

## Gene-flows and social processes: the potential of genetics and archaeology

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**ABSTRACT** – *During the past four decades, genetic information has played an increasingly important part in the study of the Mesolithic-Neolithic transition in Europe. However, there sometimes seems to be a degree of disjunction between the patterns revealed by genetic analysis and the increasingly complex social and economic processes that archaeology is starting to identify. In this contribution, I point to the multiplicity of identities, subsistence regimes and patterns of social interaction involved in the introduction of the Neolithic into northern and western Europe, and consider the implications for genetic research.*

**IZVLEČEK** – *Genetske informacije so v zadnjih štirih desetletjih igrale pomembno vlogo pri študiju mezolitsko-neolitske tranzicije v Evropi. Včasih se zdi, da prihaja do odstopanja med vzorci, ki jih razkrivajo genetske analize in med kompleksnimi socialnimi in ekonomskimi procesi, ki jih proučuje arheologija. V tem prispevku poudarjam mnogoterost identitet, prehrambenih režimov in vzorcev socialne interakcije, ki so bili vpleteni v uvajanje neolitika v severni in zahodni Evropo in ocenim, kakšne so implikacije za genetske raziskave.*

**KEY WORDS** – *archaeogenetics; demic diffusion; agency; frontiers; cultural hybridity*

### Scales and units of analysis

Over the past forty years, a fascinating dialogue has been developing between archaeology and genetics, specifically in relation to the question of the dispersal of domesticated plants and animals into Europe and its relationship with the movements of human populations. This debate has often been marked by a degree of mutual confusion, owing largely to the different temporal and spatial scales at which the two disciplines operate, and the different questions that they address (*Brown and Pluciennik 2001. 101*). While genetics generally concerns itself with the global or continental scale, archaeology is often more focused on the regional and the local, with the result that phenomena that are described at different levels of magnitude may appear to contradict each other. Some common ground is now beginning to emerge, but from an archaeological point of view it is especially interesting to ask whether the fine-

grained patterns that we *think* we can discern in the evidence can be accommodated by the broader sweep of the genetic information, or whether there is a degree of dissonance between the two, whose investigation might prove fruitful.

We are indebted to Albert Ammerman and Luca Cavalli-Sforza (*1971; 1973*) for initially stimulating debate with their discussion of the expansion of agriculture into Europe through demic diffusion, developed in the first instance in relation to radiocarbon dates from Neolithic sites, and later used as a means of explaining the distribution of genetic markers across the continent. The model of farming communities gradually expanding as their population rose, fuelled by the productivity and reliability of their subsistence base was explicitly differentiated from migratory arguments, in which communi-

ties are imagined to leave one area in order to settle in another (*Cavalli-Sforza 2002.82; Bellwood 2002.17*). None the less, subsequent debate has generally been framed in terms of the contrast between demic and cultural diffusion; the physical spread of farming societies versus the transmission and adoption of Neolithic innovations amongst indigenous hunting societies. While Ammerman and Cavalli-Sforza have been careful to acknowledge the diversity of the processes that might have been involved in the Neolithic transition in Europe, and to recognise a role for indigenous peoples in that process, some of the geneticists who have followed in their wake have tended toward a more categorical view (*Cavalli-Sforza 2003.303*). Recent publications by Barbujani and Dupanloup (2002), and by Chikhi (2002), seem to imply that demic and cultural diffusion are polar opposites, and that if the presence of substantial Near Eastern genetic material attributable to a post-Palaeolithic horizon can be identified in Europe, the Neolithic must have spread into the continent primarily, or exclusively, by population movement.

