THE ORIGINS OF *Agriculture*

An International Perspective

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The Origins of Crop Agriculture in Europe

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My main aims in this chapter are to review the current archaeobotanical evidence for the earliest crop agriculture in Europe and to show how the origins of European crop agriculture have been, and can be, explained. Because archaeological investigations of crop agriculture involve more than merely noting when cultigens first appeared in an area, a large part of this chapter is concerned with assessing their importance within the overall subsistence strategies of prehistoric communities in different parts of Europe. The outcome of this investigation suggests that it is misleading to study the first appearance of cultigens in isolation from other types of evidence: in many parts of Europe, crop agriculture initially functioned as a minor adjunct of well-established hunting-and-gathering strategies.

In many ways, prehistorians studying early farming in Europe are fortunate compared with their colleagues working in other areas. Agricultural origins have been studied in Europe longer than anywhere else, and the quantity of data now available—at first sight—is extremely impressive. There is also a wealth of supporting data on the chronology, material culture, architecture, animal domesticates, and environmental background that is usually unavailable for other regions. Despite this, both the quantity and quality of archaeobotanical data for the first crop agriculture in Europe are still far poorer than one would wish. Serious attempts to rectify this situation have been made only in the last twenty years, and in many areas of Europe the evidence for early cultigens is still very inadequate.

These inadequacies can often be blamed on the scarcity of serious attempts to recover archaeobotanical data from prehistoric sites. Over much of Europe, however, early cultigens will continue to be poorly evidenced simply because they were of little *initial* value to those who used them. For that reason, such evidence as large carbonized grain and seed samples, crop processing and storage areas in settlements, and ancient field systems may not occur in many regions of Europe until long after cultigens were first used.

Three problems in particular complicate the study of early crop agriculture in Europe. The first is that it is difficult to treat early European plant domestication in isolation from animal husbandry, because crop yields depended heavily on animal manure as fertilizers, while livestock—including oxen for plowing—often relied on crops for much of their winter feed. Animal feeding requirements were probably one of the main demands on any prehistoric crop-growing

community (see, e.g., Dennell 1978; Barker 1985 for discussion). The second problem is the need to consider the local (Mesolithic) hunting-gathering background, as well as contemporaneous developments in the Near East where agriculture originated at an early date. As discussed below, the role of European Mesolithic societies in the expansion of farming across Neolithic Europe may have been seriously underestimated. The third problem is that the diversity of European prehistoric studies is as great as that of the societies under study. This is immediately apparent in the number of languages in which excavation reports are published: those working in Europe have to digest publications in languages as diverse as Finnish and French. An additional but less obvious problem is the effect of different academic traditions, whereby similar types of material are often studied and published in entirely different ways to the detriment of interregional studies. In archaeobotanical studies there are important differences in emphasis between continental and British researchers. The former—particularly in Germany and Switzerland—tend to work within a tightly defined multidisciplinary framework, often with a major interest in vegetational history. British workers, especially in recent years, have tended to favor a holistic approach with a greater emphasis on the interactions between populations, their plant and animal resources, and the environment.

Europe: Preliminary Considerations

The diversity of the European landscape often comes as a surprise to those from larger and more homogenous areas, such as North America or Australia. Dividing Europe into logical, homogenous units is difficult, and most who do so resort to a variety of criteria, whether geographic, climatic, political, or historical. If we bear in mind the state of the current database on early European plant domesticates, we can use the following units: Southeast Europe, the northern margins of the Mediterranean, central Europe, Atlantic Europe, the Alps, and East and Northeast Europe.

Southeast Europe

Southeast Europe encompasses Greece, Bulgaria, Yugoslavia, and southern Romania. The archaeological record for early farming in this region is very similar to that of much of the Near East. In both regions, the evidence for early farming includes "tell" or multiperiod settlements, geometrically painted ceramics, and an emphasis on cereal and legume cultivation and sheep/goat husbandry. There is also little that is immediately pre-Neolithic, except for a few cave sites at some distance from what seem to have been the main areas for early farming.

Geologically, Southeast Europe is complex. It comprises several mountainous areas that contain low-lying and often extensive valley systems, many of which were cultivated by the fifth millennium B.C.[1] The drainage of this region is dominated by the Danube and its tributaries. Historically, and doubtless in prehistory too, these river systems also provided the main routes of communication within the region. The climate of Southeast Europe reflects first the effects of distance from the Mediterranean, and second marked differences in altitude over small distances. In general terms, winters become colder and longer, and summers cooler and wetter from south to north. Local altitudinal differences are superimposed upon this large-scale gradient. In intermontane valleys, winters are less severe and summers are hotter and drier than in the mountains. These upland areas are poor for crop cultivation, but often provide valuable summer grazing for sheep and goat. One of the main themes of agrarian land use in this region, as well as in the Mediterranean, in historic times has been that of transhumance, with valley-based farming communities grazing their sheep in the hills in the summer and returning them in autumn to be fed through the winter on stubble and whatever natural fodder was available in the valley.

Northern Margin of the Mediterranean

This unit is easy to demarcate because it is so precisely defined by its warm, dry summers and generally frost-free winters and by the distribution of the classic Mediterranean crop, the olive. As in Southeast Europe, this region is marked by major altitudinal differences over often short distances between coastal plains and inland mountains. Not surprisingly, transhumance between the two areas has been an important feature of many areas in the Mediterranean basin for at least three millennia.

Central Europe

For our purposes this notoriously ill-defined area can be described as covering the distribution of the Lin-

ienbandkeramik (LBK) culture (ca. 4500–4000 B.C.). This is a remarkably uniform phenomenon that is centered on Germany, much of Poland, Austria, and Czechoslovakia and extends into eastern France and southern Holland. In terms of prehistoric agriculture the main features of this region are areas of loess and other well-drained soils that are extensive, discontinuous, and usually located in river valleys lying between upland areas of only moderate relief. The Rhine, Elbe, and their tributaries would have provided the main communication routes over much of this region. Climatically, the region experiences cool and often wet summers and moderately cold winters with abundant frost and snow.

Atlantic Europe

Atlantic Europe comprises Portugal, northern Spain, western and northern France, the British Isles, Belgium, coastal Netherlands, northern Germany, Denmark, Norway, and southern Sweden. Two themes help unify this otherwise highly diverse region. One is the sea, which presents opportunities for fishing, commerce, and other maritime activities. The other is climate, which again reflects the influence of the Atlantic with its prevalent westerly winds, high rainfall, and ameliorating influence on winter temperatures. The northern part of this region, comprising the British Isles and the Norwegian coast, can be treated as a subunit characterized by rainfall, allegedly temperate climate, and notoriously fickle weather.

The potential for crop agriculture varies enormously across this region. In the northern and highland parts of Britain, as well as Norway and much of Sweden and Denmark, the severity of the winters and the shortness of the growing season greatly constrain crop production, which often is based on barley and oats. Further south, wheat, as well as a variety of legumes and vegetables, tend to be the favored crops. The overwintering of livestock is an important aspect of many crop economies in this region. In southerly areas this can be done by grazing livestock on straw and stubble, but further north leaf fodder and hay increase in importance.

The Alps

This area encompasses Switzerland, southwestern Germany, western Austria, northern Italy, and parts of eastern France. This tiny area has an archaeobotanical significance that is entirely out of proportion to its size, being the area where this type of research began following the discovery of the so-called "lake dwellings" in the 1850s (see the next section). As might be expected, this region is characterized by extensive areas of high mountains, many over 4000 m high; substantial areas of summer grazing; and only limited lowland areas, usually located around lake margins. Farming systems in this region have long emphasized dairy products, the use of summer pasture, and the production of fodder in the lowlands for overwintering livestock.

East and Northeast Europe

This region, which includes Sweden, southern Finland, northwestern Russia, and northern Poland, is marked by long cold winters and short but often hot summers and by a generally low relief (excluding such areas as the Polish Tatra range). An important aspect of early farming evidence in this region is that hunting, gathering, and foraging were often a better alternative to farming. Indeed, in some areas agriculture was adopted only within the last millennium or so.

History of Archaeobotanical Research in Europe

Archaeobotanical research in Europe can be traced back to the beginning of systematic prehistoric research in the 1850s. Until recently, European archaeobotany has been dominated by studies of the origin and diffusion of cultivated plants. It began with the brilliant work of Oswald Heer (1866) on the plant remains from the so-called "lake dwellings" of Switzerland. Even now, this work still ranks among the most innovative and thoughtful ever undertaken in European archaeobotany. In addition to identifying the material from these sites, Heer made many perceptive comments about the type of crop processing activities likely to have been performed there and about the way samples varied in composition within single horizons—topics that did not receive serious attention until the 1970s. After his work, little comparable research was done until after World War I. De Candolle's (1884) *Origin of Cultivated Plants* was a useful synthesis of what had been learned about the history of various cultigens from literary and linguistic sources, but it touched only lightly on archaeo-

logical discoveries. By the 1930s, however, enough had been learned for Bertsch and Bertsch (1949) to draft their *Geschichte unserer Kulturpflanzen,* which contained numerous maps showing the distribution of various cultigens throughout Europe during different prehistoric periods.

Until recently, the number of people active in European archaeobotany was very small, both absolutely and in proportion to those undertaking pollen analysis. In this context it is interesting to note that suggestions that slash-and-burn cultivation was the earliest type of crop agriculture in northwestern Europe were based on inferences from pollen diagrams (Iversen 1941) and not on carbonized plant remains. Because the basic interest in archaeobotanical research concerned the origin and dispersal of different cultigens, only minimal collaboration between archaeologists and archaeobotanists was needed. Archaeologists tended to be more interested in material culture than in subsistence, and archaeobotanists usually showed more interest in vegetational history than in agriculture. Neither party had much interest in retrieving evidence of plant foods from archaeological sites in a large-scale or systematic manner. When attempts were made to estimate the importance of a crop, an estimate of its abundance relative to other plants usually was considered adequate. In addition, the first appearance of a cultigen often was assumed to indicate the adoption of crop agriculture as a major component of the economy. This seemed logical in that crop agriculture supposedly spread through the colonizing activities of farmers (see section below on origins of crop cultivation). Equally logical was the supposition that the first appearance of pottery was also a reasonably accurate indicator of early farming because early farmers used pottery, whereas Mesolithic hunter-gatherers by and large did not. As will be seen later, these assumptions may be true for some areas of Europe but are certainly not so for others, and their uniform application has probably seriously distorted our understanding of early European crop agriculture.

Major developments in European archaeobotany occurred in the 1970s. By then, the New Archaeology was already underway and encouraged a change in emphasis from regional diachronic studies to local synchronic ones. Many prehistorians began to show a greater interest in how the components of a prehistoric cultural system—the physical environment, subsistence, social organization, technology, ideology, and so forth—interacted with each other while a site and its neighbors were occupied. One important consequence of this focus was that both archaeologists and archaeobotanists began to study prehistoric subsistence as a topic in its own right. As a result, the development of large-scale flotation techniques (e.g., Jarman et al. 1972) led to a dramatic increase in the quantity of plant remains retrieved from excavations. Much attention has also been paid since the 1970s to establishing reliable methodologies for assessing the relative importance of each plant resource represented in an archaeological context, for determining which were cultigens and which were commensals of other crops, and for inferring the cropping system to which each crop belonged. Lastly, and importantly, much attention has been paid to evaluating the importance of crop agriculture relative to other food sources in prehistoric farming societies.

