

BETWEEN GELEEN AND BANPO

THE AGRICULTURAL
TRANSFORMATION OF
PREHISTORIC SOCIETY,
9000 - 4000 BC

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INTRODUCTION

The first millennia after the end of the last glacial saw a fundamental change in people's way of life. The hunter-gatherers adopted a new subsistence system, based on crop cultivation and stock keeping. From a few key centres this new lifestyle spread across the entire world, in phases and in numerous different expressions, but at an unrelenting pace. The term 'agricultural revolution' was at some stage coined to describe this process, but that led to criticism from scholars who found it incorrect to refer to such a gradual process, which had taken such a long time as a 'revolution'. Be that as it may, the agricultural transformation of prehistoric society remains one of the most fundamental changes, especially because of its unforeseen consequence of the development of increasingly complex forms of society.

In regional prehistory all over the world much attention is paid to describing the process of this transition and its dynamics - did it involve immigration or 'only' a change in culture? - and to explaining how and why it occurred. For a proper understanding of this process we should, however, not regard the developments that took place in our own region, or even its immediate surroundings - in my case the Netherlands and Northern Europe - in isolation, but should instead see them as specific expressions of a widespread, universal cultural process of change. Only then can we assess whether the developments in our own field of study may be termed exceptional, or on the contrary representative, and can we choose between general and culture-specific explanations for what took place.

This rather ambitious task I set myself forced me to move beyond the field of my own research into an area involving a body of literature far too vast for one person alone. I profited from the earlier Kroon Lecture by David Harris (1990) and made much grateful use of the volume recently published by him (Harris ed. 1996). The outcome of my efforts I would class as a finger exercise rather

than a definitive discourse - nothing more than a rough, incomplete and first attempt to view our *Bandkeramik* and Swifterbant communities in a wider context.

DEVELOPMENTS IN THE NETHERLANDS

The arrival of the Bandkeramik

A very long time ago in our eyes, but only very recently on the timescale of human existence, 5300 years BC to be exact, our corner of Europe was for the first time confronted with farmers. Communities which we refer to by the term *Bandkeramik* settled on the loess in the lower Rhine Basin, in particular also in the southern part of the Dutch province of Limburg, along the margins of the Graetheide plateau, at Geleen, Elsloo, Sittard and Stein (Modderman 1985, 1988). Many archaeologists have used these farmers to model the European Neolithic, probably because they are so accessible and left behind such a clear, highly detailed archaeological record. We should, however, realise that from a European Neolithic perspective they are actually rather exceptional - very extraordinary in fact. In the eyes of the native occupants of our parts they will have been exotic foreigners, though the natives will have seen them coming long before they actually reached the Netherlands.

The *Bandkeramik* people were farmers: they had familiar (dog, cattle, pig) and hitherto unknown (sheep and goat) domestic animals, grew exotic crops, ground grain in their large hand querns and spent little time hunting. Within their community they distinguished themselves with ornaments made from Mediterranean *Spondylus* shells, symbolising their relations with their homeland, and adzes made from exotic amphibolite and basalt. The most conspicuous aspect of these new arrivals was, however, their passion for digging large pits, chopping and felling trees. They settled in the dense virgin forests and felled lime trees to create large clearances for their fields. They also chopped down colossal oaks and cleft the trunks into manageable pieces of timber which they transported back to their settlements. There they used the

wood to build their exceptionally sturdy longhouses and long palisades, and incidentally to line deep wells. They dug clay from deep pits to plaster the walls of their dwellings. None of this had ever been seen in Europe before.

Whether or not the *Bandkeramik* people lived in *permanent* settlements has recently once again become a topic of debate (Whittle 1996, 160). It has been argued that it is not really possible to prove that a settlement was occupied on a permanent basis, but this argument was put forward in a context in which the alternative seems plausible as well (Belfer-Cohen 1991, 177, quoting C.P. Edwards). In the case of the *Bandkeramik*, with its agricultural system, its continuity of site location embracing many centuries and the *landnam* identified in pollen diagrams there, however, seems to be little sense in reopening the *Wanderbauern* discussion (Modderman 1971).

The *Bandkeramik* culture continued almost unchanged for 400 years, but then - in the Netherlands in particular - there was a crisis. The system of the Rössen people that replaced it seems to have been more flexible, but its buildings were even more formidable, and that, too, eventually came to an end. A new transformation led to a society with an entirely different structure in which we recognise very little of the *Bandkeramik*, but I will return to this later.

In cultural terms, the Dutch *Bandkeramik* came from 'the east', more precisely the northwestern part of the Hungarian Plain, where late Starčevo communities had a few centuries earlier transformed into what is known as the *earliest Bandkeramik*. This transformation might have resulted from a change in contacts with the neighbouring native population, the incorporation of native know-how in new knowledge systems, adaptation to the wet, Atlantic conditions and the development of a sustainable arable system specifically suited to the dense deciduous forests of the Central European loess. It was in that area that the soundly built longhouses with their indoor storage facilities were developed and settlements with a spacious layout, which differed

markedly from the former small huts in compact settlements on tells. We may assume that the occupants of these longhouses had to breed new varieties, better suited to the cold, wet conditions of Western Europe, of what had originally been Mediterranean crops - this will indeed have been inevitable, but it is not visible in the archaeological record. This is incidentally no call for alarm, for there are so many things that are archaeologically invisible.

The native hunter-gatherers

Wherever they arrived, the *Bandkeramik* people were confronted with a native population whose economy was based on gathering, fishing and hunting. In the Low Countries, this population is at this time as invisible as almost anywhere else. Very few sites have been dated to this period and at those sites only flint has survived.

I will here pass by the communities concealed behind the La Hoguette pottery. In my opinion, the chrono-typological arguments for regarding La Hoguette as a derivative of late Cardial Ware are valid. Those arguments, and the almost complete absence of independent settlements, lead me to support the idea that the La Hoguette pottery was produced by mobile groups of ceramic foragers or nomadic shepherds with contacts in the western Mediterranean who came into contact with the earliest *Bandkeramik* colonists at the northern boundary of their distribution area. Some specific characteristics of the western *Bandkeramik* - Y-shaped arrangements of house posts and poppy seed - may be ascribed to this confrontation. The camp or settlement that yielded La Hoguette pottery at Sweikhuizen and the flint connections between the earliest *Bandkeramik* in Hessen and the southern part of Limburg can then be seen to foreshadow the arrival of the *Bandkeramik* (Lüning, Kloos & Albert 1989).

It is only since the excavation at Hardinxveld in 1997-'98 that we have at least some evidence from which to reconstruct the Late Mesolithic population in the Netherlands, thanks to this wetland

site's excellent preservation conditions and in spite of the fact that this location, on top of a former dune surrounded by swamps, must have had a special function in the original settlement system. The site was used for several centuries between 5300 and 4700 BC, seemingly with some breaks in occupation. The occupants practised hunting (of beaver, otter, red deer, wild boar, waterfowl, *etc.*) and fishing. At this distance from the loess there was only very little influence from the farmers. No remains of field crops have been found and the only domestic animal was the dog. The site yielded one remarkable find showing that there were indeed contacts with the farmers, notably a true *Bandkeramik* arrow head, recovered from a level dated to *c.* 5000 BC. The bone and antler industries fit in well with our general picture of the northern Mesolithic and the later Neolithic of the delta, but the antler tools show a clear style of their own: many of the axes are actually nothing more than axe *blades*. They were not perforated, but were evidently hafted in perforated wooden handles, just like Neolithic stone axes. They give the assemblage an original character. Together with wooden artefacts, paddles and one half of a bow, they constitute an impressive, complete Late Mesolithic inventory. A spectacular discovery were the burials of a few human beings and dogs. These burials - may we class them as (part of) a cemetery? - suggest that the site was a base camp rather than a hunting station. Another argument supporting this interpretation is that the only complete skeleton belonged to a comparatively old woman. This surprising discovery makes us see the later occupation phases of the submerged dunes in a different light. On the other hand, this evidence agrees well with the finds from Swifterbant and their interpretations. The burials and burial traditions show a remarkable resemblance to traditions in southern Scandinavia, in particular the cemeteries of Vedbaek and the contemporary Skateholm on the coast of Skane, where dogs were also buried (Larsson 1990; Albrethsen & Brinch Petersen 1977; Kannegaard Nielsen & Brinch Petersen 1993). In this respect the Dutch hunter-gatherer communities seem to

have been members of a single, large, northern population. However, as we will soon see, they reacted to the farmers' arrival in an entirely different way.

The toiling *Bandkeramik* farmers, whose lifestyle contrasted so markedly with the hunter-gatherers' life in plenty, will have inspired awe and admiration in the native population. Where the latter were at one with nature, the *Bandkeramik* farmers, in their self-created culture enclaves in the forest, personified the contrast between nature and culture. It is no coincidence that Hodder (1990) used precisely the *Bandkeramik* in illustrating his *domus:agrius* dichotomy and his view of a Neolithic 'domestication of Europe', which is much less applicable to the later Neolithic. It is the contrast between a native attitude, rooted in the North European Mesolithic, and ultimately in the hunting communities of the West European Late Palaeolithic, with - we assume - well-developed native knowledge systems on the 'wild' of which they formed part, and an implant from the east, with a successful, but highly artificial subsistence system they themselves had created. This system was indeed so specific that, as a whole, it was evidently not considered suitable for adoption by the native population living in ecological conditions that differed substantially from those of the loess. In the natives' eyes the *Bandkeramik* farmers must have been strange specimens.

Contacts

Material evidence for contacts between the *Bandkeramik* farmers and the northern population are the farmers' typical adzes, which have been found scattered in small numbers all over the sandy part of the Netherlands. Their characteristic arrow heads have been found in somewhat greater numbers. One of the most informative sites is Weelde-Paardsdrank, which has been dated to this period and which yielded points resembling those of the *Bandkeramik* (Huyge & Vermeersch 1982). *Bandkeramik* remains are somewhat better represented in a zone up to 30 km to the north of the boundary of the loess. Here, too, we find small

settlements with pottery and complete flint tool kits. These two different interaction zones suggest different processes, the most plausible being movements of people and cattle for the first zone, hunting expeditions and exchange relations for the wider zone. In the Rössen period the relations intensified and came to embrace larger areas. The Rössen *Breitkeile* have been found in relatively large numbers and up to the southern parts of Sweden. Typical Rössen pottery was also imported into the northern regions, for example to Aalten in the Netherlands, to Hüde I on the shore of lake Dümmer in Lower Saxony and further north to Hamburg-Boberg. Inspired by this novelty - we assume - the hunter-gatherers also started producing pottery around 4800 BC. They used a very simple technology of their own, based on coil construction, possibly derived from native basketry, to produce distinct, very simple types, which appeals greatly to our evolutionary subconscious. Around 4200 BC or possibly slightly earlier they finally started keeping domestic animals and growing crops, too. This process seems to have occurred earlier, and with more drastic consequences, in the southern part of the Netherlands, which was then incorporated into the flint network of the mines in the chalk regions. To the north of the major Dutch rivers things went much more slowly. Cattle and crops were incorporated into the existing system with virtually no indications of any social reorganisation. This led to a semi-agricultural society in which Mesolithic and Neolithic elements were united in an original package: the Swifterbant culture. Outside the Netherlands, the British Isles and Denmark, in contrast, witnessed a drastic cultural transformation that resulted in a complete, new 'Neolithic package' with a distinct, new pottery style, impressive megalithic burial monuments, large, complex central sites and deep flint mining. While the flow of information to the north can be fairly well followed in the material remains, which seem to suggest a high degree of social continuity, the reverse holds for the south. There is no material evidence for any flows of information or know-how

from the hunting communities to the farmers, but there are indications that the farmers underwent at least two crises, each resulting in a differently organised society with a different settlement structure and settlement system. Many aspects of the Rössen complex betray its *Bandkeramik* origins, but the Michelsberg culture is fundamentally different (Louwe Kooijmans 1998).