At a philosophical level, many of the difficulties that we encounter in trying to reconcile archaeological and genetic evidence arise from the ways in which we conceptualise past human communities and populations. Here, archaeology must take much of the blame for developing and perpetuating the image of human groups as self-contained and bounded entities. It is instructive to remember that Gordon Childe formalised the notion of the archaeological culture precisely in the context of his study of the early agricultural societies of south-east and central Europe, in work that led up to the publication of *The Dawn of European Civilisation* (Childe 1925) and *The Danube in Prehistory* (Childe 1929). While Childe was adamant that culture and race did not coincide (1950.1), and even though he was an enthusiastic proponent of cultural diffusion, he none the less instituted the expectation that a variety of different aspects of human identity should be congruent, so that definable distributions or assemblages of artefacts could be identified as the material signatures of 'peoples' who existed in the past (*Jones 1997.17*). I would argue that this is an understanding that arises from the modern experience of living within the nation-state, where political, ethnic, linguistic and expressive entities are generally bounded at the same level. This, then, grounds our expectation that in prehistory we should be dealing with neatly bounded social units (*Thomas 2004a.Ch. 5*). Of course, such an emphasis on bounded and inter-

nally homogeneous social wholes was by no means exclusive to culture-historic archaeology: it was also a hallmark of much processual archaeology (*Brumfiel 1992*).

### Indigenism and evolutionism

One of the most innovative and attractive aspects of Ammerman and Cavalli-Sforza's work was that it challenged both the culture-historic image of bounded ethnic groups in prehistory, and the processual vision of autonomous communities in parallel evolution, influenced only by environmental selective pressures. As they point out, their initial papers were written at the high point of anti-diffusionist sentiment in archaeology, the time of 'the autonomy of the south-east European copper age' and of 'Wessex without Mycenae' (*Cavalli-Sforza 2003.299*). More recently, Albert Ammerman has explicitly juxtaposed the internationalist aspect of a perspective based on demic diffusion, spreading agriculture across the continent in a wave of advance, with what he calls 'indigenism' (*Ammerman 2003.4*). Indigenism holds not only that each society is independent and autonomous, but also that its development can be attributed to internal processes, or to its specific relationship to its environment. As such it chimes with the culture-historic image of the bounded cultural unit, and shares its affinity with nationalistic approaches, which often hark back to a mythical golden age of ethnic homogeneity (*Gellner 1983.57*). Each nation has its own tribal ancestors, who were responsible for their own independent domestications, and their own rise to statehood. So at a time of heightened friction between the western and Islamic worlds, Ammerman is absolutely correct to emphasise the importance of a Near Eastern contribution to the European genetic inheritance.

But on the other hand, there is the equal and opposite danger of a crude social evolutionism which presents hunters and farmers as representatives of different stages of cultural development (*Borić 2005; Warren 2005; etc.*). While demic diffusion is a population model, the peril is of casting hunters and gatherers as passive and powerless in the face of the oncoming Neolithic steamroller, while the farmers are active and dynamic, even if only in demographic terms (a position apparently adopted by *Rowley-Conwy 2004.97*). Mesolithic populations are thus understood as being 'absorbed', 'incorporated' or 'recruited'. Here again, we are faced with a problem of scale, for while there is a virtue in describing and explaining a pattern at a pan-European level, it

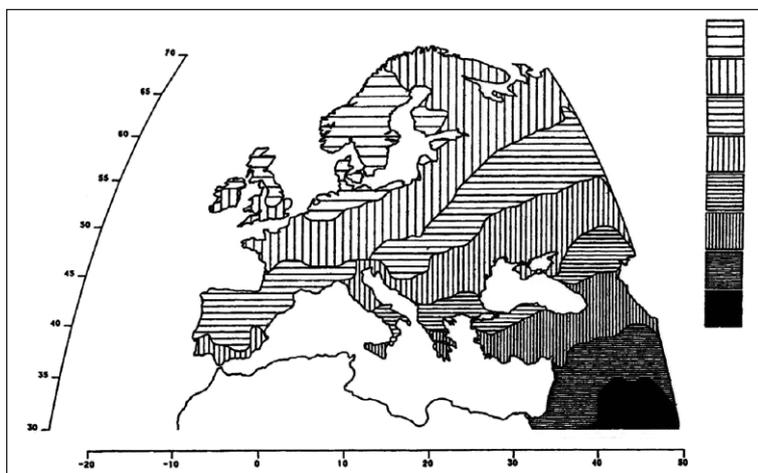
leaves little space for any consideration of agency and contingency: outcomes that could have been otherwise, and decisions made in the context of inherited historical conditions. So the fate of hunting and gathering groups appears determined and unavoidable. Similarly, by discussing the change from Mesolithic to Neolithic at a continental scale, such models run the risk of relying on stereotypical and over-generalised models of hunters and farmers. Yet as we are well aware, prehistoric Europe contained colossal variation, between mobile and sedentary hunter-fisher-gatherers, and between tell-based, longhouse and broad-spectrum forms of the Neolithic (Zvelebil 2004:45). It may be that in the near future the questions that genetic information will be able to help us unravel are ones concerned with the kinds of interactions that took place between these diverse communities.