Research Goals in Archaeobotanical Studies of Early Farming

In order to investigate the early history of crop agriculture in Europe, the following questions must be asked:

1. When was a potential cultigen first used in an area?

In some parts of Europe, this question can often be answered fairly confidently because plant remains frequently occur in dense concentrations that are easily visible during excavation. Even so, it is worth noting that barley was not evidenced in early Neolithic Bulgaria until the use of large-scale flotation devices. In most areas of Europe, however, carbonized plant remains are present in only low densities and often are diffused throughout an archaeological horizon. If the number and size of samples are small, rarer cultigens may not be detected. In multicomponent sites (e.g., caves), seeds or grains may have percolated downward; in some cases, accelerator radiocarbon dating has indicated that cereal grains might have migrated downward through over 3 m of compacted archaeological deposits (Legge 1986). Consequently, claims for early or pre-Neolithic crop usage based on very small numbers of individual seeds or grains need to be regarded cautiously unless the remains are dated by radiocarbon.

In parts of northern Europe, the main evidence for the earliest crop cultivation is indirect and consists of pollen profiles indicating episodes of woodland clear-

ance that are usually associated with the pollen of plants that can be weeds, such as *Plantago lanceolata,* of arable land. Cereal pollen is often, but not always, found as well. It was once thought that these clearances began in the Early Neolithic (ca. 3500–3000 B.C.), but recent British evidence indicates that woodland clearance also took place in the Mesolithic. This finding indicates that direct evidence for crop cultivation may not be preserved in archaeological settlements until some time after it was practiced.

Finally, the earliest evidence of plant cultigens in some parts of northern and eastern Europe sometimes consists of grain impressions in pottery. Although useful, such impressions need not indicate what was happening locally; for example, some of the pottery made by farmers could be present in the territories of hunter-gatherers as the result of gift-giving or exchange.

2. When was a potential cultigen first cultivated as a crop in its own right?

This question is difficult to answer if samples of carbonized plant remains contain several potential cultigens. Indeed, the commonest plant represented in a sample might be the least valued part of a crop if the sample represented the waste left after crop cleaning (Dennell 1974a). This point emphasizes the need for detailed contextual information on the circumstances under which plant material was preserved. Unfortunately, the absence of this information in most European archaeobotanical reports often makes it impossible to determine whether a plant was an actual or potential cultigen. Unless samples are both large and overwhelmingly composed of the remains of a cultigen, sample composition alone is a poor guide to when a potential cultigen was actually cropped.

Long-distance trade may also be significant in two circumstances. The first is when farming communities may have exchanged cereal produce for other goods with hunter-gatherers in adjacent territories, and the other is when they traded or exchanged with nomadic pastoralists. Hillman (1981) has suggested that imported produce should be discernible if the plant assemblages from a site represent fully processed crops with no evidence for such activities as grain threshing or winnowing. The absence of cereal pollen from or near sites that contain charred grain can also provide an indication that grain was imported. Until this factor is controlled, the scale of crop cultivation in Neolithic Europe may be overestimated, especially in or near areas where hunter-gatherer populations were well established.

3. What was the relative importance of each crop?

Ranking prehistoric crops in terms of their importance has proved to be difficult, and so far two main approaches have been tried. The first is *quantitative.* This was initially done by counting the number of each type of grain or seed in samples from an archaeological horizon to arrive at a percentage (e.g., see Renfrew 1973; Hubbard 1976). There are two problems with this approach. The first is determining what the percentage actually refers to: the number of grains/seeds of that crop as a proportion of the total number in the annual plant diet; the amount by weight or the caloric/protein-value that a plant contributed to the total plant diet; the amount of time spent in cultivating it; or the proportion of arable land used for that crop. The second is that the method fails to take account of the biasing effect of different types of crop processing activities on the representation of material in archaeological samples of plant remains.

For these reasons, I proposed (Dennell 1976a) an alternative, *qualitative* approach that simply ranks the plant species represented archaeologically into three categories: staple, incidental, and casual. Ranking is effected by noting the domestic contexts in which each plant is represented. Thus, staple resources should figure primarily in cooking/storage contexts, while incidentals and casuals should be found mainly in refuse contexts. The main drawback to this approach is that it demands detailed, contextual information and high standards of sampling and recording. It is also inappropriate for sites that lack domestic contexts of crop processing, storage, and cooking.

In conclusion, therefore, it cannot be assumed that a plant was important economically simply because of its archaeobotanical abundance. Consequently, attempts to use the abundance of seeds or grains of particular crops to show changes in the importance of prehistoric crops must be treated circumspectly (Dennell 1977).

4. To what type of crop system did each cultigen belong?

This is one of the most interesting topics in archaeobotanical research, but also one of the least explored. Two approaches have been tried. The first is to look at the commensal plants associated with each crop to see if there is evidence for crop rotations (van Zeist

1968; Dennell 1978). An important prerequisite of this approach is the ability to decide whether commensals in fully processed crops represent contamination that occurred after crop cleaning or the relic proportion of commensals that grew in the crop itself (see Jones 1987). The second approach is to look at the weed flora associated with different types of crops and cropping systems. Modern crops (Hillman 1981; G. Jones 1984) have distinctive weed communities, and prehistoric crops (Groenman van Waateringe 1979; Wasylikowa 1981) were probably no different. The numbers and types of weed seeds that survive in archaeological samples of ancient crops, however, provide a very small and partial sample of the weeds that grew in fields. Consequently, multivariate analyses are probably needed to identify significant associations between the weed seeds and crop plants represented in archaeological samples.

5. What was the actual importance of crop cultivation?

Because the first appearance of cultigens is not the same as the first evidence of crop agriculture as a major part of the local economy, it is necessary to look at other sources of data. One is evidence for other types of plant resources. Another is information on local animal exploitation because changes in the importance of hunting or herding should provide some indication of how the subsistence strategy as a whole was changing. Changes in settlement patterns and in human skeletal remains can also provide useful information on dietary changes (see e.g., Price et al. 1985) and on the approximate importance of plant foods. Finally, environmental evidence in the form of woodland clearance and field system or drainage/irrigation ditch construction is also useful. All of these suggestions emphasize the need for an integrated, holistic approach to studies of early crop agriculture.

History of Early Crop Cultivation in Europe

In this section I concentrate on presenting the primary evidence for early crop cultivation in Europe. Because of space limitations, I emphasize only the major cereal and legume crops. The bibliography is selective rather than exhaustive, and I have utilized only the material that I consider to be both important and accessible. Wherever possible, I also favor reports or syntheses that are in English, and I assume that the reader has a basic knowledge of the European Mesolithic and Neolithic. Background reading for those who do not is referenced at the end of the chapter.

In general terms, we can note an important distinction between the archaeobotanical record for early cultigens in Southeast and Central Europe and the Alps on the one hand and the rest of Europe on the other. In the former regions, there is often a substantial amount of archaeobotanical evidence from several early Neolithic sites. In addition, the first appearance of cereals and legumes usually coincides with that of sheep/goat and other domestic livestock, pottery, and substantial settlements. There is also little evidence for any of these features in local pre-Neolithic contexts. A different picture prevails over the rest of Europe. Cereals and legumes are much less well represented and can first appear in a wide variety of contexts, ranging from late Mesolithic to late Neolithic in date (in artifactual terms) and often without being associated with sheep/goat, pottery, and/or substantial settlements. In such areas, it is rarely possible to obtain more than an impressionistic view of what might have been happening in terms of early crop agriculture. As is discussed below, these differences cannot be wholly attributed to the intensive use of flotation techniques in some regions but not in others. With these points in mind, we can consider the "crisp" evidence from Southeast and Central Europe and the Alps.

"Crisp" Evidence

SOUTHEAST EUROPE

In this region, the earliest farming sites belong to the Early Neolithic, which begins ca. 6000 B.C. in Greece, 5000 B.C. in Bulgaria, and ca. 4700 B.C. in Yugoslavia. Early Neolithic sites in this region usually contain evidence for the earliest local use of pottery, polished stone artifacts, and domesticated crops and animals. The Neolithic of Southeast Europe is outlined by Barker (1985) and Whittle (1985) and regional accounts of the archaeobotanical evidence are provided by several authors, notably Lisitsina and Filipovich (1980), Renfrew (1969, 1979), and Dennell (1978).

Greece (excluding Franchthi Cave) There are two main sources of data on early crop agriculture in

Table 5.1. Cereals and Legumes from Early Neolithic (6200–5300 B.C.) Sites in Greece

	Gediki	Achilleion	Sesklo	Argissa	Soufli	Nea Nikomedia
Triticum monococcum	x	x	–	x	–	x
T. dicoccum	x	x	x	x	x	x
T. aestivum	–	–	–	–	–	–
Hordeum distichum	x	x	x	–	–	–
H. vulgare	–	–	–	x	–	x
Panicum miliaceum	–	–	–	x	–	–
Avena sp.	–	x	–	–	–	–
Pisum sp.	x	–	x	–	–	x
Vicia sp.	x	–	–	–	–	x
Lens sp.	x	x	–	x	x	x

Source: Renfrew 1979.

Greece (see Table 5.1 and Fig. 5.1). The first are the samples collected from Early Neolithic sites after 1958 and studied by Hopf (1962) and Renfrew (1966, 1969, 1979). These were predominantly "grab" samples, collected without the use of flotation techniques, and are summarized in Table 5.1. The small size of each sample and the lack of contextual data prohibit assessments about the importance of each cultigen, but they indicate the presence of three types of wheat and legumes and two types of barley. Recent material from the Early Neolithic of Prodromos can also be included (Halstead and Jones 1980).

The second source of evidence is from the site of Nea Nikomedia (Rodden 1962, 1965). The age of this site has been given as ca. 6230 B.C. on the basis of one radiocarbon date, but a younger one of ca. 5470 B.C. is more likely on the basis of two other radiocarbon dates of 5605 ± 90 and 5330 ± 75 B.C. Although flotation techniques were not used, botanical material was found dispersed throughout the cultural debris but not in storage or cooking contexts. A preliminary study of the botanical remains by van Zeist and Bottema (1971) showed a wide range of wild and domestic plants and considerable variation in sample composition. Unfortunately, the significance of this variability cannot be assessed without further contextual information.

Bulgaria The evidence for cultigens from early Neolithic Bulgarian sites is summarized in Table 5.2. The samples from Azmak and Karanovo I were collected without flotation and were studied by Renfrew (1969) and Hopf (1973). These samples indicated that cereal agriculture was essentially wheat-based and supplemented by lentil and, perhaps, grass-pea.

