (Skoglund *et al.* 2012:469; Malmström *et al.* 2015:8).

There are several well-founded studies showing that agriculture was introduced in many areas during the early Neolithic period around 3900 cal BC (M. Larsson 1984; Persson 1999; Andersson 2003; Gill 2003; Sundström 2003; Hallgren 2008; Sørensen 2014). It has become increasingly clear that the population in southern Scandinavia had a genetically homogeneous character during the Mesolithic (Lazaridis *et al.* 2014; Haak *et al.* 2015). There are however no equivalent human genetic samples that date to the Early Neolithic. The oldest samples that are younger than the agricultural expansion are from the beginning of the Middle Neolithic. The lack of samples from the Early Neolithic Make the ge-

netic studies mentioned above problematic, since they are not based on source material from the period when farming was introduced in the region. For example, it is questionable whether the Middle Neolithic sample from the megalithic grave in Västergötland, which was used to support the idea that farming spread northwards through migration via a westerly route from the Mediterranean area, should be associated at all with the earliest agriculture. The genetic changes that were described are not necessarily the result of developments during the Early Neolithic, but might just as well be related to a later process (cf. Sørensen 2014:108). The context in a megalithic grave, where the sample was collected, suggests that the genetic material could just as well be connected to the dispersal of megalithic architecture across Europe. Moreover, the distribution of megalithic graves in the western parts of the Mediterranean region and along the Atlantic coast of Europe appears to reflect the expansion route suggested in the study (cf. for example, Bradley 1997).

Problems also arise in connection with the samples collected at the sites on Gotland, which were used to reflect the south Scandinavian hunter-gatherers. In the study, samples from Middle Neolithic burials in flat cemeteries on Gotland are used to represent Mesolithic hunter-gatherers. The study presupposes that the buried people in the burial sites belonged to a relict hunter-gatherer population, who lived in genetic isolation for hundreds of years. Such an assumption is questionable; this becomes evident when other source materials from Gotland are examined. In actual fact, there is unambiguous archaeological material showing that agriculture was practised on Gotland during the Early Neolithic and Middle Neolithic periods (Andersson 2016: 136–140, 197–199). The population of the island did not only support themselves through hunting, fishing and gathering. Sometimes they were farmers too.

Even if the population was genetically isolated during a long period it is doubtful whether these samples can be used as source material representing a surviving group of hunter-gatherers. Local developments were more complex than that (Österholm 1989; Andersson 2016). When the source material that substantiates the occurrence of agriculture on Gotland is taken into account, the middle Neolithic samples can be seen in a completely different light. They are thus shown to be from a region where agriculture had been introduced during the Early Neolithic period, but this had not resulted in any changes in the genes of the sampled population. Farming on Gotland does not appear to have arrived on the island through migration. On the contrary, the samples appear to be source material that supports the hypothesis of local adoption.

Other unclear points in the studies concern the connection between results from the analyses and the interpretation that agriculture spread

through migration. It is not argued why the results of the analyses support this idea. Moreover, there is no profound discussion about the nature of the archaeological sources, either to support the interpretation that was made, or to oppose it.

In recent years, the idea that farming spread to southern Scandinavia through migration from central Europe has not only been put forward in palaeogenetic studies. This interpretation has also been presented in research based on source material that is more traditionally archaeological (Sørensen 2014). According to Lasse Sørensen, early Neolithic farming was a relatively complex technology requiring specialized knowledge and experience to be successful. It was probably very difficult for local hunter-gatherers to begin farming without any practical experience. The expansion of farming most likely required that people familiar with how to farm themselves moved from one area to another. Sørensen's point is that farming spread to different parts of south Scandinavia through migrating farmers who came from the Michelsberg settlement complex in parts of current Germany and Belgium. The first step in the agrarian expansion would have involved reconnaissance expeditions to various parts of southern Scandinavia to collect information about areas suitable for agriculture. Thereafter, a pioneer phase followed when groups of farmers colonized the new areas. Finally, an expansion of farming occurred in areas where farming had recently been established; in this context, the farmers integrated with local hunter-gatherers creating new settlements.