Of course, most authorities now maintain that the Neolithic transition in Europe involved some combination of population movement and acculturation, as in the framework that Marek Zvelebil describes as 'integrationism' (2002:397). Zvelebil suggests that we should imagine a mosaic of different processes, ranging from demic diffusion to leap-frog colonisation, frontier mobility, contact and exchange. I would very much concur with him, but would wish to add a further element to the argument. Zvelebil described a series of different mechanisms by which agro-pastoral farming expanded. I would like to question whether it was necessarily the same *thing* that was expanding throughout, or whether the Neolithic did not undergo a series of fundamental transformations in the course of its translocation (see, for example, Arias 1999:445). The key question is whether there

was a single, constant causal motor for change throughout, such as population growth. I am inclined to doubt this. While in some areas a strong argument can be made for density-driven expansion (*cf. Van Andel and Runnels 1995:498*), in others it may be that processes were at work to which agriculture was no more than incidental. That is to say, in some parts of Europe the Neolithic may have represented as much an identity process as an economic package.

### The indigenous component

One of the original reasons why the demic diffusion model was considered pertinent to the spread of the Neolithic was that the process was evidently so slow, apparently progressing at around 1.1 kilometers per year over a period of more than two and a half millennia (Ammerman and Cavalli-Sforza 1971:684). By contrast, the cultural transmission of innovations might be expected to have proceeded much faster. But again, this neglects the agency of hunter-gatherers, who appear to have resisted the adoption of agriculture under some circumstances. In order to spread from one community to another, a cultural innovation needs to confer some perceived advantage on the recipient. Agriculture is somewhat ambivalent in this respect: it brings the advantages of higher yield and lower risk, but it might easily be recognised as corrosive of a hunter-gatherer way of life in restricting mobility and personal autonomy, imposing greater labour investment, and transforming property relations. There is certainly good ethnographic evidence of communities resisting economic and technological change for social and cultural reasons (*e.g. MacCormack 1978*).



**Fig. 1. Synthetic map of the first principal component of variation in 95 classical genetic markers (from Cavalli-Sforza et. al. 1994, copyright Princeton University Press).**

Now, of course, the first principal component of protein genetic markers shows a gradient across Europe, from south-east to north-west (Fig. 1), and Cavalli-Sforza explains this in terms of the combination of demic diffusion and recruitment or acculturation, so that as the wave of advance swept westwards the expanding Neolithic population would have been characterised by a greater and greater proportion of indigenous genes (Cavalli-Sforza 2002:82). At the peripheries, Neolithic people would have been largely 'Mesolithic' in genetic terms, and there appears to be a level of agreement between classical markers, mitochondrial DNA

and the Y-chromosome in suggesting roughly a 20% Near Eastern Neolithic contribution to the overall European gene pool (*Underhill 2002; Richards 2003*). However, this is another instance in which the broad picture of human genetics and the fine grain of archaeology rub up against one another, because for a specialist in the study of the British Neolithic the critical issue is that of what transpired when these population processes washed up against the Atlantic façade. At this point the Near Eastern genetic inheritance becomes so etiolated as to be virtually invisible. Neither classical markers nor Y-chromosomes detect any 'Neolithic' presence in Britain, yet it is of considerable importance to consider what this non-presence represents, and what the processes might have been that gave rise to it.

For instance, in proposing a 'staged population interaction' wave of advance, Colin Renfrew (*2002.100*) argues that a process of demic diffusion and the incorporation of hunter-gatherers might have continued uninterrupted beyond the point where any of the genes of Near Eastern framers were present. Martin Richards, however, indicates that this is not compatible with the mitochondrial DNA evidence (*2003.153*). On the other hand, there is the suggestion that the classical marker plots represent palimpsests of a series of north-westerly population movements throughout pre- and proto-history, which potentially reduces the impact of Neolithic population movement (*Zvelebil 2002.385*). Perhaps most interesting is Richards' suggestion that mitochondrial haplogroups J1a and J1b may relate to the very swift dispersals of the Cardial complex and the *Linearbandkeramik*, at speeds swifter than those predicted from demic diffusion (*2004.152; Sykes 2003.323*).