The evidence from Chevdar and Kazanluk was recovered by large-scale flotation (Dennell 1978). Several types of samples were found. These included large, homogenous samples from ovens/hearths at Chevdar; heterogenous grain samples with large numbers of weed seeds and generally small grains on floor deposits at both Chevdar and Kazanluk; samples comprising numerous spikelet fragments, many weed seeds, and only a few grains from middens at Kazanluk; and samples comprising large cereal grains and small numbers of weeds, again from middens at Kazanluk. By considering sample composition, grain size, and context, I explained these differences as the result of different on-site crop processing activities, such as grain cleaning and dehusking (Dennell 1974a). These data were later used to suggest that emmer, barley, and legumes (mainly lentil) had been staple crops; others such as vetch, flax, and fruits had been much less important (Dennell 1976a). Samples of fully processed crops also allowed assessments of crop purity, which was the same as in later periods (Dennell 1974b). Some kind of crop rotation involving emmer, six-row barley, and pulses was suggested from the association of each crop with its weed flora and commensals (Dennell 1978). This suggestion was strengthened by the discovery of nematode remains often associated with intensive cropping systems (Webley and Dennell 1978). Supplementary data on the catchment areas of Neolithic and later sites in Bulgaria are given in Dennell and

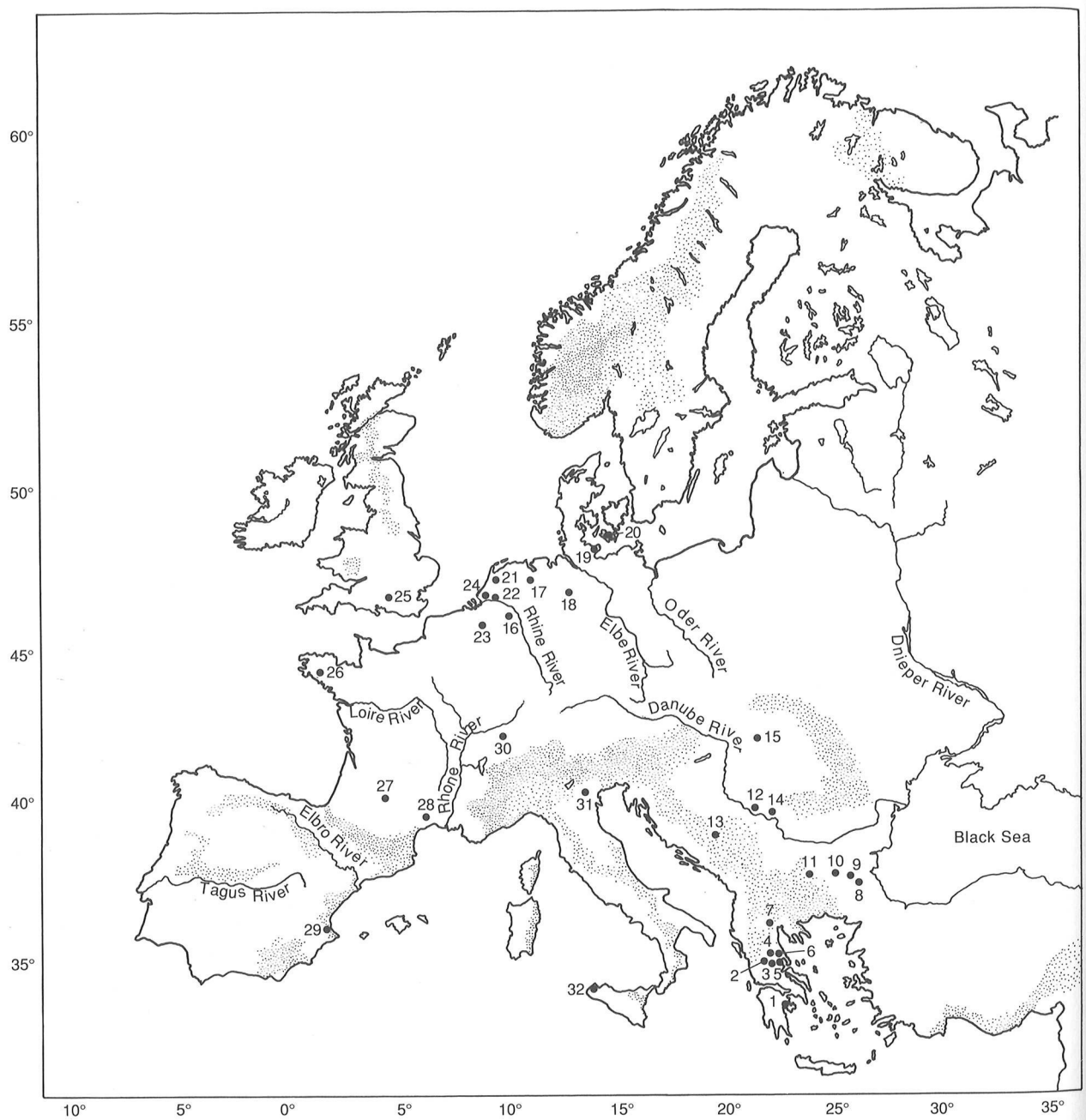


Fig. 5.1. Location of European sites mentioned in the text. **Greece:** 1, Franchthi Cave; 2, Prodromos; 3, Achilleon; 4, Argissa; 5, Sesklo; 6, Ghediki; 7, Nea Nikomedia. **Bulgaria:** 8, Azmak; 9, Karanovo; 10, Kazanluk; 11, Chevdar. **Yugoslavia:** 12, Starčevo; 13, Obre. **Romania:** 14, Icoana. **Poland:** 15, Korlat. **Germany:** 16, Alderhoven Plateau; 17, Dummer; 18, Eitzun; 19, Siggenben-Sud. **Denmark:** 20, Lidsč. **Netherlands:** 21, Swifterband; 22, Hazendonk; 23, Esloo, Stein; 24, Vlaardingen. **Britain:** 25, Windmill Hill; **France:** 26, Tevièc, Hödièc; 27, Roucadour; 28, Abeurador. **Spain:** 29, Coveta de l'Or. **Switzerland:** 30, Cortaillod (and other nearby sites). **Italy:** 31, Molino Casarotto; 32, Grotta dell'Uzzo.

Table 5.2. Cereals and Legumes from Early Neolithic (5000–4600 B.C.) Sites in Bulgaria

	Azmak	Karanovo I	Chevdar	Kazanluk
Triticum monococcum	x	x	x	x
T. dicoccum	x	x	x	x
T. aestivum	x	–	x	x
Hordeum vulgare var. *nudum*				
H. vulgare	–	–	x	–
Vicia sp.	x	–	–	x
Lathyrus cicera	x	–	–	–
Lens sp.	x	–	x	x
Pisum sp.	–	–	x	x

Source: Renfew 1979.

Webley (1975) and on the likely productivity of subsistence agriculture at Chevdar in Dennell (1978:99–112).

Yugoslavia The archaeobotanical record for Yugoslavia is still poor, considering its size and archaeological wealth. The main data from early Neolithic sites were studied by Hopf (1974) and Renfrew (1979) and are summarized in Table 5.3. As in Bulgaria, wheat, barley, pea, and lentil were probably the main cultigens. In one of the few studies of the local surroundings of early Neolithic sites in Yugoslavia, Barker (1975) indicated considerable variation in the location of such sites and, presumably, in their crop regimes. Clearly, much more work needs to be done before there is an adequate account of the earliest crop husbandry in Yugoslavia.

CENTRAL EUROPE

There are several useful English syntheses of the evidence from Linienbandkeramik (LBK) settlements (ca. 4500–4300 B.C.), including those by Barker (1985:139–47), Bogucki (1988), Bogucki and Grygiel (1983), Hammond (1981), and Whittle (1985:76–95). Because this culture appears suddenly and marks the first local use of pottery, domestic crops and animals, and substantial settlements, it often has been assumed to represent an intrusive tradition, best explained as the result of agricultural colonization from areas further south. Its origins, however, are still uncertain. Local late Mesolithic populations may have played a greater part in this early Neolithic culture than has commonly been supposed (see Whittle 1985:94). A long-noted feature is a marked preference for settlement on loess, presumably because it is well-drained, fertile, and easily cultivated (Sielmann 1976). On the other hand, sites such as Esloo and Sittard in the Netherlands are on river terraces, and loess areas on the western and eastern edge of the LBK distribution were not always occupied. In terms of material culture, LBK sites tend to be very uniform and are primarily characterized by timber-framed long-houses

Table 5.3. Cereals and Legumes from Early Neolithic (5000–4600 B.C.) Sites in Yugoslavia

	Starcevo	Vrsnik III	Anza I–III	Obre I	Kakanj	Dani
Triticum monococcum	x	x	x	x	x	x
T. dicoccum	x	x	x	x	x	?
T. aestivum	–	x	x	–	–	–
T. compactum	–	x	–	x	x	–
Hordeum vulgare	x	x	x	x	x	–
Secale sp.	–	–	–	–	–	x
Pisum sativum	x	–	x	x	x	–

Source: Renfrew 1979

(up to 45 m in length and 6 m wide) and handmade, unpainted, and incised pottery. Sites are often large with up to 100 structures. The actual settlements may have been far smaller: at Esloo perhaps only 11 to 17 huts were used simultaneously, and on the Alderhoven Plateau in western Germany settlements may have comprised small clusters of widely separated houses (Hammond 1981; Lüning 1982; Whittle 1985:88). Likewise, estimates of the amount of land in use at any one time for crop agriculture have dwindled in recent years. Earlier suggestions that the inhabitants of LBK settlements practiced slash-and-burn cultivation, relocated their settlements once crop yields fell, and thus colonized large areas quickly have been heavily criticized in recent years (e.g., Rowley-Conwy 1981). Instead, the amount of land under crops may have been only 12 to 30 ha (Milisauskas 1984), and that land may have been cropped for several years in succession. This latter suggestion is supported by Willerding's (1980) comment that some of the weeds represented on LBK sites indicate the presence of hedgerows and fixed fields.

The basic archaeobotanical text on LBK plant husbandry is by Willerding (1980), who has summarized the data from almost 100 sites. Emmer, barley, and pulses are the most common cultigens, while other plants, such as flax, opium poppy, and fruits, are also indicated. One point to stress is that plant remains are not generally well preserved or common on LBK sites, and samples tend to be small. Their archaeological surfaces often have been eroded, hindering attempts to study on-site crop processing and other domestic activities, as can be done in Southeast Europe. Much of the botanical evidence also comes from impressions in pottery and daub, and these are unlikely to indicate the range of species evident in samples of carbonized remains. It is difficult to assess at present the type of variation in crop regimes over the area of LBK settlement beyond noting that barley is represented as carbonized remains only in eastern France (Bakels 1984) and in areas north and west of the Harz Mountains, although barley impressions in pottery are found over a much larger area (see Whittle 1985:87). This may reflect the movement of pottery rather than the actual extent of barley. It is, however, probably significant that emmer is the most commonly represented cereal, and legume remains are sporadic.