For a long time the farmers on the loess and the foragers on the northern sandy soils continued to live side by side in this manner. In archaeological terms there was a stationary boundary, whose position changed slightly from time to time and which was not 'closed' but 'permeable', and became increasingly permeable through time, incidentally without any degree of cultural merging - quite the contrary in fact. In the Netherlands, this boundary was to persist for 2000 years, in Denmark and along the English Channel for over 1000 years.

Zvelebil (1986) distinguishes three zones at this boundary, and three corresponding phases in the neolithisation process:

- a first, 'availability' phase, in which there were cross-boundary contacts and goods may have been exchanged, but crop cultivation and animal husbandry were not yet adopted;
- a second, archaeologically rare and hence probably the shortest, 'substitution' phase, in which 5-50% of the economy was based on animal husbandry (as expressed in numbers of recovered bones);
- a third, 'consolidation' phase, in which farming dominated the economy.

This three-phase approach aptly characterises the situation, but does not explain it. At the end of my presentation I will attempt to explain why things happened the way they did.

At Leiden, we try to map this boundary and to describe and interpret the developments. Our research efforts focusing on this topic are divided between three different landscapes. Our excavations in the loess region, of the early *Bandkeramik* settlement at Geleen-Janskamperveld and the Rössen settlement

at Maastricht-Randwyck, the Michelsberg sites at Maastricht-Klinkers and Maastricht-Vogelenzang, are teaching us a lot about the farmers. A similar research programme focuses on the Rhine/Meuse delta, with its well-preserved remains of the northern wetland population. A key concern in this research are currently the occupation remains on the tops of submerged dunes, which illustrate social developments embracing 3000 years, from the Late Mesolithic to the end of the Neolithic, from 5500 to 2500 BC. An essential link between the southern loess and the northern wetlands, finally, is our major Meuse Valley project, comprising the scientific study of the thousands of flint assemblages found on the sandy soils in their environmental setting (Louwe Kooijmans 1993).

A WIDER CONTEXT

As a consequence of the long history of research and the rich, varied evidence, but also of our own scientific position and our Europe-centred view of the world, we tend to think that we are studying and interpreting *the* Mesolithic/Neolithic transition. We are inclined to see the North European situation as representative of the transition from foraging to a farming way of life. This is true especially where southern Scandinavia is concerned, whose Mesolithic substrate is exceptionally well known, whereas evidence on this period is often very scarce elsewhere. Zvelebil (1996, 323), for example, regards the Baltic as a '*key area for our understanding of the process of "neolithization" in Europe and of the agricultural transition in general*'. This he bases on the fact that in this area the transition took place slowly, and relatively recently, so the process can there be studied with a finer resolution than elsewhere. His second argument is that the native Mesolithic foragers of southern Scandinavia were to some extent involved in this process. But neither argument seems to cut ice, for was the process of neolithisation indeed a single process, or perhaps a whole mosaic of processes? And were native people not involved in it to the same extent elsewhere? Price (1996, 347) argues very similarly:

'If we cannot shed light on the question of agricultural transition within the evidence from southern Scandinavia, we may not be ready to resolve it anywhere.'

As interesting as this may be, we should ask ourselves first of all whether we may at all speak of *the* transition and, secondly, to what extent the specific Baltic case and the long-term stationary relationship in our part of the world are to be considered representative of the process as a whole. We must of course try to understand the developments that occurred in Northern Europe, but we must also realise that specific structuring processes will have taken place there, too.

The agricultural transition occurred after more than 2,000,000 years of living off what nature had to offer, after twenty glacials and interglacials, and after 150,000 years of *Homo sapiens sapiens* in Africa and 50,000 years outside there, too. It is a phenomenon, a cultural and social process of change never before witnessed, for it of course involved not only straightforward subsistence, but also the entire world of ideas associated with farming. It is a cultural revolution which must directly or indirectly be connected with the end of the last glacial, but also with modern man's culture. Hole (1996, 263) writes (on stock keeping):

'As with agriculture, one of these (reasons) must be "cultural" ... because any imaginable external factor (all of which start with hunger) must have existed many times during the long course of human history, yet none of these prior events resulted in domestication.'

Uerpmann (1996, 232):

'If herbivore (sheep and goat) domestication had happened as a deliberate, rational response to protein shortage (for whatever reason), then it would surely have happened much earlier, at many places in the world, and to more species than just sheep and goat, which - to our present knowledge - were the first domestic herbivores. We must continue, therefore, to look for a constellation of circumstances that made the improbable possible.'

Farming was a fundamentally novel subsistence system based on tilling the soil, sowing and planting, and breeding and herding tame, domesticated animals. A key concept is domestication, an early form of genetic engineering: intervening in the reproductive behaviour of plants and animals for the purpose of changing their outward appearance and their behaviour. Plants and animals consequently became more or less dependent on man for their survival. I am here deliberately avoiding the terms 'food production' and 'storage', because there was in this respect only a difference of degree with respect to the foraging communities, who are commonly assumed to have practised an intensive form of exploitation which also included 'cultivation' - caring for and promoting the growth of natural food resources - and sometimes also storage.

So actually there are two questions that need to be answered. First of all: where, when and why did people independently adopt agriculture and, secondly, why this new way of life was so irresistible that people all over the world switched to it within the relatively short span of several millennia, except, apparently, in the Netherlands?

POSTGLACIAL FORAGERS

So the agricultural transformation occurred in the postglacial hunter-gatherer communities. What was special about them and to what extent did they differ from previous hunter-gatherers?

At the end of the last glacial, in the early Holocene and in some places even earlier, comparable reorientations from a more specialised to a more generalised subsistence strategy occurred in regions lying very far apart. This must have been a reaction to the drastic, favourable environmental changes that occurred in that timespan. Those changes had the greatest impact at comparatively high latitudes, but the same trend is also observable in certain (semi-)arid areas at lower latitudes. Common characteristics of the communities living in these areas are a broad-spectrum economy, concentrating on aquatic resources, a trend towards se-

dentism, domestication of the dog, the development and - non-universal - use of polished stone axes and pottery, querns and storage facilities. The communities to which I am referring are the Natufian of the Near East (from 11,000 BC), the Jomon culture of Japan (from 11,000 BC), the so-called 'aqualithic' of large parts of North Africa between Kenya and Niger (after 9000 BC), and to a lesser extent also the Maglemosian of southern Scandinavia (from 9000 BC).

We must bear in mind that these communities had only little in common with present-day foragers. The whole world was at their disposal; they could settle wherever they liked, in the richest environments. They were not forced to retreat to marginal areas or to adapt themselves in any exceptionally specialistic way.

Near East: Natufian

In the Near East a period that can be correlated with the Allerød interstadial of Northern Europe (c. 11-10,000 BC) saw a general environmental change, in particular an increase in precipitation. This caused an expansion of the open forest vegetation and the associated undergrowth of grasses, among which were *Hordeum* and various *Triticum* species, wild barley, einkorn and emmer. Hillman (1996, 189) has postulated an invasion of wild einkorn in the Levant around 12,000 BC. The Natufians moved from the mountains to the plain, where they lived off hunting, predominantly of gazelle, but also fallow deer and cattle, fishing and gathering. Their favourite site locations were at the foot of the mountains, near a spring, from where they could reach mountains and valleys, the coastal plain and the coast itself.

In the Mediterranean climatic zone of the southern Levant in particular they chose to give the wild cereals a prominent part in their diet. Finds of small, portable querns show that wild cereals had been consumed in the preceding millennia, too (Kraybill 1977), so this was not fundamentally new; the difference is that these cereals started to be consumed on a greater scale than before. Of crucial importance was probably not the grain itself,

but the fact that people started to store it in pits in the ground. This meant that they could tide over periods in which food was scarce, and they could live in permanent settlements. On the basis of delayed returns they could benefit from this food resource for 52 weeks a year instead of for the harvest period (6 weeks) only. This enabled the population to expand substantially. On the one hand sedentism may have led to the breakup of population-regulating systems and thus to population growth, for which the availability of sufficient food was a prerequisite. On the other, storage implied an increase in the carrying capacity, and hence of the potential size of the population, by a factor of five at least. The size and number of the settlements indeed point to considerable population growth (Bar-Yosef & Belfer-Cohen 1989; Belfer-Cohen 1991).

This development led to a successful society of a kind hitherto unknown, with large settlements comprising round, permanent huts with sound stone foundations grouped together in large numbers in an area of thousands of square metres with heavy equipment including basalt querns sometimes weighing over 100 kg, storage facilities in the form of pits hacked into the chalk, systematic and ordered burial practices, a highly diverse material symbolism including representations of animals, and beads and pendants of many different shapes made from exotic types of stone. A little later (PPN A) the Natufians started producing their famous plastered skulls. All this is seen to reflect intensive social interaction and the emergence of a more complex social structure in these expanded local communities.

Sahara

Around the same time, after a long hyperarid period, the Sahara entered what is known as the Great Wet Phase, and was reoccupied by 'epipalaeolithic' groups who lived off varied hunting and the gathering of wild plants, as attested by large numbers of querns (Grove 1993; Muzzolini 1993; Kuper 1988). A most surprising aspect of these groups is their use of pottery, which was

apparently independently 'invented' here. The oldest sherds, found at El Adam in the Western Egyptian desert, date from c. 9000 BC, some 1500 years before the earliest pottery in the Near East. The sites of these Sahara communities were widely scattered from the Sudan to the Hoggar, those in the Nile Valley in particular suggesting a trend towards a sedentary lifestyle. These early ceramic foragers evolved into communities that concentrated on the exploitation of the resources of the many large lakes which had in the meantime formed. Their culture is therefore described as 'aqualithic'. Its main features are the hunting of hippopotamus and crocodile, fishing, bone harpoons, microliths, querns and, from Kenya and Sudan to Hoggar and Niger, the Dotted Wavy Line pottery, decorated with comb impressions arranged in bands. Round stone hut foundations and pits for the storage of wild sorghum have been found at various sites in southern Egypt, for example at Nabta Playa, dating from c. 7000 BC (Wasylikova 1993). The intensive exploitation may have led to a form of management of sorghum, but crop cultivation was not yet being practised (Haaland 1997, 375). This *ceramic*, and in some areas clearly *sedentary broad-spectrum*, Mesolithic was apparently an indigenous African development.

