The Spread of Early Farming in Europe

The "Neolithic revolution" is best thought of as a gradual transition as farming crossed Europe haltingly over the course of 3,000 years

Peter Bogucki

The shift from a mobile life of hunting and gathering to a sedentary one based on domesticated plants and animals was a remarkable transformation in human history. Although this change took place independently in at least seven distinct parts of the world over the past 10,000 years, it would have remained a local curiosity except for the fact that agricultural techniques, and often the people who used them, spread quickly throughout much of the globe. One of the most successful agricultural movements occurred between 9,000 and 6,000 years ago when a suite of domesticated plants and animals spread from the Levant and Zagros mountains of the Near East to Egypt, the Iranian Plateau and Europe.

Archaeologists call this period the Neolithic (or New Stone Age), a term coined by Sir John Lubbock in 1865 to differentiate it from the Palaeolithic (or Old Stone Age). In the 1920s the British prehistorian V. Gordon Childe, perhaps the first person to focus systematically on the historical transition to agriculture, described the change from mobile foraging to sedentary farming as the "Neolithic revolution." In recent years archaeologists have tended to play down the revolutionary character of the Neolithic and to emphasize instead the processes by which agriculture developed and spread.

The movement of agriculture into Europe is particularly interesting because of the remarkable variability across the continent. From the Aegean Sea to the Orkney Islands off the coast of Scotland, the transition to agriculture occurred many times in very different ways. We now recognize that there was no single mode by which Europe made the shift from foraging to farming. Instead, sedentary farming communities were established through one of two fundamental processes. In some instances agricultural peoples moved into an area, bringing their crops and livestock with them. Although archaeologists are now reluctant to ascribe prehistoric change to movements of peoples (an explanation applied uncritically in the early days of archaeology), it is clear that in some areas colonization indeed took place. In other cases the indigenous hunters and gatherers of a region gradually adopted elements of Neolithic subsistence and technology and eventually became fully sedentary communities. Although the primary crops and some of the livestock were clearly of southwestern Asiatic stock, the domesticates were integrated into the existing forager-subsistence patterns.

Both types of transitions raise questions in the mind of the archaeologist. Where agricultural colonization occurred, the issue is to determine the routes taken by the people and perhaps get some idea of *why* they moved. Where hunters and gatherers adopted agriculture, archaeologists wonder why the people relinquished a comfortable lifestyle in favor of the risks and the work associated with an agricultural economy.

Some of this variability can be attributed to regional differences in climate, or to the quality of the soils or the drainage of the land. In many instances, however, the regional variation is probably due to the size and organization of the pre-existing foraging populations and the choices made by the farming peoples about their crops and livestock. The resulting mosaic of agricultural communities across Europe persisted for many centuries. Here I review what we understand about the distribution of early farming and the development of Neolithic technology as well as what we know about the people themselves. (Recent refinements in radiocarbon-dating techniques have allowed archaeologists to recalibrate the chronology of these events. All dates in this paper are based on revised carbon-14 age determinations.)

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The European Habitats

More than 40 years ago, the British prehistorian Grahame Clark recognized two broad divisions of Europe, which he termed *Mediterranean* and *Temperate*. Mediterranean Europe consists of the lands bordering the sea and extending west to include the Iberian Peninsula. It corresponds to the zone whose natural vegetation would consist of Mediterranean evergreen forest, the result of summer drought and winter rains. Temperate Europe, by contrast, is the region whose natural vegetation, before being transformed by farming and industry, consisted of deciduous forest. It reaches from the Atlantic coast and the British Isles, across central Europe and southern Scandinavia, into European Russia. This zone experiences marked seasonal differences. (One of the remarkable aspects of the transition to agriculture in Europe is the rapid adaptation of plants and animals that had originated in semi-arid regions to temperate conditions.)

Although Mediterranean Europe presents relatively similar climate, soil variety, topography and natural vegetation from Greece to Spain, temperate Europe has several environmental zones. In southeastern Europe, the plains of Bul-

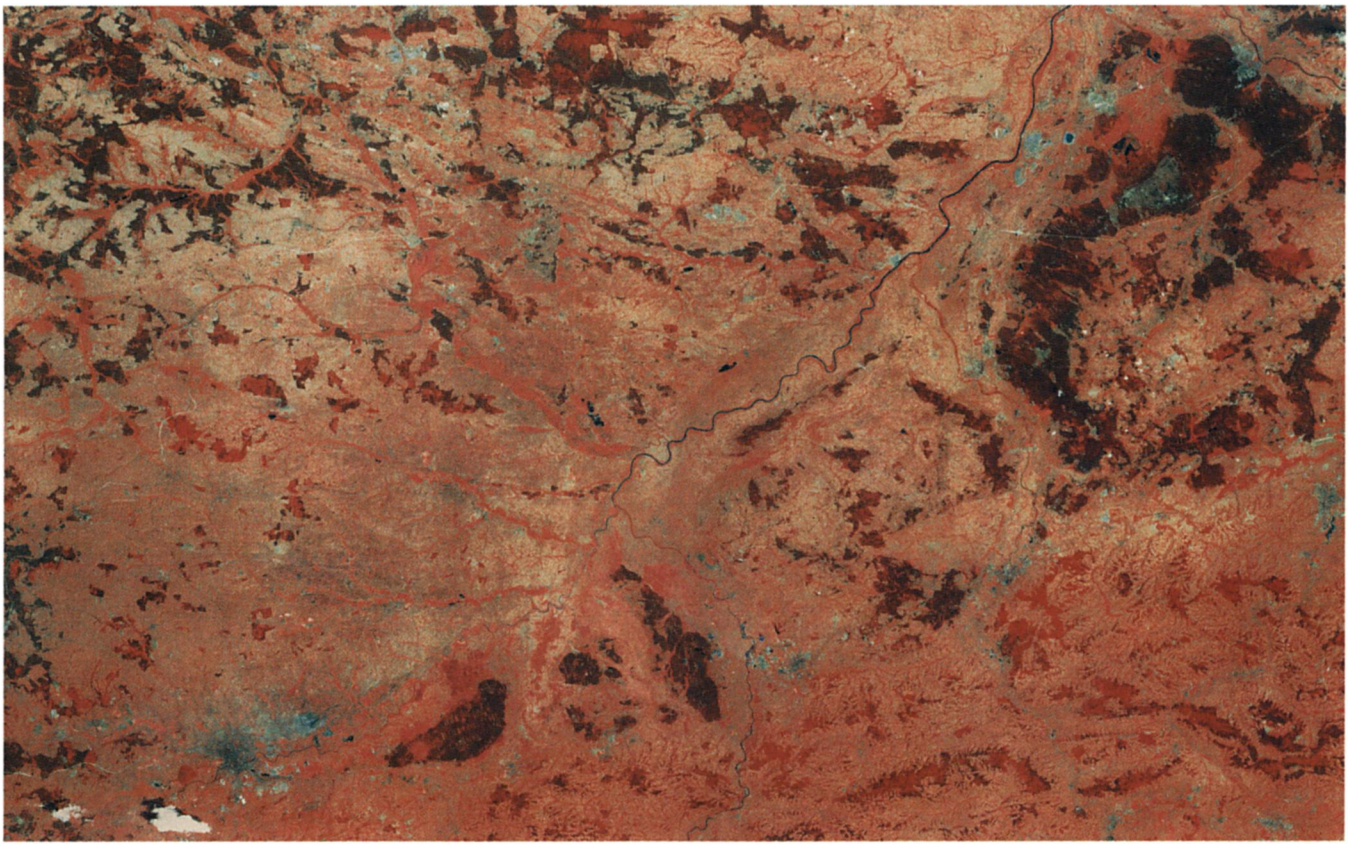

Figure 1. Fertile regions along rivers and streams of the upper Vistula basin in southern Poland supported the first farmers in the region. The moist valleys of these waterways appear in this satellite image as tendrils *(red)* against the drier watersheds *(brown)*. Post-glacial windblown sediments, or loess *(left and center)*, provided rich soils for the colonizing farmers who entered the area in about 5400 B.C. The city of Kraków is visible as the gray area in the lower left of the image. (Image courtesy of NASA Landsat.)

garia and Romania are separated from the rolling uplands of Serbia and Croatia by the Balkan mountains. River valleys such as those of the Maritsa and Morava were filled with fertile alluvium and upland basins such as the Ovče Polje in Macedonia were also important for early farmers. Further north lies the Hungarian Plain, which is broken in parts by marshes and river levees.