The literature on the LBK is vast and only a small selection is cited here, in addition to those already mentioned. Key settlement data are contained in Bakels (1978) and Modderman (1970, 1977) for the Netherlands; Kuper et al. (1974, 1977) for Germany; Kruk (1980) for Poland; and Ilett (1983) for France. Additional archaeobotanical reading includes Knörzer (1968, 1972, 1973, 1977) for Germany; Hajnalová (1973, 1976) for Czechoslovakia; Hartyányi and Novaki (1975) and Tempír (1964, 1973) for Hungary; and Kamieńska and Kulczycka-Leciejewiczowa (1970) and Wasyilikowa (1984) for Poland.

THE ALPS

Agricultural settlements associated with pottery, domestic livestock, and a wide range of cultivated plants (see Table 5.4) were established along the major lake systems of Switzerland and in the upper valleys and tributaries of the Rhine and Rhone after ca. 3500 B.C. Four major cultural groups are recognized by their pottery and other artifacts: the Cortaillod group on the western plateau and in the Jura Mountains; the Pfyn group around the lakes of Zürichsee and Bodensee; the Egozwil group around the lakes of Burgaschisee and Wauwilermoos; and the St. Leonard group in the upper Rhine and Rhone valleys. The quality of preservation of organic material is often stunning, and a detailed picture has been built up of animal and crop husbandry, as well as of the types of textiles and wooden artifacts that were used. Most settlements were small and many may have been the equivalent of individual farms or hamlets. The largest contained perhaps 150 to 180 people and was occupied for several decades. Barley, emmer and bread wheat, flax, and peas have been found in storage contexts, and einkorn, lentil, and millet, as well as a wide range of wild plants, have also been found.

Although the subsistence and dating of the local late Mesolithic are poorly understood, it may overlap with the early Neolithic (Gregg 1988:13–14). If so, foragers and farmers could have coexisted for several generations. The origins of the Swiss Neolithic are still obscure: many have argued that it represents colonists from areas of Bandkeramik settlements, but it seems at least as likely that some local populations acquired the necessary resources and developed agriculture locally (see Barker 1985:124).

Convenient English summaries of the Swiss data are provided by Barker (1985:118–24), Gregg (1988:10–15), and Sakellardis (1979), who also includes summary tables of the botanical and faunal data. Further botanical data on early alpine settlements can be found in Heitz et al. (1981), Jacomet-

Table 5.4. Cereals and Legumes from Early Neolithic (3500–3000 B.C.) Sites in Switzerland

	Chavannes	Cortaillod	Lüscherz	Neuenstadt	Port	St. Blaise	Thun	Wangen
Triticum monococcum							x	x
T. dicoccum							x	x
T. aestivum	x		x	x				S
T. compactum	x		X		S	x	S	x
Hordeum distichum								S
H. hexastichum		x	x		S	x	x	S
Panicum sp.			x					x
Lens sp.						x		
Pisum sp.			x		S	x	x	x

Source: Sakellaridis 1979: 344–45, 358–59.
Key: x = present; X = frequent; S = storage context

Engel (1980, 1981, 1986, 1987), Jacomet and Schibler (1985), Jøorgensen (1975), Küster (1984), Baudais-Lundstrom (1978, 1984), Schlichtherle (1985), and van Zeist and Casparie (1973).

Data from subalpine Italy show that foragers adopted pottery, cereals, and sheep/goat around 4000 B.C. without otherwise changing their lifestyle to any significant degree. At Molino Casarotto, for example, the remains of red deer and boar dominated the faunal sample, while cattle, sheep, and goats comprised only 3 percent of the total. Cereals were represented, but in very small amounts, and their remains were far rarer than those of water chestnuts. Farming does not seem to have become well established in this region until after 3000 B.C. (see Barker 1985:124–26).

"Diffuse" Evidence

THE MEDITERRANEAN BASIN

With a few notable exceptions, research into agricultural origins in this region is still poorly developed. The archaeobotanical record is very weak for the Adriatic coastline of Yugoslavia, much of central and northern Italy, southern Spain, and many of the Mediterranean islands. In addition, a substantial number of sites in the northern Adriatic and the Bay of Languedoc in the Marseilles area have probably been drowned by rising sea levels since the sixth millennium B.C. A further bias is caused by the lack of open-air sites outside southern Italy, as almost all the key data on early crop agriculture are from caves. These are often located in areas of low arable productivity, and many may have been used seasonally in connection with animal herding or hunting. For these reasons, discussion has to focus on those areas where useful results have been obtained, namely Franchthi Cave in Greece, Grotta dell'Uzzo in Sicily, southern France, and, to a lesser extent, coastal Yugoslavia and southern Italy.

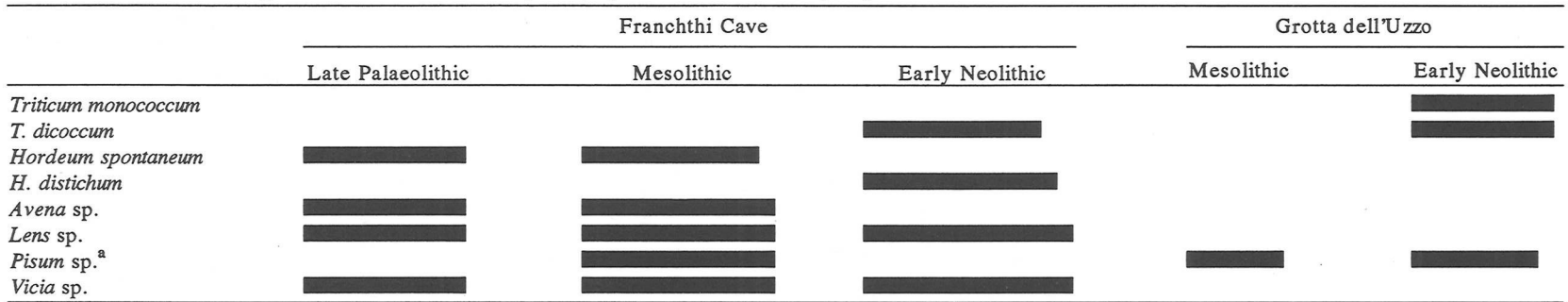
Franchthi Cave This cave site in southern Greece is tremendously important for studies of agricultural origins in the Mediterranean because of its long cultural sequence from the late Upper Pleistocene to beyond the Neolithic. Its excavation included one of the most intensive sieving and flotation operations ever mounted (summarized in Diamant 1975). Preliminary reports are provided by Jacobsen (1976, 1981), by Payne on the fauna (1975), and by Hansen and Renfrew (1978) on the botanical data. The last mentioned are summarized in Table 5.5. This information is provocative in showing that wild barley and lentil were utilized in the late Pleistocene and early Holocene, and it strengthens arguments that at least some cultigens were present in Southeast Europe before the Neolithic. Plants such as pear and pistachio also seem to have been used throughout the Franchthi sequence. Evidence published so far indicates that domestic forms of wheat, barley, and possibly lentil do not appear until the Neolithic layers (ca. 6000 B.C.), which also contain the first indications of pottery and sheep/goat. This evidence for discontinuity between the Mesolithic and Neolithic might suggest that agriculture was introduced in a developed form from elsewhere.

Grotta dell'Uzzo This cave site in Sicily rivals Franchthi in having a long and carefully researched sequence that spans the Mesolithic and Neolithic (Table 5.4). In the Mesolithic layers (8500–6000 B.C.), remains of grass pea (*Lathyrus*), pea (*Pisum*), wild strawberry, wild olive, and wild grape were found. The early Neolithic layers postdating 6000 B.C. contained remains of *Lathyrus/Pisum* and wild strawberry, but also einkorn, emmer, bread wheat, barley, and lentil, along with the remains of domestic animals. Pottery, however, seems to have appeared after the first usage of these domestic resources (Constantini 1989).

Southern France General summaries in English of the Mesolithic–Neolithic transition in southern France are provided by Lewthwaite (1986), Mills (1983), Phillips (1975), and Trump (1980). The evidence from this area is fascinating in showing a gradual transition to farming between 6000 and 4000 B.C. within the context of highly stable Mesolithic foraging strategies. Sheep appear to have been the first major local introduction. Geddes (1985) has argued convincingly that these sheep were probably Asiatic in origin and were probably derived from Italy and, ultimately, Greece. Whether they arrived of their own accord or were acquired through contacts with adjacent herders and farmers is currently unknown.

Local Mesolithic traditions in material culture and site location persisted well into the Neolithic, the beginning of which is defined by the first appearance of pottery in the early fifth millennium B.C. Mesolithic plant usage is evidenced by the sporadic appearance of dwarf chickling (*Lathyrus cicera*) and bitter vetch

Table 5.5. Cereals and Legumes from Franchthi Cave, Greece, and Grotta dell'Uzzo, Italy



Sources: Hansen 1978; Constantini 1989.
[a]This group includes *Lathyus* at Grotta dell'Uzzo.

(*Vicia ervilia*), for which a local origin does not raise any problematic issues. More controversial are the claims by Vacquer et al. (1986) of domestic and Asiatic forms of chickpea, lentil, and pea from a Mesolithic context at Abeurador, dated to ca. 6790 ± 90 B.C. Further information is required on their identification as domestic and Asiatic, and confirmation of their context by accelerator radiocarbon dating would also be needed if these identifications are confirmed. When cereals first appear in southern France is unclear, but small quantities of the remains of emmer (*Triticum dicoccum*), bread wheat (*T. aestivum*), and/or barley (*Hordeum* sp.) have been found in contexts at such sites as Chateauneuf-les-Martigues and Grotte des Eglises from the late fifth millennium B.C. (Courtin and Erroux 1974).

If we exclude the controversial finds from Abeurador, crop agriculture appeared after pottery and sheep and probably developed on a large scale only after 4000 B.C. Crop agriculture appears to have begun, therefore, in several ways in the Mediterranean basin: by a process of sudden change, along with the adoption of sheep/goat and pottery, as at Franchthi; suddenly, with the adoption of both cereals and sheep/goat but not pottery, as at Grotta dell'Uzzo; and as a process of gradual and probably minor change by foragers, who also acquired sheep and pottery, as in southern France.

One area of the Mediterranean that shows a major discontinuity between the Mesolithic and Neolithic is southern Italy and eastern Sicily. Enormous (up to 500 m by 750 m) ditched enclosures, associated with pottery and probably domestic cereals and livestock, appear between 5000 and 3000 B.C. (see Barker 1985:65–67; Whittle 1985:103). These sites often are located on areas of well-drained and easily tilled soils, suggesting that crop cultivation may have been important (Jarman and Webley 1975). Although these settlements might represent direct colonization from the Aegean, the evidence is still ambiguous, and a local origin cannot be ruled out. The same is also true of coastal Yugoslavia, where recent data (Chapman and Müller 1990) show that pottery, cereals, and domestic livestock were used after 5000 B.C.

