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Agriculture in Prehistoric Europe -- The Lowlands [and Discussion]

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Agriculture in prehistoric Europe – the lowlands

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Regular patterns in the exploitation of lowland resources can be perceived in the prehistoric and historic records. On the basis of these patterns the lowlands can be divided into two economic zones. The zone of high arable potential is characterised by cereal-based economies and high population levels. The zone of low arable potential supports animal-based economies and low population levels. Economic development has increased the productivity of each of the zones, but the fundamental patterns of exploitation have remained unchanged.

As has been emphasized by Higgs (this volume, p. 159), in many areas of Europe the lowlands are areally subordinate to the uplands. On the other hand, the lowlands offer resources unavailable in the highlands which have made the lowlands of overall critical economic importance. This importance was vastly increased when cereals became available. Figure 1 illustrates exploitation patterns before the appearance of cereal agriculture in Europe. This paper is concerned primarily with niches I and II during the later periods when cereals were available, and when, as a consequence, an increasing trend towards sedentary and mobile-cum-sedentary economies became possible within the framework of those groups. The importance of cereals in this development is highlighted by the striking coincidence of many areas of modern high cereal production with areas of known early neolithic concentration – for example, the plain of Thessaly, the Tavoliere, and the loesslands of temperate Europe.

The relation between technology and patterns of exploitation has been discussed by Higgs, and this paper deals with economies primarily with a neolithic technology. Arable-based economies of that time, because of their technology, would have been attracted to the cultivation of light, easily worked soils. Animal-based economies would not have used cultivated root crops which were brought into use only in historical times when they helped to overcome the limitations of winter fodder supplies. Long-distance transport of bulky and weighty foodstuffs would have been rare or non-existent. Even in later periods, trade in cereals only developed to an important degree where reliable transport by sea was possible. Thus, centres of production would also have been centres of consumption, and local human population densities would have been directly related to local productivity.

Economic zones

Economic zones cross climatic and vegetational zones and are defined according to other criteria. In the lowlands of Europe after the first appearance of cereals, two major economic zones are discernible on the basis of the distribution of economic staples, site location and density, and the composition of site territories.

Cereals did not appear simultaneously throughout the lowlands. The distribution of archaeological finds of emmer, one of the commonest of the cereals found on prehistoric sites

in Europe, is shown in figure 2. In many areas neither emmer nor the other cereals can be shown to have been of more than minor significance in the total exploitation pattern until the Iron Age or even mediaeval times. Not only do cereals appear at different times, but in some areas their appearance coincides with a major shift in site distribution and a change in the nature of settlements and their territories; for example, the early neolithic establishment of tell sites in the Balkans and of village sites on the European loesslands – both in areas where previous settlement was sparse or non-existent.

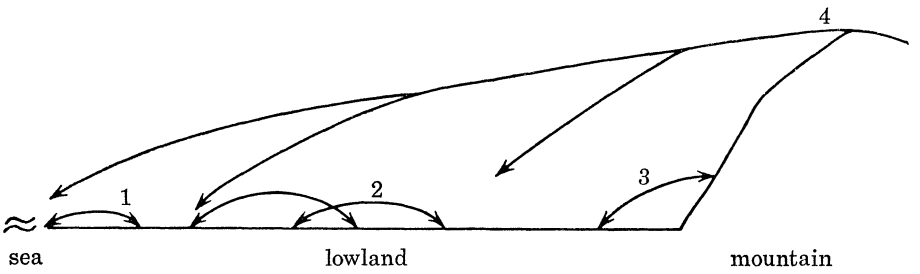

FIGURE 1. Exploitation patterns prior to the appearance of cereal agriculture in Europe.