From Ukraine to Belgium stretches a very important region for early farming in central Europe. I have termed this area the loess belt, so named for the pockets of fertile soil called *loess*, a wind-blown sediment deposited under periglacial conditions during the ice age that ended 12,000 years ago. In some areas, where the sediment was trapped by hills and basins, the loess blankets the landscape dozens of meters thick. Small rivers and creeks cut through the loess to form a dendritic drainage pattern. Loess is very fertile but also very dry. The moister zones are the floodplains of the streams rather than the watersheds that separate them. This is evident even today in LANDSAT images of central Europe.

In contrast, the North European Plain, stretching from the Netherlands to Belarus and the Baltic States, was largely covered by ice during the last glaciation. The ebb and flow of the ice altered the landforms and soils considerably, producing a richly varied—but flat—landscape. Soils vary from sandy glacial outwash to clay from glacial moraines. Lakes dot the landscape, including finger lakes scraped out by the ice and kettle lakes formed by melting blocks of ice left behind in the glacial retreat. Slow, meandering streams fill valleys left by glacial meltwaters. Along the Baltic and North Seas, shorelines have changed significantly in the last ten millennia as sea levels rose and land rebounded from the weight of the ice, then settled back down.

On the south side of the loess belt, the foreland of the Alps has many features in common with the North European Plain. It is also characterized by glacial soils, outwash fans and lake basins. The key difference is that the topography has much more variation in elevation. Moreover, the nearby mountains introduced another vertical element of variety in the local environment, while Alpine streams fed by melting snow provided ample moisture.

Finally, the broad region of western Europe to the west of the loess belt, North European Plain, and Alpine foreland can be termed the *Atlantic façade*. Unlike that of the inland regions, the climate here is maritime and moist, and the soils relatively thin. Chalk and limestone underlie much of the region; wetlands such as bogs and fens formed in areas of poor drainage. Postglacial sea-level changes were important in the formation of the coastal landscapes, although the English Channel already separated Britain from the continent during the Neolithic.

The differences among the regions of temperate Europe had considerable relevance to the first farmers. Terrain, drainage, natural vegetation and soils all conditioned the geographic patterns that characterize early farming communities. Coasts and estuaries supported large populations of indigenous hunters and fishers, whereas the dry loess basins were sparsely populated prior to the arrival of farming. Most importantly, the spread of farming did not occur

Figure 2. European habitats today and about 8,000 years ago—when the first farmers came to Europe—can be divided into a temperate zone and a Mediterranean zone *(above and below the dashed line)*. The Mediterranean zone (consisting of lands bordering the sea) comprises a more or less homogeneous habitat with respect to climate, soil variety, topography and natural vegetation (an evergreen forest). In contrast, the temperate zone consists of several environmental regions (such as the Alpine foreland, North European Plain, loess belt and the Atlantic façade) that had profound effects on the distribution and nature of the early farming economies.

at a uniform pace. There were spurts and halts at different points in its advance across the continent.

Farming Enters Europe

The initial toehold of farming in Europe took place in Greece as crops, livestock and farmers crossed the Aegean Sea. Indeed, the earliest agricultural settlements along the Aegean coast and in Thessaly have much in common with their immediate precursors in Anatolia. Many scholars of the European Neolithic begin tracing the spread of farming from settlements such as Çatal Hüyük in south-central Turkey and Hacilar in southwestern Turkey. These two sites from the seventh and sixth millennia B.C. represent large, fully agricultural communities, outside the core area of domestication in the Levant. Mud-brick houses, each with an area of about 25 square meters, were built one against another to form a dense architectural complex. Domestic cattle and pigs were added to the basic Near Eastern suite of emmer and einkorn wheat, sheep and goats. Cattle also played a key role in the symbolic life of Çatal Hüyük, for in many of the houses cattle skulls were plastered into the walls. Obsidian (volcanic glass) from nearby sources was a valuable trading commodity.

The Anatolian sites of the early seventh millennium B.C. were the launching pad for agricultural dispersal to Europe. Early Neolithic sites in Greece show distinct similarities to the Anatolian settlements in their suite of domesticates and their ceramics and other artifacts. Rather than being impoverished cousins of their Anatolian precursors, the first farming sites of Greece indicate a robust agricultural economy. The domestication of cattle and pigs in Anatolia had provided the final key elements in the complex of crops and livestock that formed the basis for agricultural dispersals into Europe.

Neolithic settlements appeared suddenly on the alluvial plains of Thessaly and Macedonia, suggesting that they were established by colonists from points to the east and that indigenous peoples' involvement in the establishment of these communities was minimal. The route of the colonization is unclear. Although the Bosporus strait between southwestern Asia and Europe provides the narrowest water barrier, a lack of early farming sites on either side suggests that this may not have been the route taken by the early farmers. Tjeerd van Andel of the University of Cambridge and Curtis Runnels of Boston University propose an island-hopping route across the Aegean, with some groups perhaps making a detour to Crete, which was settled by farmers about this time.

Van Andel and Runnels have recently emphasized the preference of the earliest Greek farming communities for alluvial and floodplain habitats. The fact that these areas have virtually no evidence of indigenous habitation strengthens the colonization hypothesis. Research by van Andel and Runnels on early farming sites in the Peneios drainage in Thessaly indicates that the choice of these locations was dictated by the presence of perennially wet floodplains whose fertility was recharged by spring flooding.

Several hundred early Neolithic sites have been found in Greek Macedonia and Thessaly, but one of the best-known remains Nea Nikomedia (more than 30 years after it was excavated by the British archaeologist Robert Rodden). By the middle of the seventh millennium B.C., Nea Nikomedia was a farming village with several small rectangular houses. The houses, although densely packed, are freestanding. Unlike the mud-brick houses at Çatal Hüyük and Hacilar, they were built using light timber frames onto which thick walls of mud plaster were applied. Thus from the very beginning, early European farming settlements had a distinct character. The diet, however, was similar to that of the Anatolian sites, with most of the faunal remains consisting of sheep and goats (with some cattle and pigs), and botanical remains yielding the southwestern Asiatic complex of emmer and einkorn wheat, barley and legumes. Pottery was present from the earliest levels.

A contrasting picture emerges in southern Greece, where the moist floodplains are absent. At Franchthi Cave, a continuous record of human habitation for 15 millennia begins about 20,000 years ago. Early in the seventh millennium B.C., the people of Franchthi Cave began to keep sheep and goats and to grow emmer wheat and barley. Continuities in the stone-tool technology indicate connections with the earlier foragers. It is unclear whether this represents the adoption of elements of the farming economy by indigenous foragers or the incorporation of local hunter-gatherers into a group of intrusive agriculturalists. At the moment, however, it appears that there were two processes at work in

the Greek peninsula: the occupation of unpopulated alluvial zones by colonists from outside the area, and some form of interaction between foragers and farmers in southern and western Greece, where pockets of indigenous peoples could be found.