Elsewhere, however, the dominant impression is one of a predominantly foraging way of life that continues well into the Neolithic and gradually involves the acquisition of pottery, cereals, legumes, and sheep/goat. Italian data are summarized by Barker (1985:65–67), who suggests that between 4500 and 3000 B.C. there was a variety of subsistence strategies in and south of the Po Valley. These included year-round foraging, seasonal foraging by herders, year-round herding, and herding-cum-cultivation. All these are recognized formally as Neolithic because of their pottery, but farming as a general way of life is not in evidence until after 3000 B.C.

Data from Spain are sparse. Pottery was probably in use by the early fifth millennium B.C., and einkorn, emmer, bread wheat, and barley were used ca. 4500 B.C. at the Coveta de l'Or site (Hopf and Schubart 1965). Other botanical reports (e.g., Hopf and Catalan 1970; Hopf and Muñoz 1974) add little to this picture. In southern Spain, there seems to have been a considerable degree of continuity between the Epipalaeolithic and Bronze Age with only a minor effect on previous traditions resulting from the introduction of pottery, cereals, and sheep (Guilaine et al. 1982). Most of this evidence comes from seasonally used caves, however, and a different picture might emerge from examinations of open-air sites.

ATLANTIC SEABOARD

There has been some excellent recent work on the Mesolithic and/or Neolithic in the Netherlands, Denmark, southern Sweden, Britain, and Ireland. Unfortunately, there has been little comparable work in Portugal, western and northern France, Belgium, and Norway; research in northern Spain has been primarily a by-product of cave and midden-oriented Palaeolithic and Mesolithic investigations; and work in southwestern France on the Mesolithic and Neolithic has always been overshadowed by the richer Palaeolithic sequences of the Dordogne. Nevertheless, the archaeological record of the Atlantic seaboard and the Baltic/North Sea region contains some important regularities.

The essential background to understanding the origins of crop agriculture in these areas is the local Mesolithic. Although most of our knowledge of this is from northwestern Europe, subsistence before 4000 B.C. was primarily based on a broad range of "traditional" resources, notably red and roe deer, pig, and aurochs; plants (such as hazel and acorn); and in coastal regions, sea mammals (such as seal), fish, and shellfish. The last were often collected in large numbers, as evidenced by the number of shell middens, which are archaeologically one of the most conspicuous types of Mesolithic sites in many coastal regions of northwestern Europe. In terms of regional productivity, population densities were probably higher

than those of Central Europe. Some (e.g., Rowley-Conwy 1983; Zvelebil 1986) have argued that many of these groups were largely sedentary and often socially differentiated (see also Price and Brown 1985). The beginning of the Neolithic in these parts of Europe, as elsewhere, is defined by the first appearance of pottery. In many cases, previous traditions of resource procurement continued unchanged. In short, Mesolithic hunter-gatherer-fishers often became simply Neolithic pottery-using hunter-gatherer-fishers. Sadly, this point has often been ignored in studies of Mesolithic and hunter-gatherer behavior since pottery can provide useful information on exchange networks and social differentiation. In areas such as southern England, however, the first pottery seems to have appeared considerably later than the earliest evidence for cereals (see below), and so no hard and fast rule can be drawn.

Otherwise, the transition from foraging to farming often spanned several centuries, extending from the time when domestic resources first appeared to the time when farming became a dominant part of local subsistence. During this transitional period, neither cereals nor domestic livestock, of which sheep are the least ambiguous, appear to have been more than minor additions to existing subsistence strategies. In this light, it is not surprising to find occasional carbonized cereal grains, palynological evidence for woodland clearance and cereal cultivation, or sheep bones in otherwise Mesolithic contexts or to find few major changes in subsistence until well into the Neolithic. Although more data are needed, the following evidence provides some indication of how protracted the transition to farming was along the Atlantic seaboard.

COASTAL NETHERLANDS, NORTHERN GERMANY, AND SCANDINAVIA

The first crop agriculture in these areas occurred within the context of well-established foraging (Mesolithic) communities. After 4000 B.C., many of these in the Netherlands, northern Germany, and southern Scandinavia began to use pottery, and the necessary techniques may have been acquired independently or from adjacent (LBK) farming groups. At some sites dated to between 4000 and 3000 B.C., there is some evidence for the consumption and, sometimes, for the local cultivation of cereals, along with the herding of domestic livestock. These, however, were generally minor additions to an otherwise foraging way of life until well after 3000 B.C.

Coastal Netherlands Two features of the general background to early farming in this area are worth noting. One is that there were LBK farming sites in southern Holland by 4000 B.C. from which agricultural resources could have been obtained; the other is that the amount of arable land decreased because of rising sea levels in the fourth millennium B.C.

The Mesolithic settlements in the Drenthe area are described by Barker (1985:164–66). Unfortunately, there are no data on the subsistence, although it is likely that a wide range of fish, waterfowl, and terrestrial mammals were exploited. Pottery may have been used as early as 4300 B.C., although the dating is insecure, and it might not have been in general use until well after 4000 B.C. (Zvelebil and Rowley-Conwy 1986:77). The key evidence on early farming in this area comes from the site of Swifterband 3, dated to ca. 3400–3300 B.C. This site was located on one of several low clay levees in an area of tidal flats that were flooded in winter. The presence of chaff fragments, as well as grains of six-row barley and emmer, shows that these were grown locally and not imported (Casparie et al. 1977). Cereal growing must have been on a small scale and would probably have taken place during seasonal visits between March/April and late September (Barker 1985:171). Otherwise, fishing, fowling, and hunting seem to have been the main sources of food. The same conditions prevailed at the site of Hazendonk (ca. 3370 B.C.), which contained numerous remains of fish and some grains and chaff fragments of einkorn and barley (Looue Kooijmans 1976). The persistence of this way of life is evidenced by the sites of the Vlaardingen culture (ca. 2500–2000 B.C.), which have produced much evidence of hunting and fowling and only a little evidence for cereal cultivation (van Zeist 1968:55–65).

Northern Germany Little is known of developments towards farming in this area, but they seem to be similar to those in the coastal Netherlands. The earliest pottery at the site of Dummer dates from 4110 B.C. and is only a little later than the LBK site of Eitzun, which is dated to 4530 ± 210 B.C. and is located 100 km to the southeast (see Zvelebil and Rowley-Conwy 1986:78–79). There is no evidence at all, however, for any domestic crops. Moreover, they are not evidenced in later layers (ca. 3670 B.C.) at Dummer (Zvelebil and Rowley-Conwy 1986:78). It seems likely that foraging provided the main source of food in this area throughout most of the Neolithic.

Scandinavia Relevant data on southern Scandinavia are summarized by Barker (1985:232–39). The appearance of cereal cultivation and stock rearing in this area coincides with the first appearance of Trichterbecker (TRB or "funnel-necked beaker") pottery between 3300 and 2700 B.C. On stylistic grounds, it now seems doubtful that the appearance of pottery represents the immigration of farming groups. Subsistence data confirm this view. According to Madsen (1982), the same types of coastal and lakeside hunting sites that were used in the (pottery-using) Ertebølle phase of the late Mesolithic were also used in the early TRB, and they were used to take the same type of fish, fowl, and game. These sites may have been used seasonally by groups operating from larger residential sites, which were situated inland and had some potential for crop cultivation. Faunal data indicate that, although some sheep/goat were kept, they were less important than cattle and pig, both of which were important in the preceding Mesolithic. Evidence for cereal cultivation is scarce until well after 3000 B.C. At Lidsč, for example, a pit yielded only 9 grains of barley, 2 of emmer, and 2 of einkorn, but they produced 58 seeds of *Rubus* and over 8,500 seeds of *Chenopodium* (Jøorgensen and Fredskild 1978). Cereals are only sparsely represented in other TRB sites elsewhere in Denmark (see Jøorgensen 1976, 1981).

Data from southern Sweden also show that early crop cultivation was incorporated on a small scale into existing foraging strategies (e.g., see Hultén and Welinder 1981). As in Denmark, crop cultivation does not appear before the TRB culture, which some (e.g., Welinder 1982) regard as an intrusive tradition, although others (e.g., Barker 1985:234; Zvelebil and Rowley-Conwy 1986:81) are skeptical. The Swedish evidence is interesting in indicating that early farming was even more small-scale than in Denmark and was then abandoned for several centuries. Subsistence data (Welinder 1982) indicate that hunting continued as the main subsistence activity at TRB sites, although there is some evidence for the cultivation of emmer and barley. There is, however, no evidence for any cereal cultivation in central Sweden between 2700 and 2300 B.C., and it seems likely that this was abandoned in favor of sealing, fishing, and hunting (Zvelebil and Rowley-Conwy 1986:81).

Data from Norway on early farming are extremely sparse, and such carbonized plant remains as have been found are summarized by Griffin (1981). According to Berglund (1985), developments might have been like those in central Sweden: a little crop cultivation at ca. 2700 B.C. and then none until ca. 2000 B.C. As elsewhere in Scandinavia, the first evidence of pottery (at ca. 3000 B.C. in southern Norway) has little economic significance.

BRITISH ISLES

Britain can be treated as a case in its own right, in view of its size, diversity of environments, and amount of relevant data. As elsewhere, the advent of farming was initially assumed to be marked by the synchronous appearance in the Neolithic of cereal cultivation, animal herding, and pottery. For this reason, supposedly "early" Neolithic sites, such as Windmill Hill, were often cited as showing the earliest farming communities in Britain at ca. 2900 B.C.

A very different picture has emerged over the last ten years through radiocarbon dating and palynological studies. It now seems that the Mesolithic and Neolithic overlapped in mainland Britain for at least 300 years and in Ireland for at least 800 years (Williams 1989; Green and Zvelebil 1990). Pollen evidence indicates that cereals may have been used before the Neolithic. Edwards and Hirons (1984) concluded that the earliest reliable indicators of cereals in Britain extend back to ca. 4000 B.C. in contexts that are otherwise indistinguishable from securely Mesolithic ones.

Interpretation of this evidence is still confused. The traditional model envisaged a period of agricultural colonization from the continent (e.g., Case 1969) on the grounds that foragers were incapable or unwilling to acquire these resources themselves. An alternative is that indigenous Mesolithic communities acquired cereals, sheep, and pottery of their own accord from the continent, and incorporated these into existing practices (Dennell 1983:184–87). Which process was the more important is perhaps subsidiary to the point that foragers and farmers coexisted in Britain and Ireland during much of the fourth millennium B.C., before farming became of major regional importance.

Undisputed evidence for cereal cultivation in the form of cereal grain remains or impressions is not found in England until after 3000 B.C. The main evidence for this is still the grain impressions on the pottery from Windmill Hill (Helbaek 1952). Because almost all these were of emmer, Helbaek (1952) concluded that this had been the most important crop. I revised (Dennell 1976b) this view by showing that most of the pottery sherds with emmer impressions had been imported from an area over 50 miles away, which was well suited for wheat cultivation, whereas

the pottery made locally contained mostly barley impressions. This conclusion has since found general (e.g., Whittle 1985:221) and partial (e.g., Monk 1986) acceptance.