Jomon

Around the transition to the Holocene in Japan the Jomon culture evolved to a sedentary, ceramic and marine-oriented Mesolithic.

The early phase, known as 'Incipient Jomon', 11,000 - 8,000 BC, is characterised by small sites without permanent structures and a small number of hammerstones and querns. Storage pits for acorns and pottery have been found on the southern island Kyushu only. The pottery is correlated with food preparation, in particular with the processing (cooking) of the acorns.

The second phase, 'Initial Jomon', embraces the whole of Japan. The sites are large to very large; stone implements, including querns, were in common use. People lived off hunting and

gathering all kinds of nuts. Pottery was widespread, which is thought to reflect the importance of plant food, '*so close correspondence is recognised between pottery, plant foods and sedentary life*'. (Imamura 1996, 443). There is evidence for sea fishing from 7500 BC, ranging from the gathering of molluscs (oyster, cockle) to deep-sea fishing for tuna and mackerel, in particular around Tokyo Bay. The latter activity may very well have even older roots, but that can no longer be established as the former shore-lines have disappeared under water as a result of the rise in sea level.

Europe

In large parts of Europe the beginning of the Holocene meant the beginning of forestation. Over wide areas the foragers switched to the intensive exploitation of the entire broad spectrum of new resources, including the aquatic ones, within limited territories. Red deer was usually the most hunted of the large wild animals. Remains of fish and fishing equipment (nets, hooks, traps) show that fishing was important, but it is difficult to quantify. The same holds to an even greater extent for plant food. Only nuts and fruits sometimes survive in the archaeological record; the actual range of plant resources consumed and their proportions in the diet can only be approximated via models (Zvelebil 1994). There was at an early stage already a trend towards strategic settlement in areas with comparatively high ecological gradients, the long-term use of such favourable locations or microregions and the development of a logistic settlement system. Examples of such sites are the clusters that have been found around inland lakes (Wauwiler See, Federsee, Dümmer), the Mediterranean rock shelters and sites like Mount Sandell, Newferry, Star Carr, Hohen Viecheln and Friesack. It has been suggested that people may have 'cultivated' hazelnuts and acorns and stored them, perhaps even preserved them, but no storage facilities are known to us. The wet, cool climate was, moreover, unfavourable for the storage of perishable goods without further measures. Cod may

in Northern Europe have been dried to produce stockfish, and other types of fish may have been smoked, but that is again mere conjecture. It is thought to be more likely that people used well-thought-out seasonal exploitation strategies rather than storage. Archaeological traces of permanent dwellings are extremely rare (Mount Sandell, Woodman 1985) and no formal cemeteries whatsoever are known. There is no evidence for the preparation of plant food: pottery was not developed indigenously and no querns or grinding stones have been found. Little differentiation is in this respect observable within pre-agricultural Europe. We must moreover bear in mind that the communities living in ecologically less varied areas will have remained more mobile.

Summary

Our understanding of the postglacial foragers is limited to a small number of areas lying far apart, where the quality of the archaeological evidence grants us insight into the former society. We have indications of similar developments here and there in the parts between these core areas, but there are half continents for which our understanding of precisely the first millennia of the Holocene shows tremendous gaps, for example India and large parts of China. This may be the consequence of a lack of research and of the poor quality of the sources, but it could be that in large areas less drastic developments had occurred. We must hence allow for the possibility of geographical differentiation and beware of regarding the development outlined above as a universal process; it was probably restricted to a few core areas.

If we nevertheless wish to lump the most prominent communities together, with due allowance for their great diversity, the gaps in our understanding and our ignorance, we arrive at the following characterisation. We indeed everywhere observe a trend towards the exploitation of the entire range of available food resources, plants, large and small wild animals and especially also aquatic animals and fish, both freshwater and marine species. The archaeological visibility of hunting and sea fishing is

incidentally globally restricted owing to the rise in sea level. The use of microliths in areas lying far apart is associated with a varied, flexible set of hunting implements. Plant food is thought to have become more important than in the past (Zvelebil 1994), though this is difficult to document. Many communities began to focus on strategic site locations, from which different ecological zones, and hence diverse food resources, could be reached. Those resources will have been exploited in optimizing, seasonal strategies. We assume that close relationships with the individual food resources developed within limited territories, resulting in an intensive man:nature relationship, 'optimal foraging' through close herding and selective cropping of the wild animals. On anthropological grounds we must assume that all these communities had an intimate knowledge about the natural world in which they lived and that they had well-developed native knowledge systems. That makes it more than plausible that they soon switched from intensive exploitation of the natural world to controlling and caring for the resources. Such management of natural crops through for example weeding, the erection of fences or even planting out young plants can be seen to herald crop cultivation proper. For these communities a culture:nature opposition is no usefull approach, and it seems that the difernce between a consumptive and a productive strategy has no sense for either of these communities (Ingold 1996). As the plants were still 'wild' and not yet domesticated, it is incidentally virtually impossible to demonstrate such 'cultivation' botanically (Hillman 1996, 194). An argument supporting an early intensive intervention in the environment is the early domestication of the dog, which apparently occurred everywhere, polycentrally, in the early Holocene.

The richer nature and the exploitation of a wider range of resources enabled a reduction in mobility within smaller territories, and in highly diverse areas we observe a clear trend towards sedentism and consequently also population growth. Residential mobility came to be replaced by a logistic system characterised

by special activity camps. Sedentism is incidentally difficult to prove archaeologically as far as foragers are concerned, but in some cases there are convincing arguments supporting it: the remains of soundly built structures (huts), storage facilities (pits), querns and other heavy implements, the more than incidental use of pottery and the burial of the deceased in cemeteries.

Why did people pursue to live in permanent settlements? There are several arguments. Positive aspects of a sedentary life are greater social contacts within a larger group, the possibility of accumulating property and the better shelter offered by permanent dwellings. On the other hand, sedentism also involved higher risks of conflicts, diseases and vermin owing to poor hygiene. Permanent settlements afforded leaders greater control over their groups. Haaland (1997, 377) sees above all a conflict of interests between the sexes:

'Women, who have the main responsibility for child-care among hunter-gatherers, bear the strain of pregnancies, birth, nursing and carrying the children when gathering the plant food. Since the burden of moving would be felt most heavily by women, I suppose that at least the female half of the adult population initially would favour a more sedentary way of life.'

Men, on the contrary, would in hunting benefit more from a more mobile existence, and permanent huts, heavy querns and large pots are in that respect obstacles. Logistic mobility then seems to be the happy medium.

Haaland also argues that aquatic resources are in such a case a reliable subsistence base. They can be exploited for large parts of the year or even all the year round. Fish can moreover be dried or smoked for storage. Sedentism, however, more rapidly leads to the exhaustion of local plant resources, but then storage is again a solution. Pottery was widely used both for storage and for food preparation. In discussing her DWL sites in the Nile Valley Haaland therefore writes:

'The most important evidence for a well-advanced sedentism is the large quantity of pottery on the sites. Pottery, which constrains mobi-

lity, would have operated as a factor favouring sedentism, as well as being promoted by sedentism.' (Haaland 1997, 376).

In the case of the Jomon sites pottery is associated primarily with plant processing, but also with settled life. The occupants of the ceramic Neolithic sites in the Sahara are on the other hand assumed to have been nomadic cattle breeders and aceramic permanent settlements are known in the Near East. There is clearly no one-to-one relationship.

It is surprising that no comparable developments took place in any of the preceding interglacials. It could well be that the pre-modern humans of those times developed some kind of broad-spectrum economy, but if so, they most definitely did not use querns, pottery or axes, they did not build permanent huts, we know of no storage facilities and they did not domesticate dogs. Various postglacial innovations, moreover, seem to have occurred independently in different places. All this seems to reflect a fundamental difference between modern and pre-modern human beings, their social organisation and their technical and intellectual skills.

So, in the early postglacial, modern man's abrupt confrontation with interglacial conditions in different parts of the world led to the emergence of communities that were, so to speak, predisposed to food production, crop cultivation in other words, assuming that, apart from good knowledge of the environment, a certain degree of sedentism is a precondition for the successful protection and nurturing of a plantation. Even so, the transition to agriculture and animal husbandry, and their combination in a single agro-pastoral system seem to have been an exceptional step.

THE UNIQUE CONSTELLATION OF THE NEAR EAST

The autochthonous transition from hunting and gathering to stock keeping and crop cultivation was not a universal, polycentric process, but was linked to highly specific natural and social constellations (Belfer-Cohen 1991; Hillman 1996; Uerpmann 1996). This is of course very satisfying for those of a contextual inclination, while the processually inclined would be happier with more general explanations; these are, however, the hard proxy data.

The question concerning the origins of agriculture was initially closely connected with that concerning the centres of domestication. Farming, after all, involves cattle and crops. The great diversity of crops and domesticated animals clearly shows that domestication is a process which, so to speak, has occurred in all places and at all times, but most domestications occurred in communities of people who were already farmers, or at least familiar with farming, so they actually led to additions to the already existing agrarian package. What I am concerned with here is the *primary* centres, and above all the *process* of the 'invention' of food production. Biological arguments, such as genetic diversity and the occurrence of wild ancestors, are then less important than archaeological arguments, that tell us what actually happened.

From the present-day distribution of the wild ancestors of the most important and oldest crops and domestic animals it has long been known that farming originated in the Near East, more specifically in the Fertile Crescent. This understanding was, however, gained only via a series of fundamental interpretation phases, each based on new evidence and new theories. I will only briefly mention them here, without discussing them: Childe's Oasis or Dessication theory, Braidwood's neo-evolutionary progress model and Binford's post-Pleistocene adaptations, all of which evolved from the interaction between theory and an expanding body of evidence.

Crop cultivation

Around 9500 BC the cereals of these 'proto-Neolithic' communities - einkorn, emmer and barley - show the first characteristics of domestication; this phase is known as PPN A. We assume that the presumed cultivation had been expanded by isolating and regularly sowing seed, so we may now speak of true arable farming. If we assume that it was primarily the women who did the gathering, it is they who deserve the credit for this innovation. On the other hand, the important annual cereal harvest may have been a communal task in which the entire community was involved.

If we conceive of the previous nurturing efforts as weeding and protecting plants against damage by game, then the transition to agriculture was not a fundamental change, but merely an intensification of the former form of management. It could, however, also be that this management actually amounted to very little at first, and that people later started to combine sowing with tillage of the soil. In that case the transition will have been a fundamental step. However this may be, a genetic change was brought about by promoting the growth of a form of cereal with less brittle ears which is unfavourable under natural conditions.

It is currently fairly commonly assumed that this innovation was not introduced spontaneously, but as a result of pressure on the successful Natufian system caused by a change towards slightly drier and cooler conditions contemporaneous with the Younger Dryas stadial in Northern Europe. Did that necessitate more intensive management to secure a crop sufficient to feed the expanded population? Whatever the case, the system survived this 'crisis', perhaps thanks to these first farming efforts.