After Greece, two grand currents of farming dispersal can be identified: westward along the Mediterranean littoral and northwest into temperate Europe along major rivers. The dispersal along the Mediterranean coast provides ample evidence that watercraft were in use by the seventh millennium B.C.—the locations of the earliest domesticated plants, animals and pottery are widely separated at both mainland and island sites. Inland, the mountainous and forested terrain posed obstacles. Communication routes presumably existed along the major rivers, and animals and indigenous foragers had already made paths and trails along which people could move and interact.

Transition in the Balkans

About a millennium after their appearance in Greece, agricultural communities were established in the southern Balkans, first in the valleys of the Vardar, Morava, Struma and Maritsa rivers and later in the Danube valley itself. Although the settlements vary in their architecture and in the composition of the animal remains, the domestic plants and animals consisted of the now-familiar southwestern Asiatic complex of emmer and einkorn wheat and barley, as well as sheep, goats, cattle and pigs. As in Greece, the presence of alluvial soils on river and lake floodplains was a critical determinant of settlement location.

In the early agricultural settlements of the Balkans, there are clear signs of an adaptation to temperate conditions. At most sites, cattle and pigs become more important than sheep and goats, while wheat and barley became summer (rather than winter) crops. Just as Anatolia provided the springboard for agricultural dispersal into Greece, the Balkans were the scene of important transitions in Neolithic subsistence and settlement that enabled the spread of agriculture further into central and northern Europe.

Studies of the transition to agriculture in southeastern Europe are hampered by an almost complete ignorance of the local hunter-gatherer populations. The sites of early foragers are almost invariably found where the early farmers did not settle, such as in the western Balkan mountains of Montenegro and Bosnia or the Iron Gates gorges between Serbia and Romania. Because of this it has

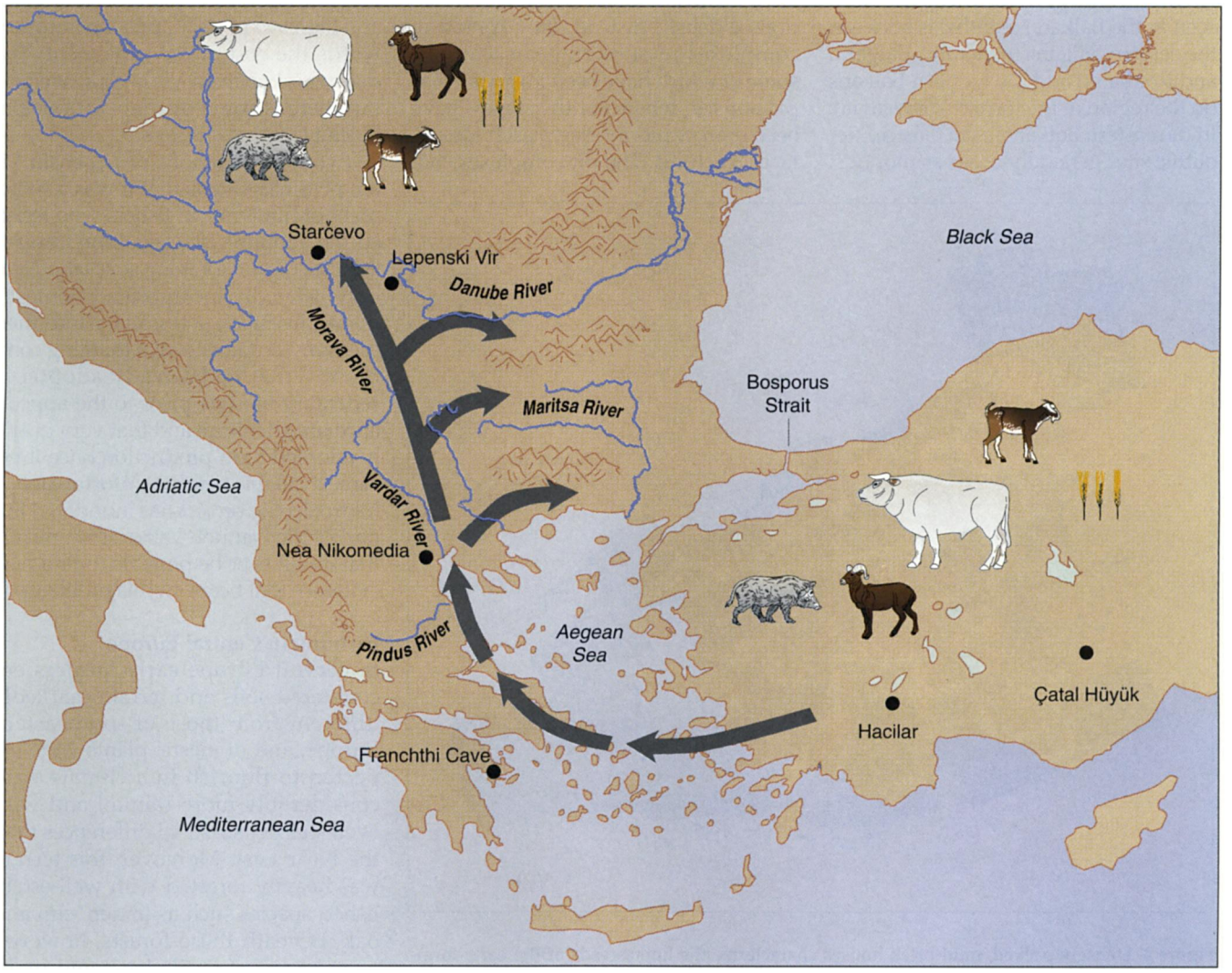

Figure 3. First farmers in Europe probably came from the centuries-old agricultural economies of southwestern Asia by island-hopping across the Aegean Sea. Archaeological remains reveal that these colonists brought their livestock (cattle, sheep, goats and pigs) and crops (emmer and einkorn wheat and barley) with them as they entered Greece. Several hundred early Neolithic sites are now known in Greek Macedonia and Thessaly.

been argued that colonization was the primary mechanism of the initial agricultural dispersal into temperate Europe. For example, van Andel and Runnels see the dispersal of agriculture to the southeastern Balkans as an extension of agricultural settlement in Thessaly. An alternative view is possible, however. Haskel Greenfield of the University of Manitoba has recently pointed out variations in the proportions of bones from wild and domestic animals at Balkan sites of this period. He suggests that such a pattern might be expected as indigenous foraging groups integrate domesticated plants and animals into their economy, each in its own fashion. Although the evidence is equivocal, it will be important to subject the colonization hypothesis to critical scrutiny and perhaps to amend it as new observations warrant.

One broad geographical division seen in the Balkan Neolithic is between the eastern Balkans (generally, Bulgaria and Romania) and the western Balkans (in the region of the former Yugoslavia). In the eastern Balkans, as in Greece, Neolithic sites generally occur as mounds, or *tells*, formed by the accumulation of baked-clay construction. The classic Bulgarian tell is Karanovo, where 12 meters of debris accumulated between the beginning of the Neolithic and the early Bronze Age three thousand years later. The layers from the early part of the sixth millennium B.C. reveal a settlement of several dozen freestanding one-room houses, built by daubing mud plaster onto upright wooden posts. Each was apparently occupied by a family or household. The nearby sites of Chevdar, Azmak and Kazanluk have yielded important information on subsistence and crop processing.

In the central and western Balkans between about 6100 and 5100 B.C., the sites of the Starčevo culture were established along the Vardar, Morava and Danube rivers. Unlike the tells of the eastern Balkans, Starčevo sites generally have relatively little vertical accumulation of debris. Instead, they consist of complexes of subterranean features, some of which have been interpreted as pit-houses, whereas others may have been borrow pits for clay plaster for surface structures. The pit complexes contain dense concentrations of broken pottery, animal bones and other rubbish, indicating a secondary use as disposal areas. Blagotin in central Serbia and Foeni in Romania are two such Starčevo settlements excavated recently by Haskel Greenfield and his collaborators.