This is significant because it harmonises both with the idea of the Neolithic transition as a patchwork of diverse population processes, and with that of alternating phases of rapid expansion and prolonged standstill. Some of these episodes of expansion may represent so-called leap-frog colonisation, which I take to be comparable with the modified form of demic diffusion described by Van Andel and Runnels (*1995.495*) in the earliest Neolithic of Greece: the selective and targeted colonisation of optimal areas. However, we should be wary of assuming that such processes were homogeneous, for while there may be a case for such colonisation in Thessaly, sites like Franchthi Cave may indicate a degree of continuity from Mesolithic to Neolithic, although the extent of this is open to debate (*Thissen 2000*). Similarly, the very particular locational preferences demonstrated

by LBK settlements in central and western Europe, and the extensive unoccupied areas between settlement cells might be indicative of swift expansion into favourable landscapes rather than slow, population-driven movement (*Lüning 1982.14; Bakels 1982*).

Recently, Chris Scarre (*2002.400*) has suggested that the Villeneuve-St-Germain sites of Normandy and the Loire might represent small and dispersed pioneer agricultural groups, who moved into areas of the landscape which complemented those occupied by hunters and gatherers (Fig. 2) (although other authorities argue that the VSG groups were themselves indigenous, and that their somewhat disparate long-houses represent *copies* of Danubian prototypes: Jeunesse, *pers. comm.*). Scarre implies that these communities were effectively absorbed by the Mesolithic population, but it is arguable that *both* groups contributed the subsequent formation of the Cerny group (*Cassen 1993; Scarre 1992*). Similarly, in east-central Europe, Nowak (*2001.582*) describes a situation in which distinct *enclaves* of Neolithic settlement existed in the period between 5600 and 4800 BC. These were migrant *Linearbandkeramik* groups and their successors, who settled on areas of highly fertile soil, creating 'small islands of farmers in the immense sea of foragers' (*Nowak 2001.590*) (Fig. 3). In a process analogous to that in western France, it was only when the indigenous communities began to make extensive use of domesticates and Neolithic artefacts that a more culturally homogeneous landscape began to develop, with the formation of the TRB.

In Britain, similar arguments have been made concerning the arrival of pioneer Neolithic groups (*Sheridan 2000; 2003; 2004*, for example), but it is arguable that they are far less convincing. In contrast to the west French or east European examples, there is no clear evidence for the coexistence of Mesolithic communities and Neolithic enclaves, and the start of the Neolithic was abrupt and uniform. Indeed, it is the complete and sudden disappearance of the Mesolithic assemblage in Britain that is the most remarkable aspect of the period, and it is my belief that it can only be explained by a transformation that the Mesolithic population were themselves instrumentally engaged in. While this may not have involved the movement of entire population groups as distinct entities from the continent to Britain, it is extremely likely that the exchange of personnel between groups took place both during and prior to the transition. For, while the manufacture of new stone tool types

and conceivably aspects of animal husbandry might have been learned by indigenous people, the techniques of potting and cereal cultivation are more likely to have been transmitted by inter-marriage or prolonged visiting and apprenticeship. While it has conventionally been maintained that Britain and Ireland had no contact with the European continent during the later Mesolithic (*e.g. Jacobi 1976*), this argument has been made on the basis of the morphological distinctiveness of microlithic assemblages. Yet the degree of similarity of artefacts *cannot* be taken as an index of the degree of interaction between social groups, while there is now evidence of the presence of domesticated cattle in Mesolithic Ireland (*Woodman and McCarthy 2003*), demonstrating that indigenous hunter-gatherers did have some dealings with continental Neolithic groups (see *Thomas 2004b* for more detailed discussion). This means that the transfer of domesticates and Neolithic material culture into Britain is likely to have taken place in the context of long-established relationships with continental communities. In this connection, it is important to remember that most of the Neolithic groups that existed along the Atlantic coasts facing the British Isles by 4000 BC (in Brittany, Normandy, the Low Countries, Northern Germany, Denmark and southern Sweden) were most likely indigenous peoples who has adopted a new way of life through acculturation or appropriation (*Arias 1999:432*). Their connections with British hunter-gatherer societies are therefore likely to have been long-established.