Animal husbandry

The beginning of stock keeping is a story, different from that of the origins of crop cultivation. Stock keeping originated in a different region and at a measurably later stage. It was, moreover, an entirely different, much less obvious development, belonging to

the domain of men. Uerpmann (1996) writes that 'most animal species can be tamed, but a few have become domesticated'. He argues that of the twelve wild animal species identified at Natufian settlements only goat and sheep were for various reasons initially suitable for domestication. They were domesticated in the northern part of the Levant in the PPN B phase, *i.e.* not before 8400 BC (Legge 1996, 258). A special constellation of ecological and cultural factors is again implied, but not specified (Uerpmann 1996, 235; Hole 1996, 263).

In my opinion domestication must have been a *prerequisite* for, rather than a consequence of, stock keeping. It implied the taming of wild animals which man had hunted from time immemorial, which was something entirely different from the taming of dogs. Uerpmann (1996, 231) disagrees with the idea of domestication and stock keeping being forms of intensification:

'The idea - favoured by Higgs and his followers - that specialization by hunters on a particular species of prey finally led to its domestication is nothing but a theoretical concept. Ecological reality tells us that specialization by a predator results in refined avoidance strategies by the prey.' ... the so-called "herd following" ... will have made the animals even shyer ... not to speak of the fact that it is physically impossible...'

He strongly criticises the idea of free range management and protective close herding being natural pre-phases of animal husbandry, as propagated by Harris. In his opinion, stock keeping must on the contrary have been deliberately developed and the only plausible way in which this could have been done was by raising and training very young animals (his 'nursing hypothesis'). But a tame animal is not an archaeologically recognisable domesticate.

'Domestication is a process that requires sustained breeding of tame animal populations. From the beginning, these populations should be isolated from the populations of their wild relatives.' (Uerpmann 1996, 232).

What induced the hunters to take this initiative? Domestication

was of course also a way of reducing risks, as it implied greater control over herds, which could thus be constrained within a group's own territory, out of reach of one's neighbours and predators. Another advantage is that tame animals will not run away when they are approached to be killed. And, last but not least, control over grazers can be seen as an active measure to protect crops.

We now also know that this primary process occurred in the Natufian core area and that it diffused to more marginal zones only in a later phase, known as PPN B. So Binford's explanatory model (1968) is no longer valid. Garrard *et al.* (1996, 220) write:

'There is no evidence from Jordan or elsewhere to support models that propose that plant and animal domestication first developed in the Marginal Zone. Where data are available, there seems to have been a time-lapse between the first occurrence of crop cultivars and domestic livestock in the Levantine Corridor and their appearance in the more arid tracks to the east and south.' ... 'It is thought that the mixed herds of sheep and goats were adopted by the indigenous inhabitants of the steppe and that the "pastoral package" would have provided a useful risk-buffer for those engaged in marginal farming and hunting.'

Agro-pastoral system

What occurred in the Fertile Crescent was not a single development, but a mosaic of domestications. It would seem that different crops were domesticated in different regions in the course of the PPN A and B, and that contacts and exchange between individual groups subsequently led to the emergence of a kind of standard agrarian package, comprising the crops emmer, einkorn and barley and the companion plants lentil, pea, linseed and others (Van Zeist 1976; Zohary 1996).

The same holds for the domestication of animals to a point. Once sheep and goat had been domesticated, man began to concentrate on the 'more difficult' species, in particular cattle and pig. Their

domestication seems to have been a plural process within the agrarian area. It was, moreover, around this same time that crop cultivation and stock keeping were integrated in a single *agro-pastoral system*. This system was fully established by about 7000 BC, at the end of PPN B, possibly even earlier. Its establishment marks the end of a formative phase in the new farming community, a 'proto-Neolithic prelude', which had lasted for over 2000 years and which seems to have been restricted to the well-known Fertile Crescent. What were the advantages of this new system? A secure existence, the only possibility of feeding an expanding population, or perhaps the possibility of the generation of a surplus by those who had control over the production means, as a route to leadership? Bryony Orme (1977, 48) writes:

'Perhaps the prospect of an afternoon sitting in the sun outside the men's clubhouse, swapping war stories, within sight of a well-fenced field, with wild animals safely outside and women safely within, hard at work weeding or hoeing, to produce next year's feast, makes the effort of clearing that field worth while after all.'

But after some time the farming way of life proved to have drawbacks, too, which will certainly not have been realised at first: increasing social inequality, greater competition and more extensive armed conflicts, food shortages, health risks and (contagious) diseases owing to poor hygiene and high population densities. The latter aspect was pointed out by Brothwell (1971, 84) in particular: *'little did the early farmers know what they were letting us all in for'*.

DIFFUSION

We have seen how in the Near East, well before 7000 BC, a long series of experiments in domestication led to an entirely new subsistence system, an *agro-pastoral* system, uniting varied crop cultivation with some twelve different crops and the herding of four domesticated animal species implicating new tasks and a new division of tasks between men and women, the old and the young. This new creation apparently appealed to all the surrounding communities.

In the next 2000 years this new system spread across the entire northern hemisphere at a remarkably fast pace. On its way north, it underwent various changes: selections were made from the overall package, new domesticates were added and entirely new strategies were even developed. This raises a few questions:

1) were there other centres where similar developments occurred independently?

2) what processes enabled this seemingly rapid diffusion?

and, as far as Northwestern Europe is concerned:

3) how exceptional or exemplary is 'our' *Bandkeramik*/Swifterbant case?

Attempting to obtain an understanding of the entire agricultural transformation process is again perhaps a somewhat overambitious aim (Meadow 1996, 396). There are many obstacles (Meadow 1996, 391, 406), one of the most serious being the major differences in research density. Entire subcontinents contain only a handful of sites and in various large areas entire millennia have hardly been defined. In areas with a high research density, such as Europe and the Near East, it is on the contrary the vast multitude of data that thwart our efforts. Secondly, it is physically impossible to consult primary sources on such a scale. In many areas (China!) primary sources are, moreover, not or virtually not accessible. And then there are the technical problems of the reliability of determinations, in particular of domesticates, and of radiocarbon dates and their associations. Lack of information on whether or not radiocarbon dates have been calibrated makes it extremely difficult to infer long-distance correlations. Authoritative recent surveys like that of Harris ed. (1996) and earlier volumes (as Harris & Hillman eds (1989); Reed ed. 1977; Megaw ed. 1977) are therefore indispensable in such an enterprise.

Turkmenia - Baluchistan

For a start, it is not even clear how large the primary area is. Is it restricted to the Fertile Crescent? It does definitely not include Egypt or the oldest bastion of agriculture in Europe, Macedonia and Thessaly, but further east things are less clear. There, along the northern periphery of the Iranian Plateau, in Turkmenia, the Djeitun culture represents an early Neolithic around 6000 BC. At the eastern periphery, in Baluchistan, Mehrgarh has yielded the earliest known evidence of agriculture with an aceramic phase dating back into the 7th millennium. The cultures of both areas, which lie 1200 and 2000 km, respectively, from the Zagros mountains, bear a remarkable resemblance to the contemporary culture of the Fertile Crescent, including their agricultural packages. Lack of information on the areas in between and on the preceding periods makes it impossible to choose between indigenous development or introduction from the west: neither mountains or seas seem ever to have prevented communication or the movement of materials or people (Meadow 1996, 407).

Djeitun, a 3-m-tall and 0.7-ha-large tell, is very similar to the earliest farming sites in the Zagros mountains (Harris & Gosden 1996; Harris *et al.* 1996). Around 6000 BC the occupants of this tell grew einkorn, emmer and barley, herded goats and sheep and hunted many different species of large game. They lived in detached square to rectangular mudbrick houses with kilns, surrounded by outbuildings within enclosed yards.

Mehrgarh lies on the Kachi Plain, at the edge of the Indus Valley (Meadow 1996; Jarrige & Meadow 1980). The earliest, aceramic, phase of Mehrgarh has been dated to the 7th millennium BC, an early ceramic phase to around 5000 BC. It is a large site with detached, square mudbrick houses with storage rooms and burials between these. Various barley and wheat species were found at the site, of which it is thought that einkorn, emmer and *Triticum durum* were definitely not domesticated locally. The site's occupants kept sheep, goats, cattle and water buffaloes and also hunted a variety of wild animals. All of the aforementioned ani-

mals - so not only the water buffalo - may have been domesticated locally. From figurines and bone analyses we know that this definitely holds *Bos indicus*, the zebu. The close ties with the western agro-pastoral system are, however, evident.

China

Much further east, in China (Underhill 1997), there seem to have been at least one, and possibly even two, independent primary development centres, both equally based on the cultivation of large-grained grasses. One lies along the central course of the Yellow (Huang Ho) River, in a dry, cool climate, and was based on millet, in particular Foxtail Millet, the other lies further south, in a warm, humid area, and revolved around the cultivation of rice. The earliest dates obtained for both centres are later than the earliest Neolithic in the Near East, but they relate to large, developed farming communities, and apparently not to their earliest fases. There is no evidence for such an early, hypothetical development, but neither are there any sites that help to bridge the 4000-km-wide gap between China and the peripheries of the Iranian Plateau. All in all, indigenous development is the most plausible. The independent development of the cultivation of maize in Central America, *c.* 5000 BC, warns us to seriously consider the possibility of there having been more than one independent centre. Blumler (1996, 37) has incidentally suggested that the cultivation of millet in the north could be not a primary, but a derivative development within (in the north of) the area where rice was first cultivated.

In the past it has been proposed, on the basis of the great genetic diversity of present-day wild rice, that rice cultivation originated in the mountains of Southeast Asia (Swaminthan 1984). But from archaeological evidence it is now becoming increasingly clear that the area of origin was not in the mountains, but further north, far outside the areas where wild species grow nowadays, namely along the lower and middle Yangtze River, at least 7000 BC (Glover & Higham 1996, 430).

Pengtoushan is a 1-ha-large, 3-4-m-high tell along the middle Yangtze with house plans, pottery and - considering its context - domesticated rice, dated 8000-6500 BC. The most important site along the lower Yangtze is Hemudu, 6000-5000 BC, where agricultural implements, pottery, domestic animals (dog, pig, water buffalo) and large amounts of carbonised rice were found (Glover & Higham 1996, 426). Interestingly, very early ceramic foragers are known from southeast China, too, from caves with dates up to 9000 BC (Imamura 1996, 445) and dated even earlier (10.000 BC) from the open air site of Nanzhuangtou in the northeast (Underhill 1997, 113).

The earliest agricultural settlements along the middle Huang Ho are those of respectively the Peiligang and Laoguantai Cultures, dated to the end of the 7th and 6th millennium, from 6300 BC onward, with domestic dog, pig, sheep, water buffalo and chicken, and large quantities of millet. Sites have houses, storage pits, kilns and formal burial areas with sophisticated burial gifts in the graves. A parallel Houli Culture has recently be defined along the lower Huang Ho (Underhill 1997).