Variable as this patchwork of new agricultural settlements was, one area stands out as unique: the Iron Gates gorge on the border between Serbia and Romania. Here the site of Lepenski Vir has puzzled archaeologists since its discovery in the late 1960s. Situated next to a whirlpool at a bend in the Danube, Lepenski Vir is a multi-period settlement with numerous trapezoid-shaped huts, each with a stone hearth and often with enigmatic piscine stone sculptures. For most of its existence the economy of Lepenski Vir appears to have been based on fishing and hunting, with domestic plants and animals and Starčevo pottery appearing only towards the end of the settlement. The dating of Lepenski Vir is controversial, but there is some overlap with neighboring farming cultures.

Two interpretations of Lepenski Vir are possible. One is that it was a settlement of hunters and fishers who resisted the adoption of agriculture through their successful foraging adaptation and only belatedly incorporated domestic plants, livestock and pottery into their economy. Another is of a foraging community that had already adopted a sedentary lifestyle prior to the appearance of agriculture and that very quickly adopted food production once it became available nearby. Unfortunately, a hydroelectric project has inundated this part of the Danube Valley. It is unlikely that it will ever be possible to find new evidence that bears on this problem.

Figure 4. Densely packed, mud-brick houses characterize the homesteads of the early farmers in Near Eastern sites such as Çatal Hüyük in the seventh millennium B.C. As the mud-brick buildings collapsed through decades of use, new buildings were built on top of the old remains, eventually forming large mounds, or *tells*. Archaeological excavations of the mound at Çatal Hüyük reveal that the city (one section of which is tentatively reconstructed here) was continuously inhabited for at least eight centuries. (Adapted from Mellaart 1975.)

Farming in Central Europe

In central Europe early farmers encountered soils and terrain markedly different from those of southeastern Europe, and domestic plants were expected to flourish in a climate with considerably more rainfall and with even sharper seasonal differences than the Near East. Moreover, this terrain was heavily forested with well-established species such as linden, elm and oak. Beneath these forests, however, were basins of fertile loess and moist stream valleys, which were very attractive to farming communities.

Agriculture appears to have been introduced into central Europe by farm-

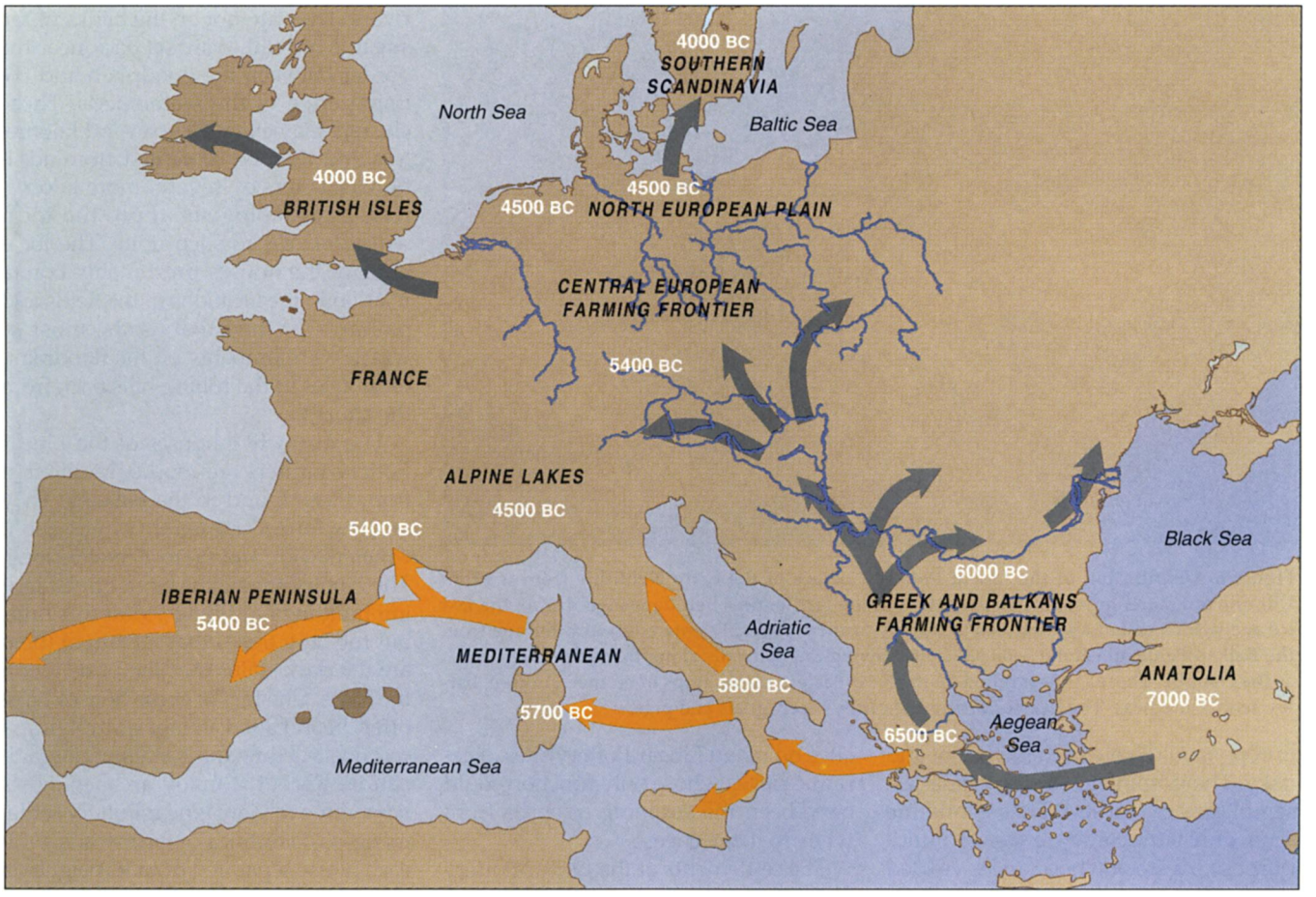

Figure 5. Two major currents of movement characterize the spread of European agriculture after the first farmers entered Greece from southwestern Asia. One progression corresponds to the Mediterranean habitat zone in which agriculture spread along the coast and across the sea to the major islands *(orange arrows)*. Another current of early farmers followed the fertile river valleys of the Balkans and into central, northern and western Europe *(gray arrows)*.

ing peoples who colonized the loess basins. From Slovakia to the Netherlands, the similarity of pottery, house forms, crops, settlement locations and stone tools strongly suggests that the indigenous peoples did not participate in bringing agriculture to the region. These early farmers of central Europe are known as the Linear Pottery Culture (or *Linearbandkeramik*, LBK) because of the distinct ceramics they decorated with incised lines. The Linear Pottery Culture has its roots on the Hungarian Plain about 5600 B.C. and spread within a matter of centuries across central Europe westward to France and northward to Poland and Germany.

The loess basins were attractive to the Linear Pottery Culture for several reasons. First, these areas appear to have had few settlements of indigenous foragers, although recent work has revealed that some hunter-gatherers were present. Any foragers living on the loess were rapidly absorbed or displaced into outlying areas such as the glacial outwash plains of central Poland. Second, the natural fertility of the loess was especially suited to wheat and barley. A third reason was the nature of the terrain and drainage in the loess basins. The spring flooding and groundwater from the watersheds would have recharged the soil nutrients in the narrow floodplains of the small central European streams. As a result, the fertility of these regions was sustained for years despite continuous cultivation.

The crops grown by the Linear Pottery farmers were the familiar domesticates of Near Eastern origin, emmer and einkorn wheat and barley, as well as lentils and peas. Adaptation of these crops to the soils and climate of central Europe indicates the genetic malleability of these plants. It also suggests that the climate of central Europe was somewhat warmer than it is at present, providing a gentler transition from the Balkan and Near Eastern temperatures. Mixed among the carbonized plant remains found on Linear Pottery sites are seeds of shade-loving weeds, which appear to have grown among the crops. Palaeobotanists have concluded from this that Linear Pottery fields were relatively small forest clearings, where the edges were shaded by adjacent trees.