### Frontiers, interaction and hybridity

These arguments suggest that our investigation of the genetics of prehistoric communities in Europe needs to take more account of what happens when personnel are exchanged between spatially juxtaposed communities which are not bounded but permeable. After all, recent strontium isotope analysis by Bentley et. al. (*2003*) on skeletons from Vaihingen and other LBK sites in Germany suggests that between 30 and 50% of the burials there were of non-local origin, putatively Mesolithic people who had married in to the community. This was happening not in the context of expansion, but of a period of prolonged stasis in which some form of interaction took place between Mesolithic and Neolithic communities. It is these extended periods during which the Neolithic did not expand that I want to emphasise. Recently, Dušan Borić (*2005*) has offered a cogent critique of the post-colonial assumptions implicit in the notion of a 'frontier' between Mesolithic and Neolithic groups in Europe. He argues that such a model reinforces a dichotomous relationship between two essentialised and ahistoric ideal types, hunters and farmers, and that it implies a social evolutionary scheme in which the replacement of foraging by farming is an inevitable outcome. As an alternative, Borić presents an account of Lepenski Vir in which multiple, complex identities existed side by side (*2005:99*). Undoubtedly, Borić is correct to reject the view that the Mesolithic and the Neolithic re-

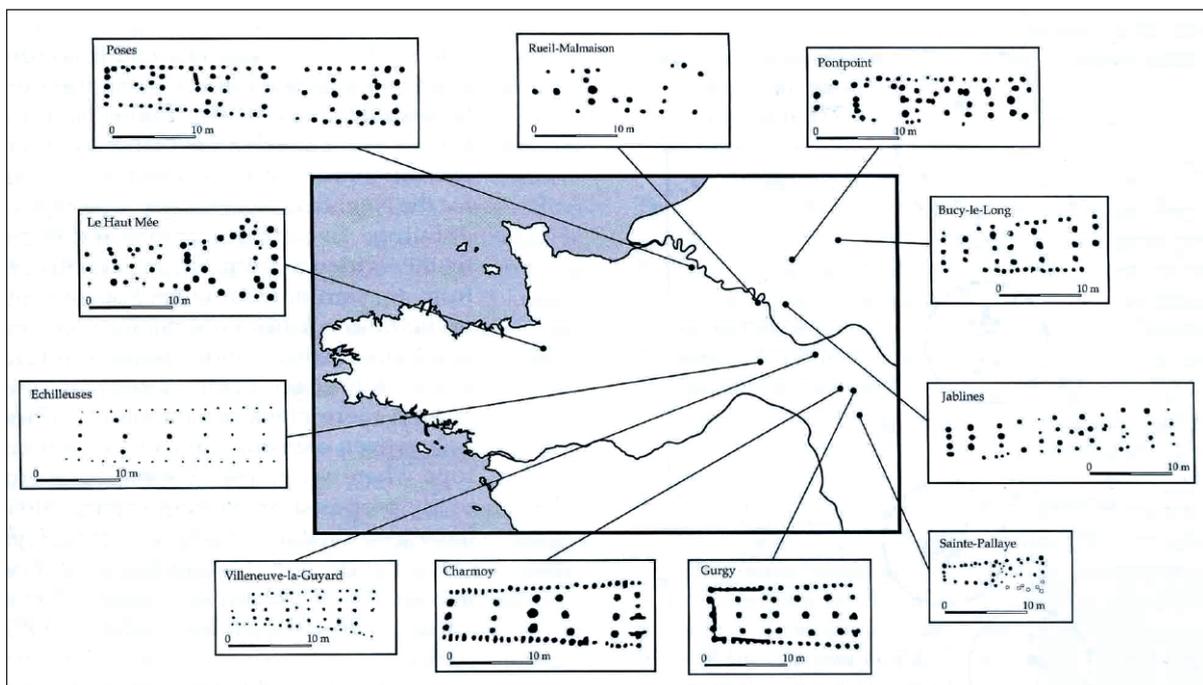


Fig. 2. Villeneuve-Sain-Germain longhouses in northern France (from Scarre 2002).

presented two fixed and opposed entities. However, it may still be worth retaining the terminology where we acknowledge that sixth-fourth millennium BC Europe was a patchwork of different *kinds* of Mesolithic and Neolithic societies, each of whose social and economic arrangements were continually open to transformation.