The large settlements of the subsequent better-known Yangshao Culture (offer varied pottery, sickles, querns and storage pits. The most famous of these settlements is Banpo (Pan-p'o or Pan-p'o-ts'un, Chang 1977, 94 f; Banpo 1987), which was excavated in the 1950s. In its earliest phase it already comprised several dozen round and square huts, an enclosing ditch, potters' kilns, storage facilities and a cemetery with pottery as grave goods. The occupants grew millet and kept the same domestic animals as in the preceding period (Chang 1977, 95; Underhill 1997, 125 f). The occupants of this site supplemented their diet with the products of hunting and gathering.

Later Neolithic goats, far outside their original habitats, suggest long-distance relations with culture areas farther west, but nothing to that effect has so far been proposed for the earlier stages. The earliest evidence for agriculture certainly does not represent the earliest agricultural stage. The substrate - the

postglacial foragers - does not, however, seem to be well specified, so we remain in the dark as to what, if any, relationships may have existed between the two Chinese core areas. An even more important question arises if we are here dealing with two independent developments, for how are we then to interpret the converging developments in central China and 'the west' *vis-a-vis* the view that the entire agro-pastoral package evolved in the west?

Southeast Asia

From both the Near East and the middle and lower Yangtze an agricultural transformation wave washed across the world.

The cultivation of millet seems to have been restricted largely to northern China. The diffusion of rice farming was a relatively late process, but the crop nevertheless spread across the whole of southern and eastern Asia in the millennia BC. Many new varieties were developed in the process, including some that were suitable for wet-rice farming. Further north, rice was introduced to the millet farmers along the Huang Ho around 3500 BC (Glover & Higham 1996, 431).

In the Hoabinhian tradition of Southeast Asia a distinction is made between coastal and inland communities. No coastal sites from before *c.* 5000 BC are known owing to the rise in sea level, but we do know of permanent settlements from after that date, representing a coastal Neolithic with pottery, polished axes and domestic animals (dog, pig, cattle), but without botanical evidence. Rice seems to have been introduced in these coastal areas only around 2800/2500 BC. Domesticated rice and pottery at the contemporary, but much less well known inland sites of broad-spectrum foragers are attributed to exchange with the occupants of the coastal areas. The earliest evidence for rice farming in the Indonesian archipelago dates from the 3rd millennium.

No explanation has yet been proposed for the relatively late diffusion of rice, several millennia after its domestication. Its even later introduction in Japan (between 1000 and 400 BC) has been

related to the fact that it did not spread to Korea until fairly late (around 1000 BC), but also to the highly successful Jomon way of life. Another factor that may have retarded the diffusion of rice are in my opinion the northern ecological conditions (Glover & Higham 1996; Bellwood 1996, 481 f.).

Further west, domesticated rice has been found in northern India in the early 3rd millennium. There, Koldihwa with its circular huts, pottery and polished axes is the oldest site with domesticated rice, dated around 3000 BC (Glover & Higham 1996, 416). Rice became widespread in India only around 2500 BC, after which it rapidly spread into Pakistan and to the eastern periphery of the Iranian Plateau (Glover & Higham 1996, 417), where the 'eastern system' was confronted with the 'western', based on wheat and barley.

The whole process of diffusion can at this stage be described in such general terms only, owing to the limited number of reliable sites, dating problems and problems in distinguishing between wild and domesticated rice varieties. No definitive statements can be made on the diffusion process but there are good arguments for granting the native population an important role in it, as it is highly unlikely that the natives were passive bystanders. Their motives, however, elude us (Meadow 1996, 407).

Towards the west

From the Near East, agriculture spread westwards via three zones with highly diverse conditions: continental Europe, the Mediterranean and what is now the Sahara desert - three entirely different macrolandscapes in terms of climate, vegetation and geography. It is hence not surprising that we find ourselves confronted with very different processes.

In continental Europe the agricultural transformation occurred in several culturally and chronologically clearly distinct stages: a bridgehead in northern Greece around 7000 or slightly earlier, an expansion wave covering 1000 km across the entire Balkan

around 6500, a third step around 5500 BC, again covering 1000 km up to the Rhine, followed by a more gradual expansion further west and, after a considerable time lag, introduction in the north around 4000 BC. In the first phases, Thessaly and the Starčevo complex, the entire Near Eastern system was introduced: villages with small square huts, settlements at sites in river plains, tells, all the crops and the whole range of domesticated animals, dominated by sheep/goat, plus the associated artefacts and symbolism. These communities were - of course - soon to show a style of their own and regional differentiation, but no essential choices or additions to the system were made. In the *Bandkeramik*, after 5500, the system did undergo fundamental changes, which resulted in entirely new house construction, settlement lay out, site locations, (practically absent) material symbolism and an emphasis on cattle. The only thing that remained unchanged was the range of crops.

The phasing of the process and the changes in the system can be related to the diffusion of agriculture to fundamentally new ecological conditions: the Atlantic deciduous forest and the Boreal zone.

The new system spread across the Mediterranean around 7000 BC, covering 2500 km, from the Adriatic to Portugal, in a rapid process that was restricted to the coast. This must mean that it was transmitted by sea-borne communities, for which for example the obsidian networks indeed provide clear evidence. Very little to nothing in the material remains of these Cardial Ware or Impressed Ware people reminds us of the Near East, and the same holds for the little we know about their settlements. Rock shelters, for example, continued to be used as in the past. Actually only sheep/goat and cereals were selected from the package, we assume by the native coastal occupants. In my opinion the evidence suggesting agricultural pioneers' settlements in Portugal (Harris 1996, 560) does not alter this in any way.

Finally the Nile Valley and what is now the Sahara desert. Around 5000 BC at the earliest the entire complex of Southwest Asian domesticates was introduced into the Nile Valley, first of all at sites in the Fayum Oasis and the delta (Muzzoloni 1993; Wetterstrom 1993). There were no independent developments in these areas: none of the domesticated crops' wild ancestors grew here and the sorghum gatherers in the south had not evolved into cereal growers by this time. Around the same time, the 'aqualithic' communities throughout the vast Sahara area switched to nomadic cattle herding, as we know from for example their rock art. This took place in the middle of the 'Neolithic Wet Phase', without any clear ecological correlation. As the earliest dates for domestic cattle postdate those in the Near East by at least 1000 years, it is more likely that the animals were introduced from those parts than that they were domesticated independently (Clutton-Brock 1993). Relics from these times are the rock engravings and rock paintings of wild animals and cattle found in the middle of what is now the desert. As the Sahara region became drier and drier (from around 2500 BC, the beginning of the 'post-Neolithic arid'), it became increasingly difficult, and eventually impossible, to keep cattle there, partly as a result of man's own destructive activities. It would seem that cereal cultivation was never introduced in the Sahara region, presumably because of the unfavourable ecological conditions.

DIFFUSION MODELS

There was clearly no question of the immediate diffusion of the earliest forms of crop cultivation and stock keeping. What happened instead is that an agro-pastoral system developed, which spread beyond its area of origin only after it had evolved into a more or less fully-fledged regime. This holds for both the Near East and - if a few millennia later - the rice centre of eastern Asia. Highly diverse diffusion mechanisms can be distinguished: rapid and phased, complete and selective, even though the offered system was in each case the same and those to which it was

offered were always the original affluent societies. People were apparently responsive to the new system everywhere, but their acceptance of it varied. Once it had been accepted in a macro-ecological zone (Sahara, Mediterranean, Southeast Asia), it was rapidly diffused. Surmounting major ecological boundaries to areas with fundamentally different conditions (Central and Northern Europe) evidently took much longer. The rate of diffusion does not seem to have been a problem *per se*, which is understandable. Because of their comparatively high degree of mobility, the post-glacial broad-spectrum foragers were in contact with one another. As their mobility decreased, contacts continued to be maintained via long-distance exchange networks. Kauri shells, for example, made their way from the Red Sea to Anatolia, while Anatolian obsidian travelled to the far south of the Levant.

What mechanisms lie behind this diffusion? Within communities of the kind concerned here, novelties may spread at a very high speed via what is known as 'cultural diffusion' without this involving any migrations on an appreciable scale. A responsive attitude on the part of the native population seems to be a crucial factor in this mechanism.

'Demic diffusion' on the contrary does imply migrations; the party introducing the novelties must have reasons to move to a new territory. In the case of the diffusion of agriculture those reasons may have been the presumed expansion of the farming population and the availability of unoccupied land in its surroundings. The pastoral element of the new system ensured the group's mobility. This demographic push factor and the pull factor of 'unused' areas adequately explain the diffusion process; we do not have to search for additional ecological factors such as environmental changes, for the minor changes in climate that occurred in the Holocene could never have triggered such a large-scale process.

There where we encounter all the elements of the new system, including the specific type of dwelling and the distinct equipment (quern, sickle, pottery), as intrusive elements, as for example at

Djeitun and Mehrgarh, migration seems to be the most likely option. Both options - adoption and colonisation - or a combination of the two are possible there where farming systems were developed (partly) on the basis of different crops or animal species. This holds for example for the pig-millet farmers of northern China and for the dry cultivation of rice in India and Southeast Asia. There where only one element or aspect was adopted, or several elements in a certain timespan (especially in the case of rapid diffusion, as in the Mediterranean), cultural diffusion is more plausible. Along with the subsistence strategies and material culture, religious and social ideas will have spread across the same vast areas.

Existing networks and the groups' own mobility were important factors in rapid diffusion and in both of the mechanisms described above. 'Rapid' is in this context of course a relative notion, considering the great length of time the process actually took. One century is four generations, so 2000 years corresponds to roughly 80 generations of 25 years. In combination with the action radii of the people involved this, however, yields sufficient time depth for the diffusion process.

The diffusion process is generally seen as a process of adoption, in other words as 'cultural diffusion', but in some cases migration is seriously considered. Price (1996, 359), for example, has strong views on this issue:

'In prehistory, agriculture spread through the diffusion of ideas and products rather than people. The spread of agriculture across most of Southwest Asia and Europe seems to have been largely an inside job. With only very few exceptions, the first farmers were the last hunters.' ... 'The exceptions to this pattern are often found in situations where new adaptations permit the occupation of previously uninhabited areas. Examples would include the Linearbandkeramik expansion into the dense forests of Central Europe and the movement of cattle pastoralists into the Eastern Sahara. Colonisation should be understood as the exception rather than the rule in the spread of agriculture.'

The pace at which it took place and its global character suggest that the diffusion of agriculture was an autonomous cultural process, whose course was primarily self-controlled, *i.e.* dominated by its own interaction with the surrounding communities, rather than by external factors. The driving force was the new system, offered to a receptive 'periphery'.

All over the world, from Dakar to Banpo, and from Khartoum to Geleen, the native foragers were confronted with agriculture, brought to them by foreign colonists or via a long process of adoption, in the west in the millennia after 7000 BC and in the east a few millennia later. And all over the world this confrontation led to cultural frontier situations, to transformation and differentiation, and to the development of a mosaic of cultures, all variations on the 'Neolithic' theme - an unprecedented, global, cultural transformation process.