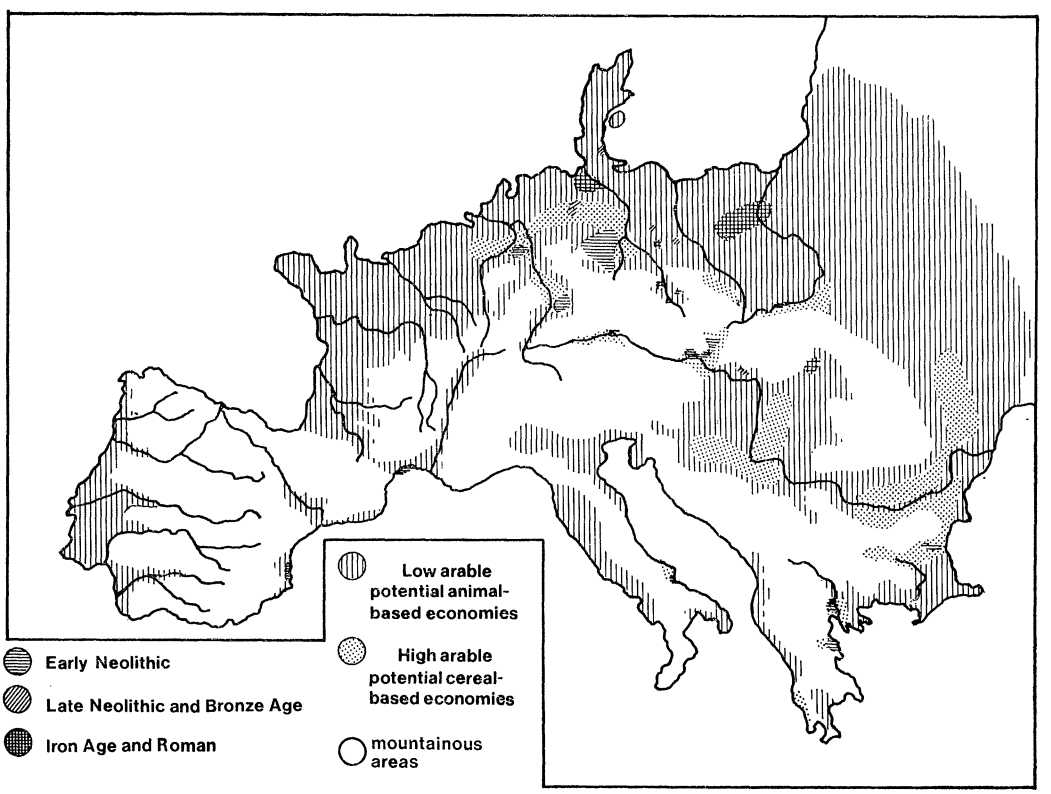

FIGURE 2. The spatial and chronological distribution of archaeological finds of emmer in relation to economic zones in lowland Europe.

Figures 3 and 4 illustrate the difference in site territories. The sites in figure 3 lie in one of the areas where cereals appear at an early date, and their territories combine land of high arable potential with grazing. The sites in figure 4 are located in an area where cereals arrive relatively late and combine land of low arable potential with grazing. In the long term it is highly unlikely that identical economies would have been maintained in the two contrasting areas. Sites with

access to moderate or good arable land and to the technology of cereal production have greater extractive potential than sites with access only to poor arable and grazing land. At the latter sites, animal-based economies are more productive than cereal-based economies, but not so productive as sites with adequate arable land. Therefore, given the long-term trend toward a maximization of the utilization of resources, cereal-based economies tend to dominate in areas with high arable potential and animal-based economies in areas with low arable potential. The differential in the productivity of the two areas is reflected in population levels, which tend to be higher in the former than the latter.

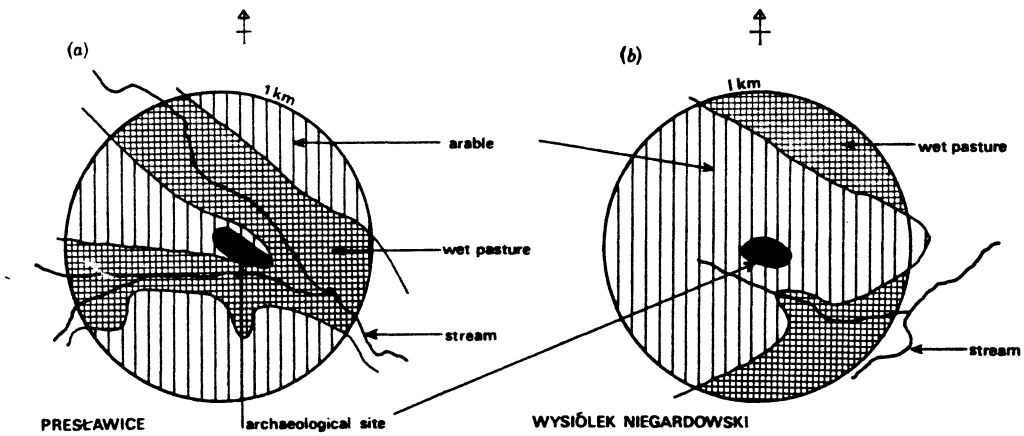

FIGURE 3. One-kilometre site territories of (*a*) Presławice and (*b*) Wysiólek Niegardowski.