COASTAL FRANCE, NORTHERN SPAIN, AND PORTUGAL

A useful discussion of what little is known about the transition to agriculture in these areas can be found in Zvelebil and Rowley-Conwy (1986:68–73). As elsewhere, the advent of "the Neolithic" has usually been defined in ceramic terms only and does not appear to indicate more than the acquisition of pottery by well-established foragers. In western France, much of the record for coastal exploitation before the end of the sixth millennium B.C. has been lost due to rising sea levels. The earliest sites with pottery date to ca. 4500–4000 B.C. and seem to indicate a basic continuity with the preceding "Mesolithic" in terms of site location, lithic technology, and resource exploitation. A few also contain faunal assemblages that are dominated by the remains of wild animals but also contain a few sheep or goat bones. The only evidence for cereal cropping comes from the inland site of Roucadour. Despite Scarre's (1983:267) assertion that "even the earliest of the known pottery-using sites had an agricultural base," there is no clear evidence that agriculture was ever more than a minor component of a foraging lifestyle until well into the Neolithic. The same is true of the Pyrenees. As Bahn (1983) points out, if there was a "Neolithic revolution" in this area, it did not happen until the Bronze Age and, even then, pastoralism was far more important than crop agriculture.

A slightly different situation may have prevailed in Brittany in northwestern France, although more data on Neolithic and Mesolithic plant usage are needed. Palynological studies indicate the presence of ruderals and cereals in profiles dating back to the fifth millennium B.C., and so some form of agricultural clearance may have occurred by that time. Data from such sites as the Mesolithic middens of Téviec and Hödièc (ca. 4500–4000 B.C.), however, show an overwhelming predominance of coastal and marine resources, albeit with some very slight evidence for dog, sheep, and domestic cattle. These sites may, of course, represent only part of the annual activities of Mesolithic groups in the area, and crop cultivation and livestock herding may have been more important inland. There is no evidence as yet, however, that crop cultivation was important in this area until late in the third millennium B.C., long after the beginning of the Neolithic, as defined by the first appearance of pottery (see Hibbs 1983).

BALTIC REGION AND WESTERN RUSSIA

As in northern Europe, the history of the earliest crop cultivation in the Baltic and western Russia is essentially one of a minor component being added to hunter-gatherer subsistence strategies, long after the first appearance of pottery and the ensuing advent of the Neolithic (see Fig. 5.2).

The onset of agriculture in southern Finland coincided with the appearance of the Boat Axe culture at ca. 2500 B.C. Crop agriculture, however, did not take place on a large scale until the mid-first millennium A.D. and even then, as now, wild resources continued to be important (Zvelebil 1978). Much the same picture emerges from western Russia (Dolukhanov 1979, 1986). In the forest zone in the northern part of western Russia, pottery-using foragers persisted from the mid-fifth millennium B.C. until well into the first millennium B.C. Further south in the forest-steppe zone, crop cultivation was practiced on a large scale between ca. 4000 and 2500 B.C. at sites with Triploye assemblages, most of which are found between the Dneister River and the Romanian border. This may indicate a process of agricultural expansion similar to that of the LBK culture into central Europe; whether it supplanted or assimilated local foraging populations is still unclear. Thereafter, pastoralism seems to have been of major importance, and large-scale crop agriculture is not evidenced until the end of the second millennium B.C. Botanical data from southern Russia (Janushevich 1984) indicate a gradual expansion eastward of emmer from the Romanian border areas toward the Don River, but there is no clear indication that crop cultivation was of major importance in these easterly regions until historic times.

Explanations for the Origins of Crop Cultivation in Europe

Despite the immense variation in the material culture of early farming groups and in the quality, quantity, and type of evidence for early agriculture from different parts of Europe, the archaeological evidence indicates three types of patterns (see Figure 5.3). These are:

1. Areas where farming communities appear suddenly.

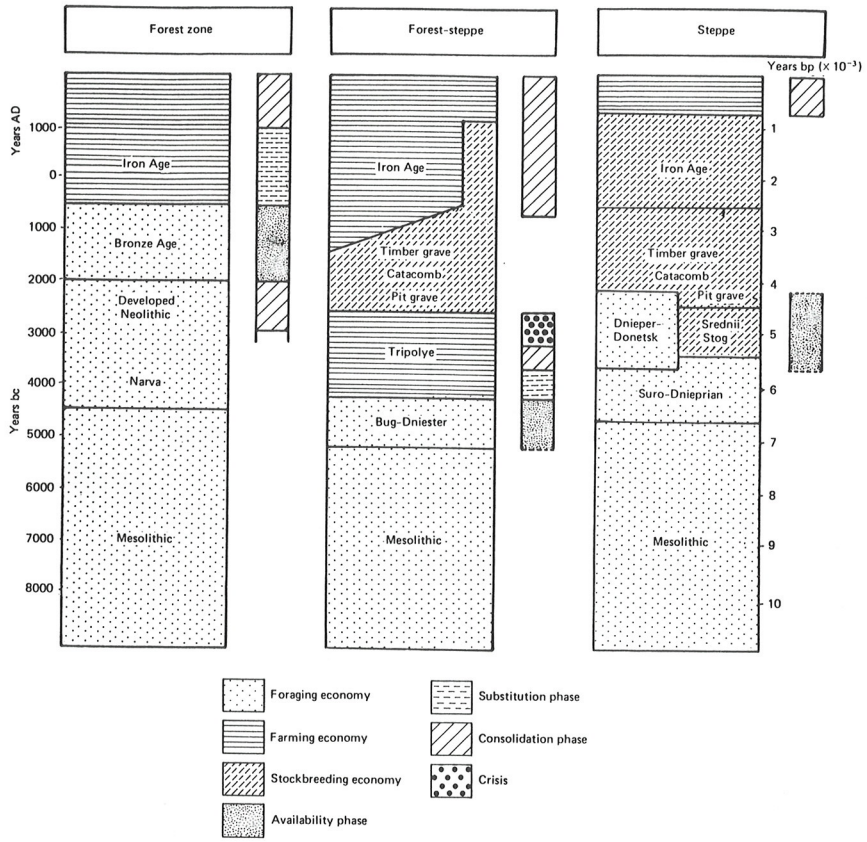


Fig. 5.2. The transition to agriculture in eastern Europe. (From Dolukhanov 1986:118)

In some areas, notably much of Southeast and Central Europe and the Alps, the early Neolithic appears as an intrusive phenomenon into a local Mesolithic foraging context. In those areas where the Mesolithic has been researched, the Mesolithic and Neolithic are spatially distinct and often coexist as distinct entities for up to several centuries before the former disappears.

The remains of villages associated with pottery and domestic crops and animals are a conspicuous feature of the archaeological record in these areas. Some of these settlements, especially in Southeast Europe, were occupied for several centuries; elsewhere, they were occupied for perhaps a few decades. Most were also small by comparison with later examples and rarely contained more than 200 inhabitants. As discussed above, current estimates favor numbers of between 150 and 200 for the largest tell settlements in Bulgaria (Dennell 1978), perhaps 20 to 60 people for most LBK settlements (Hammond 1981), and around 100 for the first farming settlements in Switzerland (Barker 1985:127). The density of early farming communities in these areas was also low, at least at a regional level. Many areas remained unoccupied long after farming first appeared. Examples are large parts of mainland Greece and the Mediterranean islands (Halstead 1981; Cherry 1981); other areas were only lightly settled, such as large parts of Bulgaria (Dennell 1983:156) and Germany (e.g., Hammond 1981).

Overall, the areas where farming appeared suddenly tend to be those with the best archaeobotanical data. Some of the best evidence has come from the tell or occupation mounds of Southeast Europe where large amounts of plant material were processed and cooked near hearths and ovens; sometimes it has come from settlements like Chevdar, Azmak, and Ezero in Bulgaria, which were gratifyingly combustible (see Dennell 1978). Swiss lakeside settlements often were exemplary traps for archaeobotanical material, although LBK sites are generally poor for such

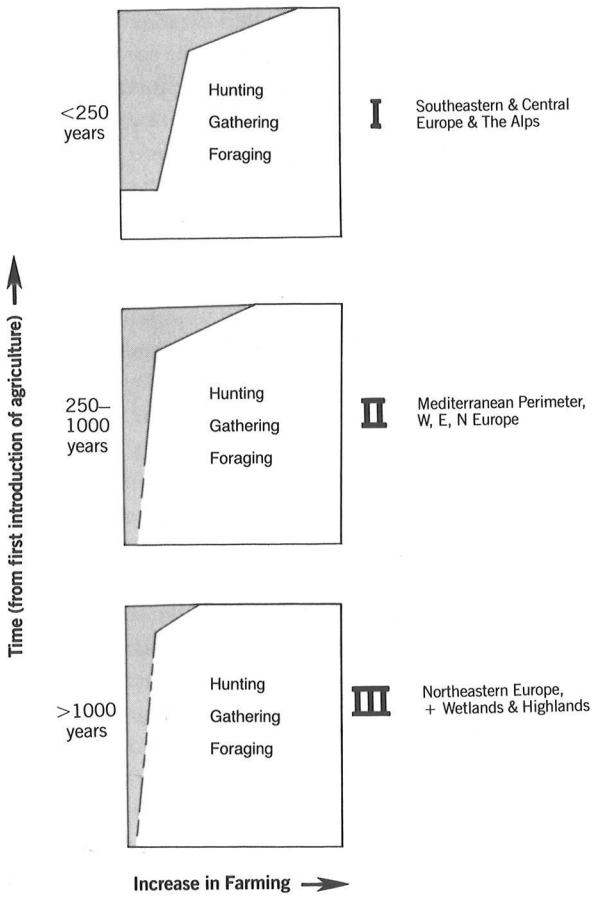


Fig. 5.3. Three archaeological patterns for the transition to crop agriculture in Europe. The vertical axis represents the length of time taken from the first introduction of cereals and legumes to the establishment of a predominantly agricultural way of life. The horizontal axis represents the importance of farming relative to hunting and gathering during this transition.
I, cereals appeared suddenly in the Early Neolithic, along with domestic livestock and pottery. Although there may be a slight overlap with the local Mesolithic, communities entirely dependent upon foraging seem to have disappeared within 250 years. This pattern seems to apply to large areas of Southeast and Central Europe and the Alps.
II, there is no clear point at which domestic crops and animals and pottery were first used in the Mesolithic. Sites used specifically for farming are very rare, and foraging seems to have provided most of the food for several hundred years. In areas such as much of the Mediterranean perimeter and western, eastern, and northern Europe, agriculture was of minor importance for up to 1,000 years after the first appearance of its components.
III, crop agriculture is never wholly successful and was often tried intermittently during prehistory. This pattern predominates in much of northeastern Europe and in many highland and wetland areas. In each case, three questions can be asked: (1) where did the crop and animal resources come from? (2) what factors influenced their subsequent use and importance? and (3) what processes (usually in the Late Neolithic or Early Bronze Age) resulted in a predominantly agricultural lifestyle?

remains, especially when their surfaces have been eroded.