BACK TO EUROPE: EXPLANATIONS

Bandkeramik

The time has come for us to return to our part of Europe, to the *Bandkeramik* and Swifterbant cultures. Viewed in the context of the global agricultural transformation process, the *Bandkeramik* can in no way be termed standard. Within a short space of time the *Bandkeramik* farmers rapidly swept across a previously practically empty and agriculturally demanding area. They had to create clearances for their fields, and their cattle they could pasture to a limited extent only. They consequently developed a new, specialised formula, a new agro-pastoral system, which was to last for more than five centuries before being replaced, or at least adjusted. Besides a new agricultural system, they also developed a new settlement structure and new dwellings, which played an important part in the individual manifestation of their households. The farmers seem to have embarked on a new route in an ideological respect, too. When compared with that of their predecessors and their contemporaries in the Balkan, their material culture shows an extraordinary lack of human and animal

figures and other symbolism outside the decorative motifs on their pottery. I have the impression that this remarkably distinct cultural structuration process was actually unique in the diffusion of agriculture. The original character of the *Bandkeramik* is evident not only from the many differences within its own timespan, but also from the differences with respect to the sustainable Neolithic of later times, with its small single-family dwellings and its compact or small, frequently relocated settlements. The *Bandkeramik*, finally is one of the few remaining phenomena for which demic diffusion is still a serious option, although several scholars will disagree with me on this point. The colonisation model survived in several forms since cultural historical times. It indeed seemed the only possible explanation for the entirely novel cultural package. There was, however, a major problem, namely where did those large groups of people so suddenly come from? Surely they cannot all have come from that small part of Hungary within such a small space of time. If the answer is indeed colonisation, we must assume rapid growth of the pioneering communities, a very open initial settlement pattern and rapid migration. After the first expansion wave, the spaces between the settlements must then have been filled in and the population must have spread further. But the demographic problems are equally difficult to explain in the case of the alternative - adoption by the native population.

The original population of the *Bandkeramik* area is archaeologically almost entirely invisible owing to the absence of diagnostic artefacts and sites, and possibly a small population density. If there was a population of an appreciable size, its remains have largely disappeared by post-depositional processes. There are, however, good reasons to assume that, in the mid-Atlantic, favourable settlement conditions were to be found only here and there, on the shores of lakes and at the margins of valleys, and that the population was hence small. Actually, the only remains that can tell us something about what, if anything, the native population may have contributed to the *Bandkeramik* are their

microliths, *viz.* the characteristic Late Mesolithic broad trapezes, for that's about all that has survived. But they, too, are of little use to us, as they have been found over almost the whole of (Western) Europe. Very little information can in my opinion likewise be obtained from the points found at the earliest *Bandkeramik* settlement Bruchenbrücken, and virtually no microliths whatsoever have been discovered in primary *Bandkeramik* contexts. In the Netherlands, there are no links in flint technology or flint tool typology between the Late Mesolithic and the early *Bandkeramik*. The suggestion to assume primarily cultural diffusion for phase 1a and migration for the period after that (*i.e.* from fase 1b onwards, in the Netherlands) is inventive, but likewise involves problems. Migration or adoption - it is a matter of taste. Theoretically, it is not possible to choose between the two: both processes could in principle have led to the *Bandkeramik* as we know it - an all-embracing cultural transformation along a rapidly moving front line, or colonist settlement. Both will have involved certain changes: the cultural package need not have been identical to that in the area of origin. It is a matter of sufficient time, a wide-meshed primary colonisation pattern and substantial population growth 'on the way'. Modderman (1970, 1985) has for the *Bandkeramik* population of Limburg for example calculated an expansion from some 300 to 1500-2000 individuals in 400 years. The two processes could moreover be combined: pioneer settlement according to Dennell's (1985) model and absorption by the native population. Whatever the case, the *Bandkeramik* cultural phenomenon spread rapidly, and every Late Mesolithic population all over Central and Western Europe disappeared at an equally rapid pace, absorbed into the farming population, whose lifestyle they apparently uncompromisingly accepted, in great contrast to the fully opposite attitude of the northern foragers.

I have here characterised the *Bandkeramik* as a remarkable, entirely unique cultural complex. I should at this point also mention its fairly novel farming methods. The *Bandkeramik*

farmers often settled along rivers, but not in the river plains themselves or on levees or other low elevations in them like all Neolithic communities before them had done: Çatal Hüyük on the Konya Plain, the tells of northern Greece or the Körös settlements on the Tisza floodplain. This could have something to do with their specific agricultural system. On the one hand they had exchanged sheep for cattle as the dominant animal, but reconstructions of the former vegetation show that there was actually only little room for cattle in the immediate surroundings of their settlements in the dense forest. This suggests that cattle had become less important and/or that it was pastured outside the *Bandkeramik* territories, in a transhumant regime (Bakels 1978). The crops (the entire Near Eastern range!) were grown under much drier conditions on the loess soils surrounding the settlements. So the agricultural system that the *Bandkeramik* farmers offered the native population was fairly specialised.

Northern Europe in the 5th millennium

The long-term frontier situation between the *Bandkeramik* and its successors on the one hand and the native foragers of Northern Europe on the other is exceptional from a global perspective, too. It could be that parallel situations have escaped our notice owing to the gaps in our evidence, but that is not very likely as such situations are not in keeping with the universal acceptance of farming. Something out of the ordinary is clearly at issue here. Scholars so far have always concentrated on explaining the ultimate transition at the end of the 5th millennium, but that transition fits in well with the almost inevitable step that was eventually taken all over Eurasia and Northern Africa. A far more important question concerns the long delay, the long 'availability phase'.

In southern Scandinavia more efforts have been made to explain the transition from foraging to farming than anywhere else in the world. This is due largely to the wealth of evidence and the in-

tensity of research in this area, but *in 'spite of the quality and the volume of evidence, the question of why humans adopted agriculture remains elusive'* (Price & Gebauer 1992, 112).

This is of relevance, for we tend to extrapolate the explanatory models set up for this area to other areas, including the Lower Rhine Basin. Although evidence comparable with that found in southern Scandinavia, such as kitchen middens, formal burials and cemeteries, have been found elsewhere in Europe, too, especially in coastal areas - which is not surprising as far as the kitchen middens are concerned - in the greater part of Europe shorelines from this period have disappeared owing to the post-glacial rise in sea level. It is, however, not only the coastal zones that are at issue here, but the entire area outside the settlements of the primary farming communities, in our case the entire plain of the Netherlands and Northern Germany. And the evidence in that region is not indicative of social developments comparable with those postulated for the Baltic. In my opinion the Baltic shows a specific constellation of ecological and social conditions. Something else that should be borne in mind is that our understanding of this area is influenced by the excellent preservation of material remains. Even so, the Scandinavian models have had such a powerful impact on our approach to the past that they deserve further consideration here.

In the 1970s, inspired by Binford's Near Eastern model, Danish New Archaeologists (Paludan-Müller 1978 for example) proposed population growth as a result of sedentism, followed by expansion to suboptimal zones, where the native population was allegedly more receptive to innovation and to supplementary, risk-reducing alternative activities (*i.e.* agriculture).

Zvelebil & Rowley-Conwy (1984) then postulated a trigger effect resulting from food shortages in southern Scandinavia induced by ecological changes, a serious decline of oysters and/or seals, considered essential in the resource schedule. Several objections can be made to this argument: there is no evidence for such an

environmental crisis, the alleged effect is too regional and we may assume that precisely the successful broad-spectrum foragers would have been flexible enough to take recourse to alternative natural resources.

Bender (1978) launched a post-processual explanation. Instead of taking ecological conditions as a point of departure, she focused on the adoption of cattle and cereal as elements in a system of exchange with the farming communities that also included for example the *Breitkeile*, arguing that animals and grain could similarly be used as status markers. The adoption of the farming way of life must be seen as a social choice of potential trend setters. This line of reasoning has the appeal of the contextual way of thinking, is not based on ecological factors and can be applied to Northern Europe in its entirety, from the British Isles to Skane, irrespective of all the major ecological differences.

Zvelebil has recently (1996) developed a new, more complex explanation for the Baltic. He makes a distinction between the occupants of the ecologically rich and varied coastal areas and those of the ecologically much less diverse interior. After around 5000 BC the former allegedly (independently) evolved into more or less sedentary, 'complex hunter-gatherers' with 'wild pig management, management of woodland and its resources, food processing and storage. All this suggests the delayed-return male-dominated social structure presented by Woodburn on the basis of ethnographic data. "...*Ertebølle society was probably organized along lines similar to "complex" hunter gatherers in the ethnographic record: it retained the hunter-gatherer mode of subsistence, but was socially too differentiated to fit within the hunter-gatherer "mode of production".*' (Zvelebil 1996, 332). Meanwhile in the interior, the traditional, more mobile way of life persisted.

To continue with this line of reasoning, after an initial period of supportive relations, involving cooperation and the exchange of prestige items, in particular *Breitkeile*, the two groups were to react in entirely different ways.

The groups in the interior experienced a disruptive phase, characterised by violent conflicts and stronger competition - competition between the hunters and the farmers over land use, causing the hunters to overexploit their territories so as to be able to meet their exchange obligations. A unilateral flow of women to the farmers (hypergyny) is thought to have been the most serious source of disruption of the foragers' society.

The 'complex' hunter-gatherers in the coastal areas are assumed to have had a more stable organisation. Zvelebil postulates a well-developed delayed-return subsistence system with preservation and storage, which would explain why food production (crop cultivation and stock keeping) did not appeal to them, though they were interested in the exchange of - progressively more and increasingly diverse - prestigious status markers. Such complex forager communities will have been well capable of adapting themselves to short-term fluctuations, and will hence have been able to resist the attractions of the farming way of life and will not have been exposed to the disruption mentioned above. They will on the contrary have been vulnerable to long-term changes (population growth resulting from sedentism and resource fluctuations). According to Zvelebil, they avoided a crisis by adopting agriculture in a controlled manner at the right time (Zvelebil 1996, 333).

Price assumes that the more marginal communities did not adopt agriculture because they could not afford to engage in risk-bearing activities. It was only the more successful and more complex communities that could risk such experiments with supplementary options:

'Agriculture appeared first in areas of abundant resources, in lands of plenty rather than in marginal or poor environments. People already in an environment of risk seldom try new subsistence strategies that carry even greater risk. New strategies are initiated in situations where the risk is affordable.' (Price 1996, 359).

Price (1996, 335) refers to Fischer and Jennbert with respect to the generation of surplus for feasts and the preservation of status as

reasons for the adoption of agriculture:

'They suggest that these successful foragers did not require additional sources of food and that the only obvious reason for farming was to generate surplus. Jennbert argues that certain leaders were probably responsible for encouraging the accumulation of wealth through cultivation and herding. Competition between higher-status individuals for prestige might then explain why successful foragers adopted farming.'

In my opinion there are several problems attached to this line of reasoning.