The animal bones found on Linear Pottery sites are characterized by a large proportion of cattle, with relatively few sheep and goats and almost no pigs. These proportions are notable for a number of reasons. In a largely forested environment it would make good sense to minimize the number of sheep, although goats as browsers would still have found adequate food. The numbers of cattle that could be supported in such a habitat also would have been relatively low, yet this species dominates the faunal collections. Pigs, which are ideally suited for forested conditions, are remarkably scarce in Linear Pottery faunal assemblages.

To raise cattle only for meat in the forests and small meadows of central

Figure 6. Distribution of the Linear Pottery Culture of the early Neolithic from western Ukraine to France approximates the extent of the fertile loess belt deposited during the last ice age (which ended about 10,000 B.C.) Early farmers probably entered central Europe from the Balkan Peninsula about 5400 B.C. by following the rich soils along the major rivers, such as the Danube. These farmers relied on the Near Eastern staple crops of emmer, einkorn, barley, lentils and peas. The livestock included cattle, sheep, goats and pigs.

Europe would have been inefficient and risky. The dominance of the faunal assemblages by cattle makes economic sense only if the cattle are seen as multipurpose livestock whose males yielded meat and females were kept primarily for dairy products. Use of dairy products is further documented by the presence on many Linear Pottery sites of ceramic sieves whose only function could have been the straining of curds from whey to make cheese.

The settlements of the Linear Pottery farmers consist of houses that are clustered along the valleys of creeks that drain into the larger central European rivers. They are not on the banks of the streams but rather are set back near the border between the floodplain and the rising edge of the watersheds. These clusters may extend for several kilometers and then be separated from additional clusters by several more kilometers. Archaeologists apply the term *settlement cells* to such units. The locations of the houses presumably bore a relation to the locations of the fields and pastures of the inhabitants, most of which were probably on the floodplain or in vales in the rolling hills back from the stream.

The distinctive houses of the Linear Pottery farmers are markedly different from those found in the Balkans. They are long timber-framed structures, about 6 meters wide and up to 40 meters long. These houses were the largest freestanding buildings in the world at this time, but the only traces that remain of them are the dark stains that the posts left in the loess. Clusters of these houses have often been called villages, implying a certain structure and settlement organization. Recently, many archaeologists have come to view Linear Pottery settlements as collections of farmsteads, with each house separated from its neighbors by some physical and social distance. The shifting of house locations over time produced a palimpsest of postholes and

Grummer/Van Sloun

Figure 7. Distinctive patterns of incised lines on clay pottery made by the early farmers of central Europe are the basis for the name of the Linear Pottery Culture. Although similar ceramic forms and decoration suggest that the Linear Pottery culture was relatively homogeneous, some regional and temporal variation does exist.

pits, which makes settlement on Linear Pottery sites appear denser than was really the case.

Until the 1970s archaeologists believed that the Linear Pottery sites were occupied for only short periods of time. Unlike a Balkan tell, the timber architecture and dispersed layout of a Linear Pottery site did not lead to a large accumulation of debris in one spot—giving the impression of short-term occupation. The apparent brevity of the occupation at these sites was believed to be a consequence of the farmers' agricultural system. Since many subsistence farmers around the world today practice slash-and-burn agriculture (sometimes called shifting agriculture or swidden), Linear Pottery farmers were presumed to have done likewise. Since slash-and-burn depletes soil nutrients quickly (hence requiring the shifting of fields and settlements), the Linear Pottery farmers were thought to have relocated their settlements every few years because they depleted the fertility of the loess.

Recently, however, several lines of research have converged to displace this argument. First was the realization that loess, particularly in the rich habitats favored by the early farmers, is capable of sustaining high crop yields almost indefinitely. It differs significantly in this regard from the thin nutrient-poor soils of the tropics where slash-and-burn is practiced today. Second, a careful study of Linear Pottery settlements indicates that they were in fact long-term habitations. Settlement cells were occupied for several centuries, although houses may have been rebuilt in slightly different locations or abandoned as their inhabitants died. Most archaeologists today do not believe that Linear Pottery farmers routinely "shifted bag and baggage to a new site on fresh virgin soil," as Childe once wrote.

If soil depletion was not the cause of Linear Pottery dispersal, then what was? Settlement cells were not overpopulated—there was ample room in areas that were subsequently occupied by later peoples. Its more likely that community fissioning was the result of local factors. It is possible to envision the occupants of a longhouse as a single social unit (a household), which was the primary unit of social organization and decision making. A household could decide to relocate for many reasons, including conflicts with adjacent households and perceived opportunities for economic and social improvement.

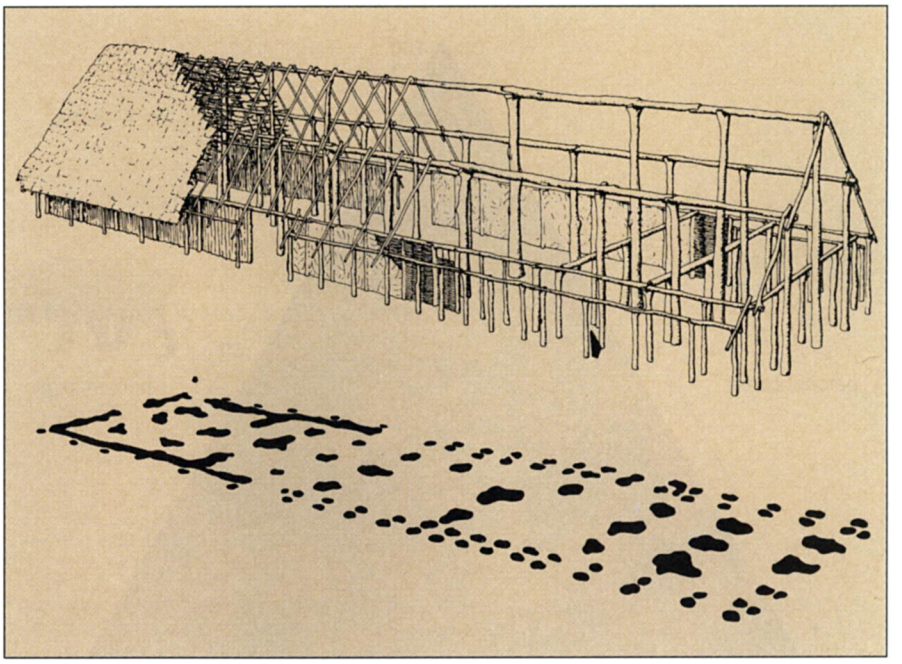

Figure 8. Free-standing timber-framed houses—as large as 40 meters long and 6 meters wide—characterize the farmsteads of the Linear Pottery Culture. Each building is believed to have housed an extended family, and several would make up a settlement site not far from a river or a creek. The dramatic change in architectural design from the densely packed houses of Çatal Hüyük reflects the use of a modular house type suitable for pioneer settlement and made from abundant local materials. The separated dwellings also suggests a greater social distance among the household units that colonized central Europe. Here a reconstruction from a settlement site in Rössing in Germany is positioned over the remains of the wood-frame building left in the soil. (Reproduced from *Ausgrabungen in Niedersachsen*, ed. K. Wilhelmi, 1985.)

Moreover, desire for suitable mates and rules of postmarital residence may also have caused moves that eventually resulted in the establishment of a new household cycle. In any event, it is likely that the reasons for the dispersal of farming across central Europe lie more in the motivations and aspirations of individual households than in single-factor explanations such as soil depletion or population pressure.