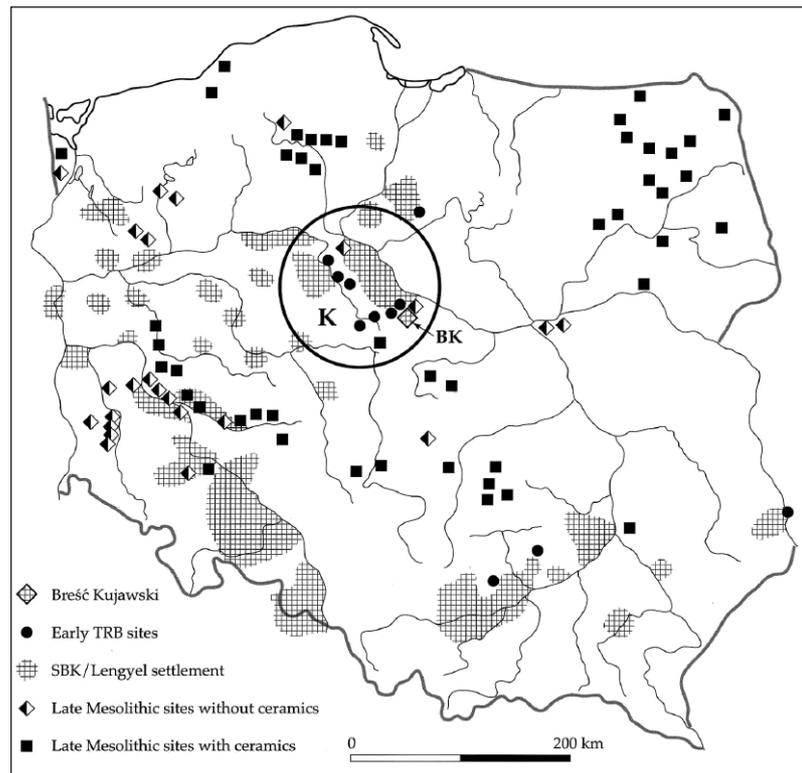
Wherever formally 'Mesolithic' (that is, indigenous hunter-fisher-gatherer) and 'Neolithic' (having access to domesticates, ceramics and polished stone tools) communities came into spatial juxtaposition, the potential was created for social interaction and cultural innovation. The 'frontier' between such groups is best seen as a zone in which unpredictable social and cultural exchanges might take place: possibly violent (Gronenborn 1998), but also potentially creative and transformational. It is unhelpful to think

of such interactions as taking place under the sway of a 'law of cultural dominance' (Sahlins and Service 1960.69), in which the 'inferior' Mesolithic was always influenced or dominated by the 'superior' Neolithic. Rather, the encounter might affect either group equally, through a process of hybridization or creolization of cultural repertoires that were never 'pure' to begin with. Thus, while hunter-gatherer groups in central and northern Europe adopted ceramics and other Neolithic innovations, it is arguable that in the post-*Bandkeramik* era, the various forms of Neolithic that emerged incorporated elements of a Mesolithic cultural inheritance (Arias 1999.445). Simply because societies that used ceramics, polished stone tools and domesticates eventually replaced aceramic hunting and gathering groups across much of Europe, we should not accept the teleological argument that this was the only possible outcome.

I suggest that through these episodes of interaction at relatively long-lived 'frontiers', indigenous groups acquired and assimilated new cultural and material resources, but in addition the Neolithic was itself repeatedly transformed. There are a series of reasons why such situations of contact and interaction might persist over lengthy periods: where pioneer farmers operated under conditions in which land and re-

sources were plentiful, and had no need to expand further; where populations of hunter-gatherers were dense, and operated elaborate subsistence regimes; where physical circumstances restricted the expansion of farming economies; and where economically diversified Mesolithic groups would have perceived no benefit in adopting new resources and technology or being incorporated into different cultural or symbolic regimes.