In the first place I have my doubts about the interpretation of Ertebølle and related groups as 'complex' hunter-gatherers. It is of course true that Ertebølle presents a different archaeological picture than the earlier Mesolithic. This is partly attributable to the poor archaeological visibility of the older coastal zone and its occupation, but we may assume that some, at least, of what we perceive as differences were indeed true differences. This holds for the kitchen middens, the formal burials and cemeteries and the comparatively small, well-defined territories. My doubts are concerned more with the intensive exploitation systems, in particular the degree of management and storage and the associated view of society, and also with the degree of social differentiation and competition for prestige inferred from grave goods and exchange practices. In my opinion too much significance is here being attached to relatively weak archaeological arguments. I particularly dispute the relevance of all ethnographic references, especially references to the American Northwest coast Indians. The Ertebølle communities were not - like these - specialised, but broad-spectrum communities, and their material culture differs markedly from that of the Nootka/Kwakiutl. The emphasis on the different behaviour of the allegedly so much more complex coastal population - which we may assume was to be found in only very few other places in Europe, if at all - *a priori* makes it impossible to grant these lines of reasoning wider validity.

In my opinion well-thought-out seasonal exploitation, and above

all the use of the permanently available aquatic resources suggested by Haaland (1996) constitute a far more plausible basis for sedentism than storage. If we moreover assume that it was not sedentism *per se*, but the generation of surplus that enabled substantial population growth, we may also delete population pressure from the model. Those are at least the relevant parameters for the population outside southern Scandinavia, in the North German Plain, the Low Countries and the British Isles.

Secondly, the above lines of reasoning apply to a distinct region, the specific constellation of the southern Baltic, which means that they cannot be applied elsewhere, in different contexts. What we need is an explanation that holds for the whole of Northern Europe, for universal processes, and not for regional or culture-specific developments. The agricultural transformation is a wide-ranging, highly differentiated process, not something that spread from a single core area where the transition took place first. All the North European communities, from Ireland to the Baltic, switched to the farming way of life within a relatively short space of time, namely the last centuries of the 5th millennium (4100 BC), be it in different expressions. The 'new' farming communities of the British Isles and southern Scandinavia were very concerned about their identity and their relationship with the land and the landscape: they manifested themselves via distinct pottery styles and built long barrows and causewayed camps to mark their territories. Their settlements, however, were small, briefly occupied and frequently relocated and they hence have very poor archaeological visibility. Artefacts and land, symbol and function were linked in the shaft mining of high-quality flint for the production of axes and tool kits. Many aspects of this organisation and this way of life seem to have been borrowed from or inspired by those of the Chasséen and Michelsberg cultures, which were also characterised by the development of mining and the construction of central sites around this time, although no long barrows were yet being built. All this shows that the new farming communities were far more

complex and more hierarchically organised than the hunters who had preceded them. Price (1996, 347) in this context adds bog offerings and long-distance exchange.

While the communities in England and Denmark have many things in common, the remains of the Swifterbant communities in the area between them betray a more reticent attitude. In this area we observe different developments: no camps and no barrows, but, it would seem, the continuation of an organisation and material equipment that were essentially Mesolithic; no rapid transition to a completely new social structure, but the gradual adoption of individual elements. As in the Danish Ertebølle culture, this started with pottery, resulting in a 'ceramic Mesolithic'. This was followed by the development of a distinct agrarian package, in which the former Mesolithic material presentations (pottery, flint industry, burial practices), wetland exploitation and settlement mobility were retained. We observe a much longer symbiotic relationship with the farmers (Swifterbant 1-4), an exceptionally long substitution phase and a much later transition to a completely agricultural way of life (TRB).

This brings me to the conclusion that the long availability phase and the transformation that was meanwhile taking place across the whole of the vast, differentiated area of Northern Europe are best understood by considering the following arguments (*cf* Louwe Kooijmans 1998):

- 1 fundamental cultural differences between the *Bandkeramik* and the native population, the former with cultural roots in the east, ultimately even the Near East, the latter rooted in the late-glacial reindeer hunters of Northern Europe. The native communities evidently chose to adhere to their traditional way of life, as proposed with respect to many sub-recent hunter-gatherers in the revisionism debate that has arisen in cultural anthropology (Solway & Lee 1990; Lee 1992; Stiles 1992);
- 2 transformation processes undergone by *both* parties, involving material innovations with prominent archaeological visibility

- among the foragers and - far more important - social changes in the groups that introduced those innovations, the farmers of the loess. In my opinion the transformation of the latter groups (LBK-Rössen-Michelsberg sequence) was of crucial importance. The rigid, loess-based system was replaced by a more flexible, mobile regime, which we may assume was more in keeping with the lifestyle of the northern communities. The development of this regime could even be associated with the constant flow of information from the native population;
- 3 the major ecological hurdle that had to be taken in the neolithisation of Northern Europe, implying that crops had to be grown under far more restrictive climatological conditions and in less favourable soils. There could be a link between the Swifterbant communities' initial reluctance to adopt agriculture and the less favourable arable conditions in the coversand region.

CONCLUSIONS

After the end of the last glacial, communities of broad-spectrum foragers inclined towards sedentism in areas with conditions suited to such a way of life evolved under favourable conditions 'all over' the world. In areas lying far apart these communities domesticated dogs, developed heavy polished (edge-ground) stone hacking tools (axes), pottery, sometimes also sickles, and querns. In the final phase of this development people lived in permanent dwellings, stored surplus foodstuffs and buried their dead in formal cemeteries. Many 'characteristics' of early farmers were actually already developed in the preceding phase of (semi-)sedentary affluent foragers.

The development of an 'agro-pastoral system' in these communities can be termed exceptional; it was related to special ecological and sociocultural constellations and was by no means a universal process. It would seem that individual domestications can be fairly accurately dated, but the development of a new subsistence

system was no 'invention' but a long-term formation process that embraced several millennia.

Storage seems to have been of much greater importance for the subsequent process than sedentism. Storage implies the availability of a suitable product and the required technical means. They may (storage pits and vessels), but need not necessarily (baskets) be archaeologically visible. The decisive factor in the expansion of the native population must likewise have been storage rather than sedentism.

There is one centre where the transition to agriculture was definitely an independent development and that is the Levant (cereals and various animals), where this occurred between 9,000 and 7,000 BC. At a few other centres independence is a serious option: along the lower Yangtze in southern China (rice, water buffalo) and along the Huang Ho in central China (millet, pig). This would imply the development of comparable systems at slightly different times. The alternative is that diffusion has escaped our notice owing to the gaps in our knowledge on the areas between these centres.

Unlike its independent development, the diffusion of (elements from) the agro-pastoral package was an unstoppable process that embraced the whole (old) world. It started in the Near East around 7000 BC and swept across the greater part of the Afro-Asian continent within only a few millennia. It was only then, at the beginning of the 3rd millennium, that the cultivation of rice in eastern Asia began to expand.

The explanations for the universal, world-wide diffusion of farming, the agricultural transformation, can lie only in the process itself, in the interaction between the new system and its surroundings into which it was introduced, and not in 'specific constellations' of the kind that determined its original development.

This means that the postglacial foragers were in principle willing to adopt the new way of life, out of a desire to reduce the risks in their existence, secure or raise their status, or for some other reason.

The *Bandkeramik* in this context represents an extraordinary 'solution', focused on the conquest of the forests of Central Europe. A major ecological frontier was crossed and a transformed version of the agro-pastoral system from the Levant was implanted in a cold, wet northwestern corner of the contemporary farming world.

The main problem with respect to the agricultural transformation of Northern Europe is not why the new system was adopted, but why it was adopted only after a substantial time lag. A first explanation for the long stationary boundary between the loess farmers and the northern native population is the fact that, after the Atlantic ecological zone, the Boreal zone had to be conquered. Secondly, we may assume that the *Bandkeramik* agricultural package was too specialised for the affluent foragers, and possibly didn't appeal to them for other reasons, too. What may have been a third important factor is the overall cultural difference between the two populations. These are but a few possible explanations. However it may be, the major condition for the diffusion of agriculture in a still more northerly direction is more likely to have been a restructuring of the system offered, than social processes among the communities to which it was introduced.

Within the wider context of the global agricultural transformation, the *Bandkeramik*, the long stationary front line and the 'semi-agricultural' Swifterbant communities are all exceptional phenomena, associated with an exceptional social and ecological constellation.

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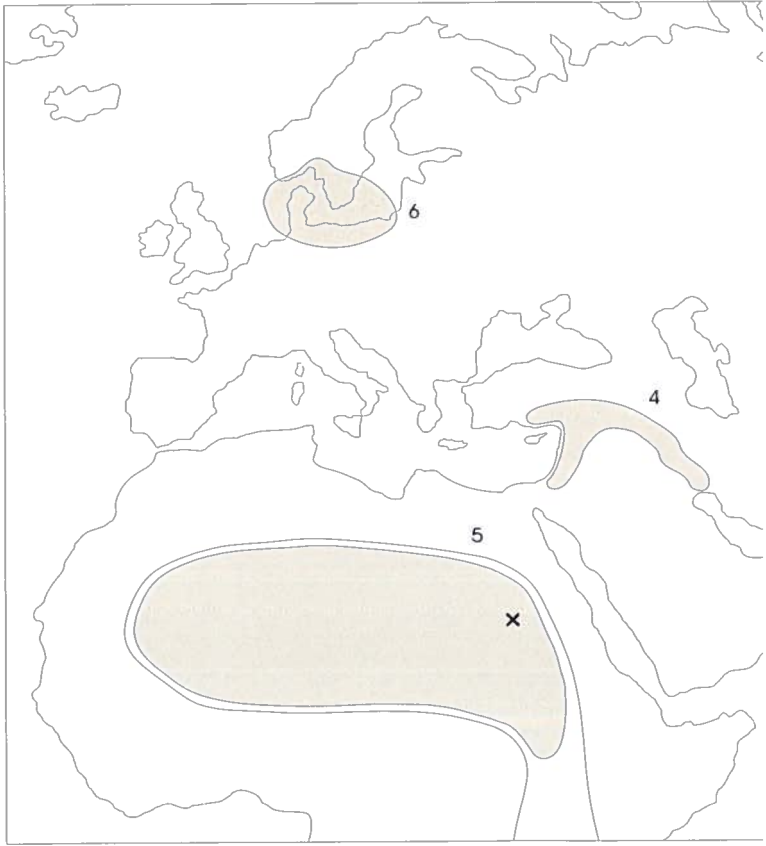
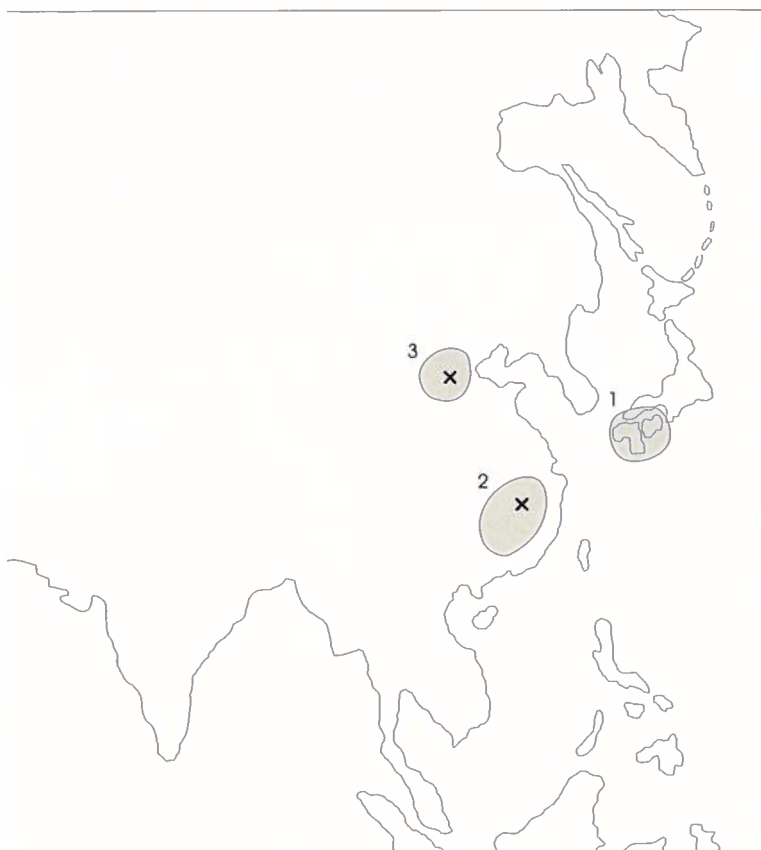


Figure 1. Early Holocene (semi-)sedentary foragers.