Farming along the Mediterranean

As agriculture spread along the Danube basin into central Europe, it was also spreading along the Mediterranean coast westward to Spain. For many years archaeologists believed that there was a Mediterranean "Neolithic package" similar to that found in central Europe—pottery, domesticates and sedentary settlements—that was dispersed through colonization. Recent research, however, has shown that the picture is much more complex, and there is no consensus about the nature of the process. It is a difficult question to answer partly because the coastal and estuarine areas are now submerged after the rising sea levels in post-Neolithic times. As a result most of the research has focused on caves and rock shelters.

One hypothesis holds that the indigenous foraging communities around the Mediterranean selectively adopted some of the characteristics of a food-producing economy as much as a millennium before they became sedentary farmers. In Tuscany, for example, pottery is found in levels dating to the late seventh millennium B.C. even though there is no evidence for an agricultural economy. Evidence from the Grotta dell'Uzzo in Sicily indicates that crops and livestock had moved west by the early sixth millennium B.C., yet the local diet consisted primarily of wild plants and animals. Domesticates also appeared in southern France, Sardinia, Corsica and eastern Spain around this time. Of particular note is the discovery of domestic sheep at several sites, which may have been acquired through trade (or poaching) between foragers and herders.

The Portuguese archaeologist João Zilhão takes a dissenting view, arguing that the beginning of the Neolithic in the western Mediterranean occurred when small groups of settlers brought domesticated plants, animals and pot-

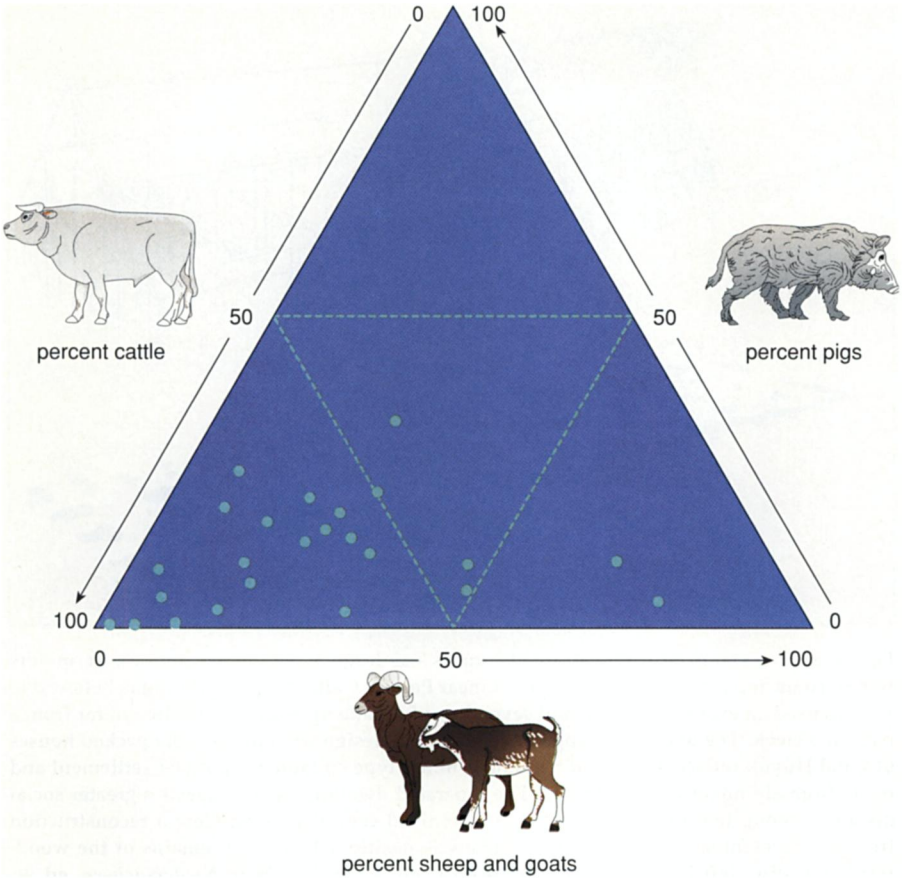

Figure 9. Representation of different livestock types among the remains at farming sites of the Linear Pottery Culture suggests that domesticated cattle were very important to the agricultural economy of Neolithic Europeans. The bones of cattle almost always outnumber the remains of sheep, goats and pigs. The recovery of ceramic sieves—which may have been used for straining curds from whey to make cheese—suggests that the cattle may have been used for dairy production. The bones of wild mammals are usually rare, suggesting that hunting was a small part of the farmers' subsistence strategy. Here the percentages of the domesticated species are estimated from the relative number of bones found at 24 sites in central Europe. (Adapted from Bogucki and Grygiel 1993.)

tery and eventually interacted with the indigenous foragers. Zilhão bases his position on critical analysis of the stratigraphy at many early sites and claims that the mixing of deposits gives the impression that Neolithic technology and domesticates appeared piecemeal earlier than they actually did.

By the late sixth millennium B.C. fully agricultural villages are found in several areas. On the Tavoliere Plain in southern Italy at sites like Passo di Corvo, household complexes, each surrounded by a ditch, contained a complete range of domesticates—sheep, goats, cattle, pigs, emmer and einkorn, barley and lentils. In central Italy, sedentary pottery-using agricultural communities lived at sites like San Marco. The key question here is to determine what happened during the millennium between the acquisition of pottery, crops and livestock by foragers and the development of fully agricultural settlements. Did the foragers settle down and begin to farm in earnest, or was there an influx of farmers from elsewhere?

Critical to understanding the adoption of agriculture in the Mediterranean is the analysis of trade in various materials and products to examine patterns of regional interaction. William Barnett of the American Museum of Natural History has traced the circulation of Neolithic pottery in southern France, and Albert Ammerman of Colgate University and Robert Tykot of Harvard University have both studied the distribution patterns of obsidian. In the absence of evidence for large-scale movements of people, there is a good possibility that the dispersal of agricultural techniques and domesticated plants and animals followed patterns of exchange that were established by the indigenous foragers.

North and South of the Loess

Areas north and south of the loess belt (on the North European Plain and in the alpine foreland) were populated by more hunter-gatherers than was the loess during the sixth and fifth millennia B.C. Forager bands appear to have confined their movements to increasingly smaller areas during this period, particularly the meltwater valleys, marshes, estuaries and coastal regions on the North European Plain and the glacial lakes in the alpine foothills. In some parts of the North European Plain (in central Poland and along the lower Oder river) outlying settlements of the Linear Pottery Culture and its descendants formed "islands" of sedentary agriculturalists.

My Polish colleague Ryszard Grygiel of the Museum of Archaeology and Ethnography in Lódź and I have focused our research on one such "island" in north-central Poland, where we have investigated a series of early farming settlements of the Linear Pottery Culture and its successor, the Lengyel Culture, which spans the period between 5400 and 4000 B.C. These sites are located in glacial meltwater channels, which are analogous to the moist stream basins of the loess. Lengyel settlements in northern Poland represent long-term commitments to particular settlement locations. Here the inhabitants built trapezoidal-plan longhouses among which they buried their dead. The full suite of domesticated plants and animals is found on these sites along with extensive evidence that they relied on local wildlife, including waterfowl, turtles and fish.

Domestic plants and animals became a part of the forager subsistence pattern about a millennium after the appearance of farming communities on the southern edge of the North European Plain. The basis for agriculture was available during this period, but the foragers resisted adopting it until about 4000 B.C. As T. Douglas Price and Anne Birgitte Gebauer of the University of Wisconsin point out, the most reasonable explanation for the delay is that the success of their foraging adaptation meant that the hunter-gatherers saw little immediate use for domestic plants and animals. The answer to the question of *why* they eventually adopted agriculture remains elusive.