However, as we have seen, Gotland's population did not appear to have been affected genetically by the agrarian expansion to the island. Here, it seems likely that the local hunter-gatherers were those who adopted farming at the onset of the early Neolithic. If migration was not a necessary precondition for the introduction of agriculture to Gotland, it was probably not required for a successful introduction in Östergötland, or other parts of southern Scandinavia. Farming does not appear to have been too difficult for the local hunter-gatherers to learn.

As discussed above, the first farming in Östergötland can be connected to newly established farm settlements in the prehistoric inland. The farms consisted of small two-aisled buildings. This was the kind of place to which the pioneers from the Michelsberg settlement complex would have migrated. According to Sørensen, however, it is difficult to find architectural influences for these buildings in the central European agrarian societies, particularly from the region of the Michelsberg complex. There, the farmers constructed large houses, usually several hundred square metres in size. These houses were 30 to 60 metres in length and 7 to 13 metres wide (2014:204–210). If the farm buildings in the inland of Östergötland had been possible to relate to this tradition, Sø-

rensen's migration model would have been supported. Instead, they appear to have been developed from a local Mesolithic tradition, indicating that the hunter-gatherer population of Östergötland was a driving force in the transformation process.

Even if it is difficult to find any clear support in the archaeological sources from Östergötland for the idea of migration, there are still some important results in the genetic studies, which can help us understand circumstances related to the introduction of farming. The identified genetic difference between Mesolithic hunter-gatherers and Neolithic farmers is one of these. Despite a lack of concrete source material confirming that this change started during the transition to the Early Neolithic, this still seems likely. If the inflow of new genes into Scandinavia cannot be explained through large-scale migration, we still need to clarify what these genetic changes represent and what they convey about the agrarian expansion.

THE INTRODUCTION OF FARMING INTO ÖSTERGÖTLAND

The idea of groups of farmers expanding to southern Scandinavia and mixing with local hunter-gathering populations was presented in the third study discussed above (Skoglund *et al.* 2014). As we have seen, there is no clear evidence in archaeological sources for a large-scale migration from the continent at the beginning of the early Neolithic. One way to approach the idea of genetic mixing of the kind discussed in the article would be to regard it as an integrated part of the agrarian expansion rather than something that happened in its wake.

The assemblage of finds from the Motala site reveals the occurrence of a network for the exchange of flint and most likely other materials during the late Mesolithic. Reasonably, at the time of the transition to the Early Neolithic period, these networks would also have included exchange of domesticated animals, cereals and knowledge about farming. Such an interpretation implies that people were mobile and interested in seeking contacts with others. It cannot be excluded that the social contacts that arose in these networks created the prerequisites for the spreading of both farming and human DNA. If marriage and mobility between different regions was a natural part of the diffusion of farming, this would mean that genes were transferred from the populations of one area to populations in another, at the same time as farming spread. Population density may have been low among the south Scandinavian hunter-gatherers (Skoglund *et al.* 2014:747). If this was

the case, the genetics of the population might have changed relatively quickly, particularly if the farming that was established caused an increase in population.

The introduction of farming in Östergötland can be characterized partly as a seamless transition and partly as a rapid revolutionary event. There is plenty of evidence pointing to the local population as being in command and engaged in this transformation. After several hundred years of lack of interest, farming suddenly became a matter people wanted to embark on. What was lacking earlier appears to have been the ambition to adopt it. When local populations themselves chose to pursue agriculture, the transformation process proceeded swiftly.

The agrarian way of life became established among the hunter-gatherers of Östergötland through existing exchange channels that had existed for a long time. Within these networks, farming now spread. By means of movement southwards, as well as northwards, families were integrated with each other and new local populations evolved. Subsequently this meant that Funnel Beaker pottery started to be used in Östergötland and that new settlement patterns emerged. Hunting and gathering continued to be important, in parallel with farming. Hunter-gatherers were not passive spectators in the transformation process; they were active proponents in the transition to an agrarian way of life.

The genetic source material is an important and welcome addition to the discussion about the Mesolithic – Neolithic transition. Presumably, it will be able to show that the introduction of farming involved more than the dissemination of knowledge giving rise to a new economy. Studies of ancient DNA will provide concrete evidence of the social dimension of the transformation process, in matters concerning formation of families and establishing bonds of kinship. Through the contribution of new information about this dimension, genetic research will be able to form a basis for nuanced explanations of underlying causes for the introduction of farming in southern Scandinavia.

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