There are at least three distinct areas in which we can identify such phases of standstill and interaction. The first would be following the following the establishment of the Neolithic in the northern Balkans, where Esther Bánffy (2004.57) points to prolonged contact between Starčevo farmers, Körös communities who may have been of indigenous origin but who combined the use of wild and domesticated resources, and Mesolithic hunters in Transdanubia during the earlier sixth millennium BC (see also Whittle 2005). Out of this interaction emerged the earliest *Bandkeramik*, which combined elements of the Starčevo ceramic tradition with timber longhouses. The longhouse implies the formation of an entirely new mode of sociality: not the imposition onto central Europe of a Balkan model, but something that developed in the protracted negotiation



**Fig. 3. Poland at the time of the formation of the TRB, showing 'enclaves' of SBK/Lengyel Neolithic settlement in relation to Late Mesolithic sites (from Zvelebil 2004).**

between hunters and farmers, and which facilitated the subsequent pioneer expansion into the loess country of Europe north of the Alps and Carpathians (Gronenborn 1999). Similarly, in the period following the *Bandkeramik* expansion we can identify parallel processes in western France and the North European plain which began with the exchange of ceramics, stone tools, livestock, furs, and presumably also personnel between Neolithic and Mesolithic communities, and culminated in the formation of hybrid forms of sociality which drew on both traditions, with Cerny and the earliest TRB (Domanška 2003; Nowak 2001; Zvelebil 2004.51). Just as the formation of the LBK introduced an entirely new social focus and forum in the shape of the longhouse, so with Cerny and TRB it was monumental funerary architecture that was central to a new kind of social life (Midgley 2005.36). Again, I would stress that this was a transformation of the Neolithic, arising out of interaction, and introducing elements which had simply not been there before.

It was the development of a new form of Neolithic, in which kin relations were expressed through mortuary monuments as much as in the domestic context, that facilitated the final phase of the Neolithic expansion in Europe: into Scandinavia and the British Isles. Here the process was more thoroughly one of acculturation than elsewhere (Price 2000.299). It is important to note that the significance of domesticated species altered subtly at this point. Where agriculture spreads by population movement, we might expect domesticated plants and animals to form an integrated food-production system, and to represent staples. However, where we have populations of hunter-gatherers who have a stable economic base of their own, the initial occurrence of domesticates beyond the 'agricultural frontier' is likely to be as exotica and novelties. Interestingly, there is a growing pattern of the identification of domesticated

cattle in pre-Neolithic contexts in southern Scandinavia, southern Brittany, the Rhine Basin, the Alpine foreland, northern Poland and Ireland (Zvelebil 2004.49; Woodman and McCarthy 2003). In the Mesolithic context, the acquisition of a single domesticated cow and its slaughter for communal consumption might have had an appreciable impact on local social relationships, in terms of status, prestige and personal obligation. It is arguable that the penetration of north-west European Mesolithic societies by Neolithic systems of consumption and prestige was one of the mechanisms that led to their transformation. But as we have stressed above, it should not be presumed that this was a one-way process, for the acquisition of goods and raw materials, and the incorporation of personnel from Mesolithic communities would have held a transformative potential for Neolithic societies.

Clearly, the societies that inhabited northern and western Europe between the sixth and fourth millennia BC were diverse in terms of their various combinations of hunting, gathering, fishing, herding and horticulture, their material culture, and their social organisation. The contacts and relationships between these groups will have been more complex still. The articulation of social reproduction and social interaction will, under these circumstances, have resulted in elaborate sequences of non-reversible historical change. I have dwelt on all of this complexity because each of these processes will have had their own demographic consequences and correlates. The patterns that we observe in the DNA evidence are the outcome of these processes, overlaid with four millennia of further developments. There remains a massive contribution that human genetics can make to the study of this period, but it may be that it is now time for it to address a finer-grained picture of the Neolithic transition.

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