We can be reasonably confident that agriculture came to the North European Plain through a complex and poorly understood interaction between the indigenous foragers and the inhabitants of the neighboring farming settlements. Beyond that general characterization, however, only hypotheses can be generated. Feral livestock were probably the first elements of food production to pass through the frontier between foragers and farmers. Mutually beneficial relationships may have formed between hunter-gatherers and agriculturalists, possibly involving the exchange of forest products for surplus crops. Perhaps the sedentary farming life appealed to some foragers, who became drawn to agricultural communities and eventually intermarried with the farmers. Another possibility is that the farmers adopted some aspects of the dispersed foraging settlement pattern while keeping their domestic plants and animals.

At this time the foragers of the Ertebølle culture flourished along the estuaries of the western Baltic coast. The food remains found on Ertebølle sites reflect a maritime focus, which is confirmed by carbon-isotope ratios in human bones. Elaborate cemeteries are known from sites such as Skateholm in southern Sweden. There is some evidence for exchange with farming communities to the south, but despite the local innovation of pottery there is no conclusive evidence of domestic plants or animals. All indications point to Ertebølle as having been a sedentary foraging society based on the intensive use of rich marine resources.

Around 3900 B.C., however, there is a shift to an agricultural economy in the western Baltic littoral. Although these Neolithic farmers are given a different name—the Funnel Beaker Culture—it is clear that they are a continuation of the foraging communities that have added agriculture, livestock and Neolithic technology. As Price and Gebauer put it, the last hunters in this area were also the first farmers. Funnel Beaker sites are found over a wide area, from Poland to the Netherlands and north into Denmark and Sweden. The key change from their foraging predecessors is a shift away from a maritime economy to inland farming, a transition also documented with carbon-isotope samples of collagen from human bones.

In the delta of the Rhine and Maas Rivers and on tidal creeks along the IJsselmeer near Amsterdam, several sites have been found that reveal a different type of adaptation. Hazendonk, Bergschenhoek and Swifterbant are locations that are unattractive for agriculture and have restricted arable land. Nonetheless, there is evidence of agriculture, including crops in the form of charred grain and chaff and the bones of domestic animals. These sites appear to have served different functions. Hazendonk, where 90 percent of the bones are those of wild animals, appears to have been a hunting station. The Swifterbant sites to the north were probably longer-term habitations. Bergschenhoek, which was on a floating peat island, was a short-term winter fishing and fowling station. Some remarkably-preserved fish traps have been uncovered here.

Leendart Louwe Kooijmans of Leiden University has called this type of subsistence "semi-agrarian," because hunting, fowling and fishing were supplemented with animal husbandry and the consumption of cereals. It may be that these sites are the wetland part of a larger settlement system, but sites in drier areas nearby have yet to be discovered. It seems clear, however, that these sites are an example of indigenous foragers who gradually adopted elements of a food-producing economy, probably from farmers not far to the south. This semi-agrarian pattern continued for almost a millennium, until about 3000 B.C., when it was finally superseded by a full farming economy.

A process similar to that seen on the North European Plain appears to have taken place in the foothills of the Alps. The earliest traces of farmers in the late sixth millennium B.C. are found in the form of pioneering communities from the loess to the north and from the Mediterranean basin to the south. Outlying Linear Pottery sites are found in northern Switzerland at Gächlingen and Bottmingen. In southern Switzerland, traces of early farmers with connections to northern Italy have been found at Sion-Planta and Castel Grande-Bellinzona.

As on the North European Plain, there was a delay of almost a millennium before further developments occurred. Around the glacial lake basins in north-central Switzerland, several forager communities had already settled for some time. For example, around the Wauwilersee, a series of hunter-gatherer sites mark the preagricultural shoreline. Around 4400 B.C., agricultural settlements were established on the banks of a number of similar lake basins. At the Wauwilersee, the complex of sites at Egolzwil has yielded

Figure 10. A cave in southern France (Cova de l'Esperit) contains evidence of early farming dating to the late sixth millennium B.C. The cave is located at the edge of the coastal plain, near upland valleys, ideally situated to take advantage of resources offered by both locales. (Photograph courtesy of William K. Barnett.)

Figure 11. Ceramics of the Ertebølle culture—such as this pointed-base pot and a small animal-blubber lamp—are found along the northern coast of Europe and the southern parts of Scandanavia. The people of the Ertebølle culture were sedentary hunters and gatherers who relied on the rich marine life in the region. Around 3900 B.C. the Ertebølle foragers adopted crops, livestock and Neolithic technology. Archaeologists recognize this transition to farming by giving the farmers a different name, the Funnel Beaker Culture. (Photograph courtesy of the National Museum of Denmark).

considerable data on diet and settlement plans, whereas at the Zürichsee an early settlement is found at the Kleiner Hafner.

Although there is evidence of interaction with the communities that succeeded the Linear Pottery Culture to the north, the lake-shore settlements of the Alpine Foreland are best regarded as a local development. They are found in areas of prior forager settlement and in similar lakeside locations. The remarkable preservation of organic material has provided an unusually complete picture of their subsistence economy. Although there was a primary reliance on domesticated plants and animals, a wide spectrum of wild resources was also used, including red deer, wild cattle and many different types of plants. The inhabitants of these sites lived in small rectangular houses (about 4 meters by 8 meters) in rows along the lake shore. Contrary to popular depictions of the "Swiss Lake Dwellings," these structures were not built on pilings over the water, but rather had numerous posts driven into the soft lake shore to support the house.

Farming Reaches the Atlantic

The arrival of agriculture on the Atlantic façade of Europe is still poorly understood, partly because archaeologists have been preoccupied with megalithic chambered tombs and other stone monuments (which were built somewhat later). Few settlements have been excavated, and there is little systematic information on subsistence. Western France is particularly lacking in evidence of the first agriculture. The sites of Téviec and Hoëdic suggest the presence of substantial foraging populations in Brittany. There are indications that domestic animals reached these communities, perhaps the feral livestock from farmers to the east. The little evidence we have suggests that the Neolithic of western France was a local development of the indigenous foragers.

The introduction of agriculture to the British Isles presents a particularly interesting archaeological problem. By 5000 B.C. the English Channel and the Irish Sea had attained their present-day width, so it is clear that contact with the continent required the use of watercraft large enough to carry not only seed grain but also livestock. Beyond the fact that someone had to bring grain and livestock from the European continent, the colonization-versus-adoption debate in the British Isles is lively. The evidence can usually be interpreted to support either position, largely because it is highly variable. I suggest that this variability is consistent with a gradual adoption of food production by native communities rather than a large influx of people from the continent. In contrast to the situation in Greece and on the loess, the British Isles provide ample evidence for pre-agricultural groups, who may have been part of a larger exchange network that spanned the water barriers.

The transition from foraging to farming has received particularly close scrutiny in Ireland recently, and much evidence indicates continuity from hunter-gatherers to agriculturalists. For example, in the Bally Lough area of southern Ireland, Stanton Green of Clarion University of Pennsylvania and Marek Zvelebil of the University of Scheffield have documented that the land-use patterns of foragers and farmers were not particularly different, suggesting continuity in population, resource use and social organization. As in southern Scandinavia and elsewhere in Atlantic Europe, a case can be made that the last Irish hunters were the first Irish farmers. Yet somehow the livestock and grain had to be brought across the Irish Sea. Gabriel Cooney and Eoin Grogan of the University College of Dublin have recently urged that the traditional colonization model not be discarded completely, suggesting that small-scale intrusions of farmers brought a way of life that presented an attractive alternative to foraging.

Conclusion

The introduction of agriculture to Europe does not appear to have been a uniform process in which a "Neolithic package" of domestic plants and animals, pottery and long-term settlements spread steadily across the continent. Instead, there was considerable geographic and temporal variability. In some regions, such as Greece and central Europe, colonization by farming populations from elsewhere appears to have taken place. In other areas, as in northern and western Europe, indigenous foragers adopted agriculture and pottery. In many places, controversy still exists over whether colonization or indigenous adoption was the prime mechanism of agricultural dispersal; reasonable arguments have been voiced for both positions.