The main questions to be clarified in these areas are: (1) where did the farmers and their resources come from? (2) why was farming sufficiently advantageous that farming communities could be established? and (3) why were foraging settlements later discontinued?

2. Areas where farming occurs gradually, and long before farming settlements appear.

In western Europe, the British Isles, Scandinavia, and along most of the Mediterranean littoral, there is no sharp distinction between the Mesolithic and Neolithic in terms of material culture, site histories, and resource usage. Instead, cereals, legumes, and domestic livestock (especially sheep and goat) appear gradually and in no fixed order. Independent farming settlements are rare, and it is often several centuries before a distinct farming culture appears. The density of communities using agricultural resources is usually low. For example, over much of southern France and lowland Britain, large areas of viable farming land were not used for agriculture for several centuries (see Mills 1983; Bradley 1978).

Foraging sites seem to have been unsuitable for the preservation of significant amounts of plant remains, and this may help explain the paucity of evidence from northern and western Europe in the Neolithic. Cave sites, such as those in southern France, were probably used on a seasonal basis only, and plant material retrieved from these may have been grown elsewhere. Open sites, such as middens, are by their nature inappropriate for the preservation of large amounts of carbonized plant remains in much the same way as farming sites are not likely to yield evidence of such activities as fish-drying.

The main questions to be answered here are: (1) where did the crops and domestic livestock come from? (2) why did foraging continue to form the main resource base? and (3) why did it take so long for agriculture to become the primary resource base?

3. Areas where farming was unsuccessful as a long-term resource base.

In Sweden, Finland, and probably in many highland areas of temperate Europe, the record for early farming is similar to type 2 above, but is discontinuous. Additional questions here are: (1) why was it unsuccessful? and (2) why eventually did it become viable in some areas, but not others?

Traditional Explanations

Traditional explanations were heavily influenced by the nineteenth-century agricultural colonization of North America and Australia by Europeans. This colonization model was based on the supposition that early Neolithic farmers possessed an overwhelming demographic and economic superiority over local Mesolithic hunter-foragers and thus could appropriate their lands and dispossess them. The expansion of the Neolithic across Europe could thus be envisaged as a "wave of advance" (Fig. 5.4), as suggested by Ammerman and Cavalli-Sforza (1984) and Renfrew (1987). The model indicates the progressive expansion of farming communities into Mesolithic hunter-gatherer territories, much in the manner suggested by Childe (1958).

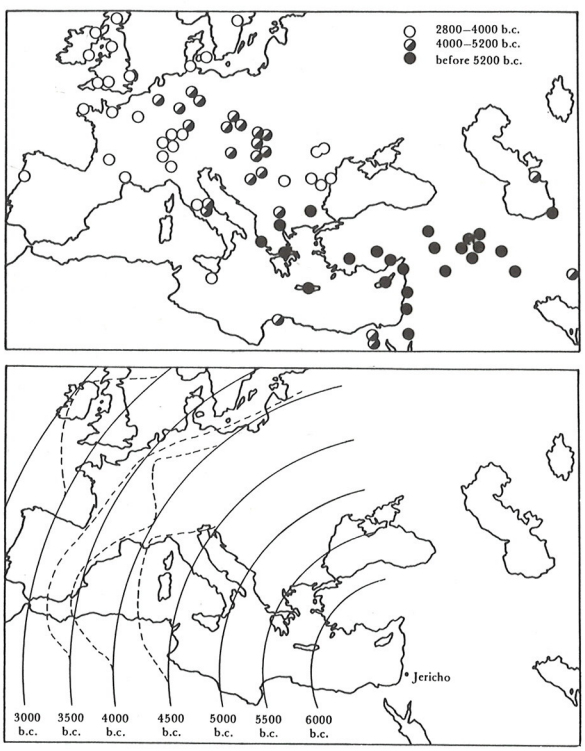


Fig. 5.4. Radiocarbon dating and early European agriculture. Top: the spread of agriculture (implied largely by the presence of pottery) across Europe according to the radiocarbon dates available in the early 1960s (after Clark 1965, fig. 2); and below, the "wave of advance" of farmers, according to Ammerman and Cavalli-Sforza (1984). The broken curved lines denote regional variations in the rate at which farming was adopted. (From Barker 1985:6)

This model has been criticized on several grounds as an all-embracing explanation for the spread of early farming across Europe (e.g., see Dennell 1983:152–89; Barker 1985:250–56; Zvelebil 1986:176–80). First, it is often unclear whether the expansion of the Neolithic indicates the first usage of pottery or cultigens; if the latter, it is often unclear whether the first evidence for cultigens indicates that crop agriculture was of major importance. Second, as seen already, the size and density of early farming populations do not seem to have been sufficiently high to cause or require high rates of emigration into new areas. Third, the "wave of advance" was often static for longer than would be expected if agriculture had expanded inexorably across Europe because of its inherent superiority. For example, early crop farming developed in pockets along the Mediterranean perimeter at an early date; however, in eastern Greece, the eastern parts of southern Italy, probably Sicily, and in small areas of southern France, it made little significant expansion from those areas for at least a millennium afterward. Likewise, in northern Europe, the early farming (LBK) settlements of Korlat and Eitzun are virtually contemporaneous (ca. 4500 B.C.), and yet are 1300 km apart. By contrast, the earliest site with evidence for agriculture that is north of Eitzun is Siggenben-Sud, which is only 200 km away but 1,300 radiocarbon years later (see Zvelebil and Rowley-Conwy 1986:79). Another instance is Sweden, where the agricultural frontier expanded but then retreated. A fourth weakness of the "wave of advance" model is the protracted nature of the transition from foraging to farming in many areas. As noted above, the transition to agriculture often spanned at least several centuries; what the evidence suggests is less the rapid adoption of agriculture than its slow and very gradual assimilation.

A second traditional explanation that has been tried in the last twenty years favors local domestication of cereals and legumes. Mesolithic populations in Southeast Europe and along the Mediterranean perimeter were probably able to domesticate some of these plants locally. As noted above, wild barley grains have been found in late Pleistocene and early Holocene deposits at Franchthi Cave in southern Greece, and similar finds might be expected from elsewhere along the Mediterranean perimeter. (As seen above, however, this is not true of Grotta dell'Uzzo.) One should also note the pollen grains of what seem to be cereals from the Mesolithic site of Icoana in Romania (Cârciumaru 1973). In this case,

the identification seems to have been careful and the context secure. On the other hand, it is highly unlikely that wild einkorn and barley grew in temperate Europe before the Neolithic, so the domestic forms and derivatives of these must have been introduced. Because domestic forms of rye are known from the aceramic Neolithic of Turkey (Hillman 1978), it is possible that they, too, were introduced into Europe. The only major cereal crop that might have originated in Europe is probably oats, but this seems to have been unimportant until late in prehistory.

The early Holocene distribution of those legumes that were later domesticated is still problematic, as is the relationship between present-day wild and domestic forms. In the absence of information on pre-Neolithic legumes in Europe, domestic pea, lentil, and vetch are usually assumed to have originated in the Near East (Zohary and Hopf 1988). If the claims of Vacquer et al. (1986) for Mesolithic domestic legumes at Abeurador in France are confirmed, however, a European origin for some domestic legumes seems reasonable.

Explanations of the origins of European crop agriculture in terms of local domestication have only a limited applicability, however. First, there is no reason to suppose that this could have occurred in temperate Europe where cultigens must have been introduced. Secondly, models of local domestication do not explain why farming appeared later as one moves from southeastern to northwestern Europe.

Toward an Alternative Explanation

Early farming in Europe always occurred in areas where there were already hunter-forager communities. These cannot be regarded as irrelevant to the pattern of agricultural expansion. First, it is likely that they were capable of domesticating or, at least, of carefully husbanding plant and animal resources if they saw it was in their interests to do so. Numerous ethnographic studies over the last twenty years have shown that modern and recent hunter-gatherers can manage their environment in deliberate and productive ways. Australian data have been particularly important in this context over the last two decades. Allen (1974), for example, documented the deliberate reaping, threshing, storage, and sowing of grasses by some aboriginal groups; Lourandos (1980) described the planned construction of channels to trap eels; and Jones (1969) discussed how Tasmanian aborigines deliberately used fire to clear woodlands as a way of increasing the productivity of game and plant foods.

Ethnographic data also indicate that hunter-gatherers are not innately conservative and unwilling to change their lifestyles. As Schrire (1980) has shown, the San bushmen are far from being examples of unchanging hunter-gatherers. Instead, they have alternated between hunting/gathering and herding their own or others' livestock since they were first encountered by Europeans in the sixteenth century. Shrire's (1985) edited volume stresses the flexibility of hunter-gatherers and their ability to innovate and adopt new strategies if they perceive it is in their interest to do so. The realization that recent hunter-gatherers can turn to herding and crop cultivation if they perceive this to be advantageous has major implications for studies of agricultural origins in Europe.

These and similar studies have blurred a formerly crisp distinction between hunting/gathering and farming and imply that European Mesolithic groups may have practiced some form of food production. Strong interest in this possibility has come from several British workers, especially those derived from the Cambridge-based palaeoeconomic school of Higgs and his associates. As was pointed out by some researchers (e.g., Jarman 1972; Jarman and Wilkinson 1972), if the criteria for recognizing animal and plant domestication were applied consistently, one would have to conclude that domestication occurred before the Neolithic and involved "wild" resources, such as red deer, hazel, and wild barley. If this were so, the question to be asked would not be "When and where did domestication first occur?" but "Which resources may have been domesticated but were later discarded in favor of others?" Pertinent examples here might be red deer, which were husbanded and perhaps herded in the Mesolithic (e.g., Jarman 1971) but then discarded in favor of sheep, which could be stocked at higher rates, were easily herded, and, at least in later periods, could be used for their wool and milk as well as their meat. On the plant side, acorns and hazel nuts may have been key Mesolithic plant foods that were later replaced by other storable, protein-rich plants, such as legumes and cereals, which had higher yields, were easier to process on a large-scale, and could be more easily harvested in greater abundance should the occasion demand it.

An alternative approach is to study early farming in terms of the ways that foragers and farmers interacted at a regional level. The "frontier" between the

two could have taken a variety of forms—from mobile to static—and both forms could have been either porous or impervious (see Dennell 1983, 1985). As indicated in Figure 5.5, there are several ways that foraging populations could have acquired the necessary techniques or resources for developing agriculture. Zvelebil and Rowley-Conwy (1986) have recently developed the notion of the "frontier" as a spatial concept by suggesting how it may have evolved through time. According to their model, hunter-gatherer populations with access to farming communities would have passed through three phases—availability, substitution, and consolidation—in their own transition to farming. The earliest evidence for cultigens should occur in the first phase; in the second phase, cultigens would gradually become more important but not significantly disrupt existing practices; and in the third phase, they would become one of the mainstays of the economy. As Zvelebil and Rowley-Conwy (1986) indicate in general terms and as suggested here archaeobotanically, the length of time involved in this process is often considerable.