- 1 incipient Jomon
- 2 Lower Yangtze
- 3 Lower and Middle Huang Ho
- 4 Natufian and related groups
- 5 'Aqualithic'
- 6 Maglemose



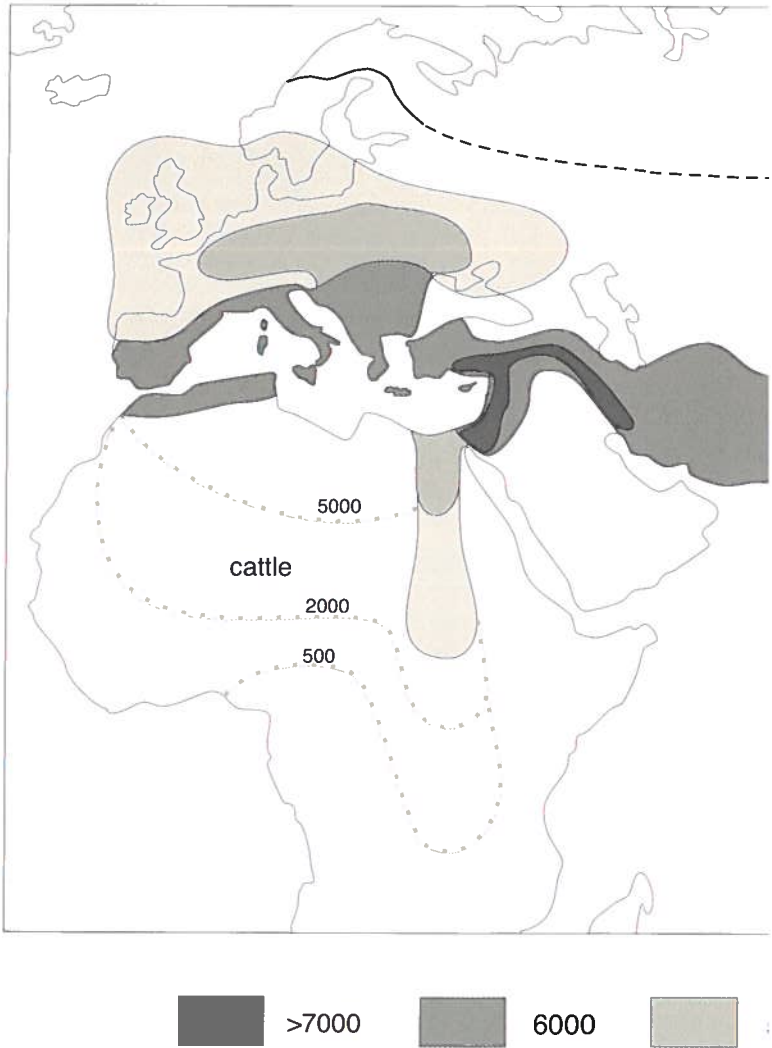
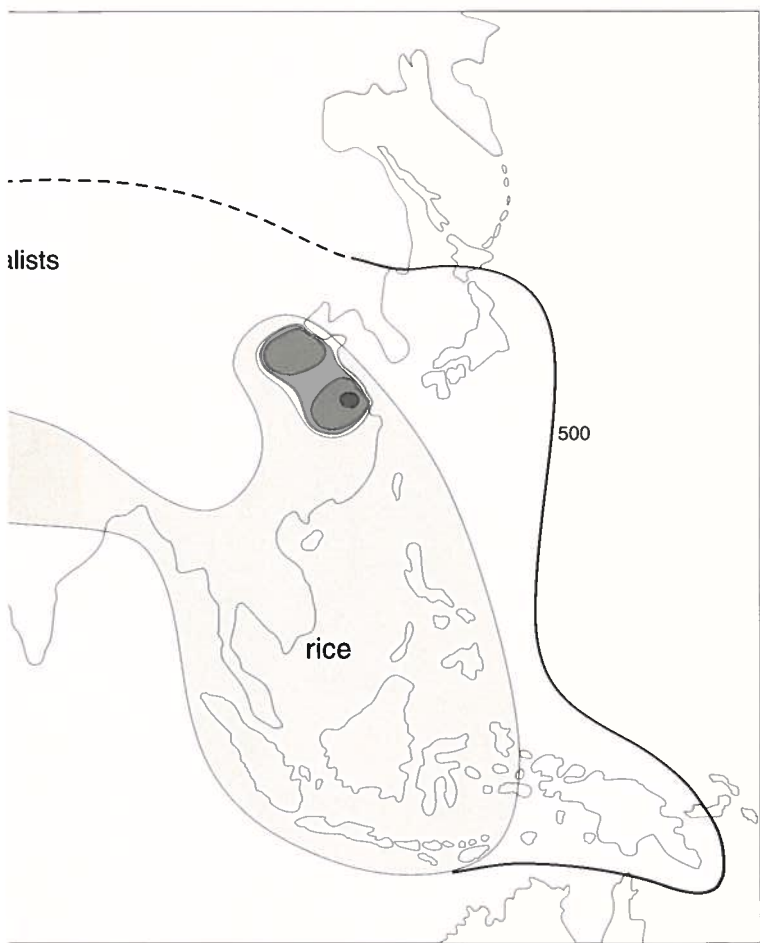


Figure 2. The spread of agro-pastoralism in Eurasia and northern Africa between 7000 and 500 cal.B.C.



4000



2500

cal. BC

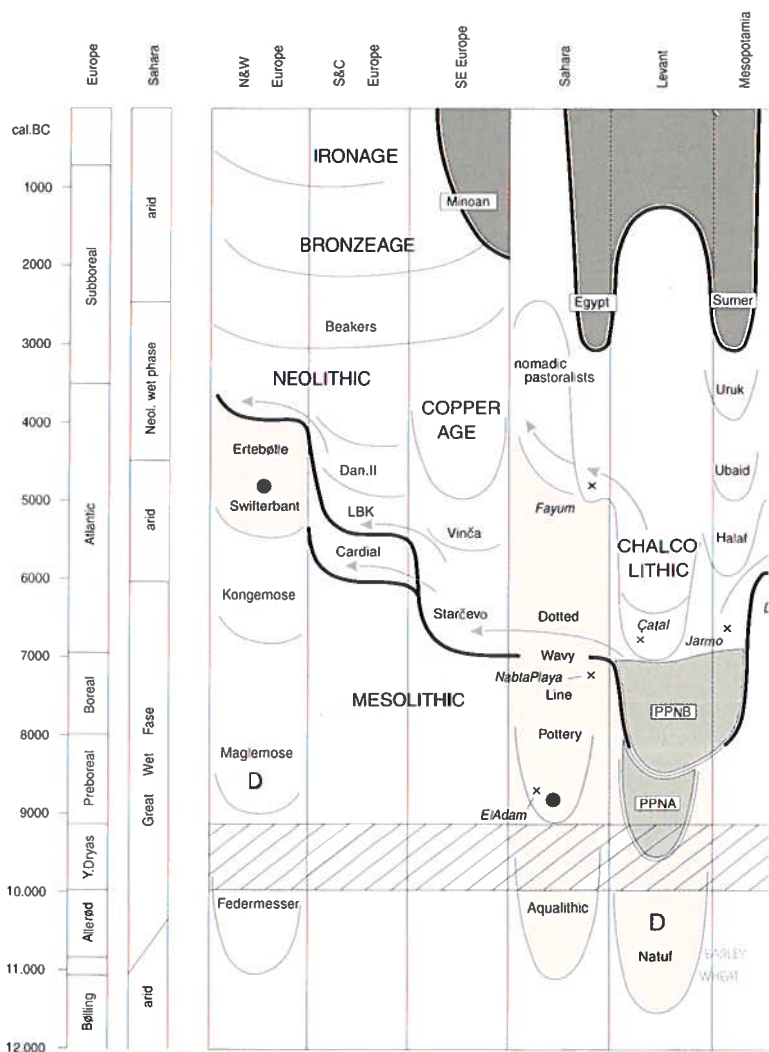
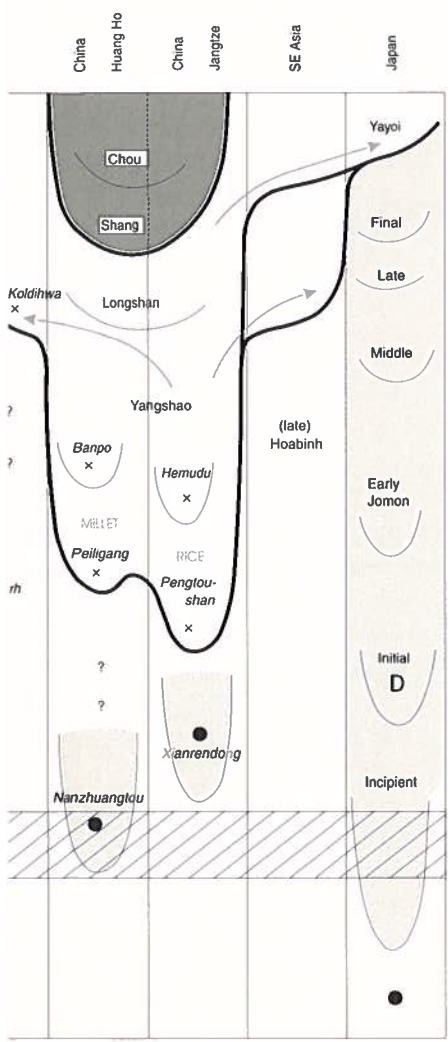









Figure 3. Chronological-geographical representation of the evolution of (semi-)sedentary foragers, pre-agricultured pottery production and the possible agropastoral diffusion.



-  state societies
-  aceramic agriculturalists
-  (semi) sedentary foragers
-  lower limit agropastoral societies
-  agropastoral diffusion
-  earliest pre-agricultural pottery
-  earliest dog

KROONVOORDRACHTEN

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