Refinement of chronology through radiocarbon dating has made it possible to examine the punctuated nature of the agricultural dispersal across Europe.

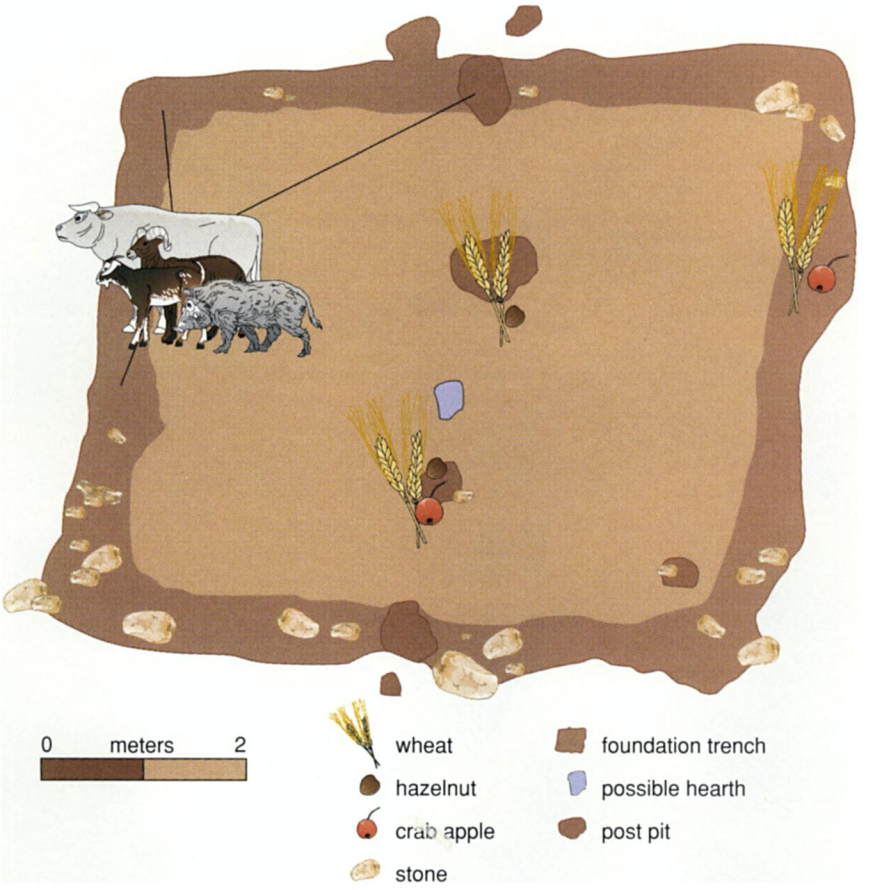

Figure 12. Remains of crops and livestock scattered about the site of a Neolithic house date the arrival of agriculture in Ireland to the early fourth millennium B.C. It appears that crops and livestock were brought to Ireland by small groups of farmers who integrated their economy with the hunting-and-gathering lifestyle. Here the location of livestock and crop remains are shown from a site in Tankardstown South, County Limerick. (Adapted from Cooney and Grogan 1994.)

For example, farming communities existed in Greece for nearly a millennium before penetrating north into the Balkans. Similarly, along the southern part of the North European Plain, a frontier between foragers and farmers persisted until nearly 4000 B.C. From a global perspective the spread of agriculture in Europe took place very quickly, but when studied in detail the spurts and halts become more apparent.

As many investigators have emphasized, soil moisture was a primary determinant of early agricultural settlement in Anatolia, the Balkans and central Europe. In these cases colonization remains the most viable hypothesis. Perhaps eventually the generalization can be made that a clear preference for floodplain and alluvial habitats is a hallmark of agricultural colonization. In contrast, where hunter-gatherers adopted agriculture, the early farming settlements continue in the same locations as their foraging predecessors. This would suggest that domesticates were integrated into an existing subsistence system.

A question that has perplexed archaeologists is why foragers who have successful, and apparently stable, hunting-and-gathering lifestyles adopt agriculture with all its risks and hard work. Perhaps the "stability" of these forager adaptations is illusory and only appears that way through the prism of the archaeological record. It is probably more realistic to assume that foragers, particularly in temperate seasonal latitudes, were *not* in equilibrium with their environment over time. Rather, they were prone to fluctuations in resource availability on both seasonal and annual time scales and on various spatial scales. Even the Ertebølle foragers with their abundant maritime resources may have experienced short-term shortages. One promising hypothesis is that it is precisely during these unstable periods that agriculture took root among foragers in certain regions at the social level of the band or household. Such questions ensure that the study of early European farmers will be an important research topic for years to come.

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Bibliography

Barker, G. 1985. *Prehistoric Farming in Europe*. Cambridge: Cambridge University Press.

Barnett, W. K. 1995. Putting the pot before the horse: Earliest ceramics and the Neolithic transition in the western Mediterranean. In *The Emergence of Pottery: Technology and Innovation in Ancient Societies*, ed. W. K. Barnett and J. W. Hoopes. Washington: Smithsonian Institution Press, pp. 79–88.

Bogucki, P. 1988. *Forest Farmers and Stockherders. Early Agriculture and Its Consequences in North-Central Europe*. Cambridge: Cambridge University Press.

Bogucki, P., and R. Grygiel. 1993. The first farmers of north-central Europe. *Journal of Field Archaeology* 20(3):399–426.

Cooney, G., and E. Grogan. 1994. *Irish Prehistory: A Social Perspective*. Dublin: Wordwell.

Green, S. W., and M. Zvelebil. 1993. Interpreting Ireland's prehistoric landscape: The Bally Lough Archaeological Project. In *Case Studies in European Prehistory*, ed. P. Bogucki. Boca Raton: CRC Press, pp. 1–29

Greenfield, H. 1993. Zooarchaeology, taphonomy, and the origin of food production in the central Balkans. In *Culture and Environment: a Fragile Coexistence*, ed. R.W. Jamieson, S. Abonyi, and N.A. Mirau. Calgary: University of Calgary Archaeological Association, pp. 111–117.

Hodder, I. 1990. *The Domestication of Europe*. Oxford: Basil Blackwell.

Louwe Kooijmans, L. P. 1993. The Mesolithic/Neolithic transformation in the lower Rhine basin. In *Case Studies in European Prehistory*, ed. P. Bogucki. Boca Raton: CRC Press, pp. 95–145.

Mellaart, James. 1975. *The Neolithic of the Near East*. New York: Charles Scribner's Sons.

Perlès, C. 1994. Les débuts du Néolithique en Grèce. *La Recherche* 266:642–649.

Price, T. D., A. B. Gebauer, and L. H. Keeley. 1995. The spread of farming into Europe north of the Alps. In *Last Hunters—First Farmers. New Perspectives on the Prehistoric Transition to Agriculture*, ed. T. D. Price and A. B. Gebauer. Santa Fe: School of American Research Press, pp. 95–126.

Scarre, C. (ed.). 1983. *Ancient France*. Edinburgh: Edinburgh University Press.

van Andel, T. H., and C. Runnels. 1995. The earliest farmers in Europe. *Antiquity* 69:481–500.

Whittle, A. 1996. *Europe in the Neolithic*. Cambridge: Cambridge University Press.

Wilhelmi, K. 1985. *Ausgrabungen in Niedersachsen*. Stuttgart: Konrad Theiss.

Zilhão, J. 1993. The spread of agro-pastoral economies across Mediterranean Europe: a view from the far west. *Journal of Mediterranean Archaeology* 6:5–63.