The three types of archaeological patterns identified in this chapter can be explained in terms of different types of interactions between foragers and farmers. In areas where farming appears as an intrusive phenomenon, it is likely that the initial impetus for agriculture came from the outside through colonization. Thereafter, it is likely that the inhabitants of these communities developed symbiotic relationships with neighboring foraging groups, as I have suggested for the LBK (Dennell 1985) and Zvelebil (1986) and Gregg (1988) have suggested for the Alpine forelands. It is debatable whether the success of farming in these areas stemmed from the stability of these relationships as much as from its own strengths. In areas where farming appeared gradually within the matrix of local Mesolithic traditions, it is more probable that the resources were acquired from neighboring groups and then developed indigenously, with only minor modifications to existing subsistence strategies and without the need to establish independent farming groups.

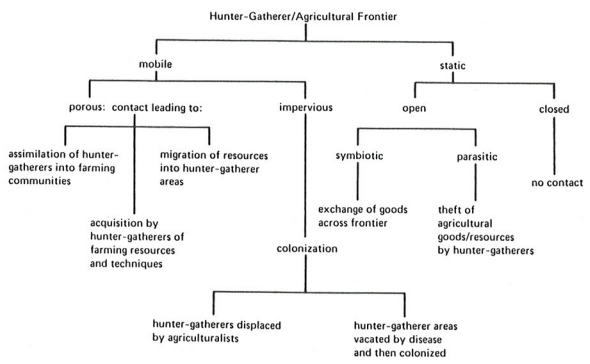


Fig. 5.5. Some examples of the types of frontiers that could have existed in Europe between early farmers and hunter-gatherers at the time of contact. (From Dennell 1985, fig. 6.4)

The reasons why crop cultivation was first adopted as a minor addition to existing practices probably varied from area to area. In areas such as Jutland and Finland, the eventual adoption of crop cultivation may be explained by the failure of traditional resources, such as the oyster and seal, respectively (e.g., Zvelebil and Rowley-Conwy 1986:88). Elsewhere, the critical factor may have been the need for a storable resource for winter usage, or the desirability of a reliable resource, or one whose production could be expanded at short notice, or one that used otherwise unproductive members of a group, such as the very young or infirm, to produce food by weeding, crop processing, etc. Other reasons might include the attraction of a storable resource that could be used to generate surpluses and thus enhance the status of individuals or groups.

Zvelebil (1986) has suggested that the adoption of farming proceeded through the three phases of availability, substitution, and consolidation, irrespective of how it began. In general terms, the process was accomplished far more rapidly in those areas where it appeared suddenly than it did along the Mediterranean and in northern and western Europe. What is interesting, however, is that even in these areas agriculture was firmly consolidated by ca. 3000 B.C. To that extent, there was an agricultural revolution in temperate Europe, even though it occurred long after farming was first practiced.

Conclusions

The concept of the "Neolithic" as signifying the appearance of agriculture probably has done more to obscure than to illuminate the nature of the processes involved. This is because there is a very rich record of hunter-gatherers buried under the general rubric of "the Neolithic." Such is the weight of tradition,

however, that studies of Holocene hunter-gatherers usually end with the first appearance of pottery. Conversely, prehistorians of the early Neolithic (and, in many areas of Europe, the remainder of the Neolithic and often much of the Bronze Age) have tended to focus their attention on the presence of pottery and on the generally scant evidence for agriculture, and have overlooked the often impressive evidence for the continuity of previous foraging strategies.

Recommendations for Future Research

The following recommendations are made for future studies of early crop agriculture in Europe:

1. More data are needed on plant usage before and after the Mesolithic-Neolithic transition. Detailed contextual data are also needed on the provenience of archaeobotanical samples from early farming settlements in order to clarify the importance and use of each cultigen.

2. Because plant remains are not generally common in early Neolithic sites outside Southeast and Central Europe, flotation techniques should be obligatory on excavations of Neolithic (and later) sites. In some cases, accelerator radiocarbon dating may also be necessary to confirm that cereal grains and seeds and domestic legumes are contemporaneous with the deposits in which they are found rather than the result of percolation from later contexts.

3. At present most European archaeobotanists are based in northwestern Europe, and few experts in this field are resident in Portugal, Spain, France, Italy, and Greece. More funding is required both for training archaeobotanists and for post-excavation analysis.

4. Scanning electron microscopy (SEM) work is needed to verify critical identifications, particularly of the wild and domestic forms of oats and many of the legumes. Data on the last-mentioned seem particularly useful if, as suggested above, some may have been domesticated locally in Europe.

5. Major changes in our understanding of the transition from foraging to farming in Europe are likely to occur through chemical studies of human skeletal remains. Techniques that have been, or are being, developed in recent years include measuring the ratio of N14 to N15, and C12 to C13 (e.g., see Keegan 1989) and the amounts of trace elements in bone tissue (e.g., Aufderheide 1989). These techniques do not provide a direct indication of which foods were eaten but may indicate which groups of foods with similar chemical "signatures" were consumed. Analyses of skeletons through time may therefore show gross shifts in diet from one food group to another, and these in turn may be linked to the conventional types of archaeobotanical and archaeozoological evidence cited in this chapter. Chemical analyses may also indicate differences in protein intake between males and females, between adults and children, and/or between high- and low-ranking individuals.

Another exciting development arises from the identification of DNA in ancient human bone and tissue (see, for example, Hagelberg and Clegg 1991). If it can be routinely identified in European Mesolithic to Bronze Age skeletal remains, DNA data may become vital to key debates over whether agriculture spread over most of Europe through ethnic movements—as suggested by Childe and many others—or through the movement of resources but not people, as argued here.

6. The teaching of European agricultural origins should take into account the new view of the Neolithic that is now emerging. Traditionally, a rigid distinction has been drawn between the Palaeolithic and Mesolithic as the study of hunter-gatherers on the one hand, and the Neolithic and Bronze Age as the study of farmers on the other. As I have argued in this chapter, the Neolithic over much of Europe is primarily about the coexistence of farmers and hunter-gatherers, many of whom gradually acquired agricultural resources and developed them on their own accord.

Suggested Reading

Several syntheses of European prehistory provide useful background reading for both the general reader and for those wishing to study the subject in depth. In order to understand present debates over the respective roles of colonization, diffusion, and acculturation, Gordon Childe's works are still essential starting points, particularly his best-known work, *The Dawn of European Civilization* (1925; revised until 1957) and what is arguably his finest general summary, *The Prehistory of European Society* (1958). Graham Clark and Stuart Piggott's (1965) *Prehistoric*

Societies and Piggott's (1965) *Ancient Europe* provide similarly well-written and magisterial overviews. Colin Renfrew's (1973) *Before Civilisation* shows how radiocarbon 14 dating undermined previous views on the importance of the Near East as a source of innovation. More recent accounts of the European Neolithic can be found in Sarunas Milisauskas's (1978) *Prehistoric Europe;* Patricia Phillips's (1981) *European Prehistory;* Tim Champion's (1984) *Prehistoric Europe;* and Alistair Whittle's (1985) *The Neolithic of Europe.*

Three works specifically on early European agriculture should be mentioned. One is the volume from the Cambridge palaeoeconomic school of the late Eric Higgs, *Early European Agriculture,* edited by Michael Jarman et al. (1982), and the other is a more rounded work from the same tradition, *Prehistoric Farming in Europe* (1985) by Graeme Barker. *Hunters in Transition,* edited by Marek Zvelebil (1986), provides an important perspective on early farming in Europe from the viewpoint of the indigenous Mesolithic communities.

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Notes

1. All dates cited in this chapter are uncalibrated radiocarbon dates, unless otherwise stated.

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many had some knowledge of the properties of clay, are called Pre-Pottery Neolithic in the Levant (PPNA, ca. 9400–8500 B.C.; PPNB, ca. 8500–6700 B.C.) and simply the Aceramic Neolithic elsewhere. An extended discussion of local sequences and chronological problems is beyond the scope of this chapter, but they have been discussed by others (Aurenche et al. 1987; Bar-Yosef and Vogel 1987; Braidwood and Howe 1960; Henry 1989). The early farming societies adopted various combinations of crops and animals in different parts of the Near East. Village life based on the complete Near Eastern complex of wheat, barley, pulses, sheep, goat, pig, and cattle took several thousand years to develop (Table 3.2).

The Nature of the Evidence

Several lines of evidence contribute to the study of agricultural origins. Prehistoric tools and facilities provide indirect evidence of plant use, human skeletal remains are used in dietary reconstructions of the Epipaleolithic, and ecological and botanical studies of plant remains found on archaeological sites shed light on the transition to food production. Finally, the archaeological context in which plant remains are found must also be considered.

Plant processing equipment and facilities became important elements of Epipaleolithic material culture. Grinding stones, some of which were used for pigments (Moore et al. 1975:58), could also have been used for grain or acorn processing, and flint sickle blades were used for cutting grasses. Roasting pits, which are present on some sites, could have been used to process grain. Storage technology developed as well. Although pottery had not yet been invented, underground pits were used to solve the problem of preserving seasonally abundant, storable plant resources, particularly wild cereals.

Flannery used the term "preadaptation" for the technological changes that preceded and permitted reliance on agricultural production. Until recently, the association between increasing dependence on plant foods and the development of new food processing technologies has been somewhat conjectural. Now, however, it has been borne out by several studies showing that human skeletal remains bear traces of an individual's dietary history. For example, the consumption of stone-ground foods has been shown to lead to a rapid wearing down of teeth. While this pattern is typical of later agricultural villagers of the Near East, it first appears in the skeletons of the late Epipaleolithic (P. Smith 1972). Bone strontium analysis provides additional, although somewhat contro-

Table 3.2. Simplified Chronology for the Epipaleolithic and Neolithic in the Near East

Calibrated Date[a] B.C.	Levant	Syria/Anatolia	Zagros	Uncalibrated Date[b] (B.C.)
		Pottery Neolithic		
6700				6000
8000	PPNB		Aceramic Neolithic	7000
		Aceramic Neolithic		
8500				7600
9000	PPNA		(Proto-Neolithic)	8000
9400				8300
11,000				9000
	Natufian		Karim Shahirian	
12,000				10,000
	Geometric Kebaran			
		Epipaleolithic	Zarzian	11,000
				12,000
	Kebaran			13,000
				14,000
				15,000

Source: The information on local sequences was compiled from Aurenche, Évin, and Gascó (1987) and Bar-Yosef and Vogel (1987).
[a]Calibrated radiocarbon dates are interpreted from Stuiver et al. (1986, fig. 7).
[b]Uncalibrated dates are based on Libby half-life (5568 years).