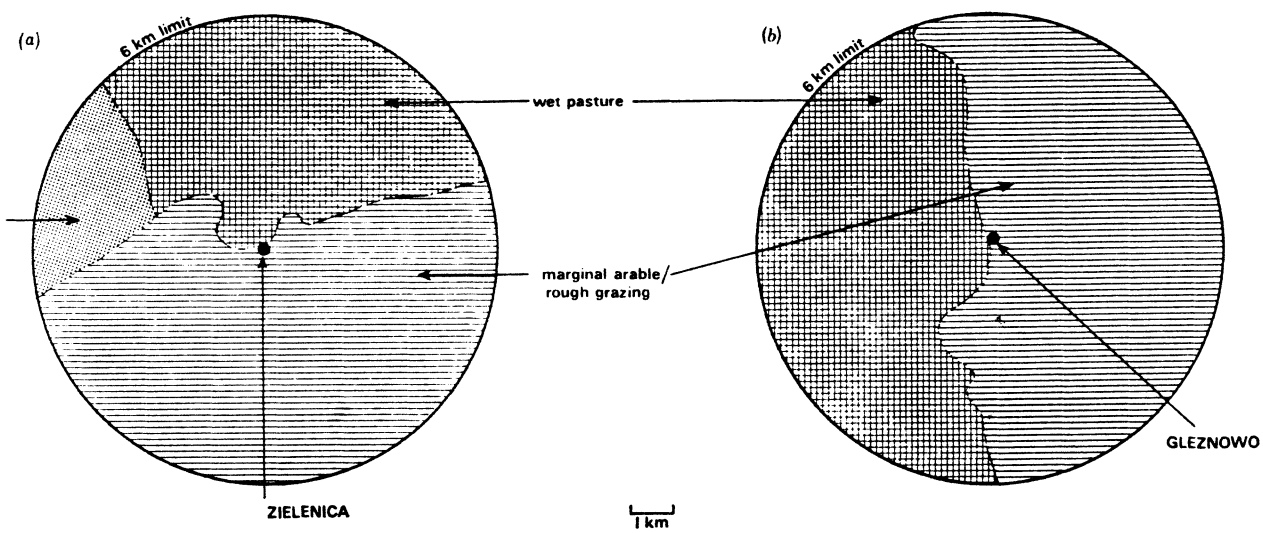

FIGURE 4. Six-kilometre site territories of (*a*) Zielenica and (*b*) Gleznowo.

Figure 2 shows the approximate extent of these two zones in lowland Europe. The zone of low arable potential with animal-based economies lies primarily around the edges of the continent; the zone of high arable potential with cereal-based economies mainly inland with a few exceptions such as the plains of Macedonia and Thessaly. Accepting that there is some overlap between the two zones and that pockets of high arable potential occur in the midst of poor arable and vice versa, the two categories broadly represent a real difference in economic potential,

the effect of which is not only visible in prehistoric data, but manifests itself in later periods in such things as the distribution of mediaeval field systems and population concentrations.

In present-day Europe, technological developments since neolithic times have caused an even greater blurring of this dichotomy. Extensive drainage of marshland and the use of caterpillar tractors has turned previously intractable environments into high quality arable land. The introduction of crops tolerant of infertile soils and climatic extremes has allowed arable agriculture to gain more importance in previously marginal areas. Nevertheless, the two zones can still be perceived in broad outline. Cereals retain their importance in much of the zone of high arable potential and in the zone of low arable potential a high proportion of the arable sector is directed toward fodder production – animals still being the end product.

Zone of high arable potential

Exploitation patterns in the zone of high arable potential are influenced by the characteristics of cereals as a resource in subsistence economies. As dietary staples they are nearly unique among plants as suppliers of energy and protein, but a nutritionally adequate diet is easier to maintain if animal protein is included. Most site territories contain some land that could only have been used for livestock production.

The fact that cereals, unlike livestock, cannot easily be moved after harvest, and not at all before, has important economic repercussions. It means that not only are cereals far more susceptible than are animals to local unpredictable climatic fluctuations, but that during the growing season they cannot be moved to avoid unfavourable conditions nor to take advantage of good ones. Sites therefore must be located in areas where the agronomic conditions allow the production of an ensured annual minimum yield. In a subsistence economy an abnormally large yield once every third year is not adequate if the intervening harvests are insufficient to fulfill the dietary requirements of the population. Although it is possible to store surplus production from year to year, the longer it is kept the greater the opportunity for loss through rodent and fungal attack, and after the first year, its value as seed grain decreases drastically.

Also unlike livestock, cereals are naturally harvested all at one time, producing a large amount of heavy foodstuff. This quality tends to favour a sedentary or mobile-cum-sedentary economic niche with complementary resources, such as grazing, integrated into a single site territory.

The distance between the habitation site and arable fields is of considerable economic importance. Modern studies of subsistence farming villages show that the most intensively cultivated area usually lies within 1 km of the village. Beyond that, the net return for arable exploitation tends to decrease with distance from the settlement out to its economic limit of about 4–5 km. The critical value of the land immediately adjacent to the place of habitation is supported by evidence from prehistoric sites. For example, although arable agriculture is economically feasible up to a distance of 5 km from the site and therefore one would expect contemporaneous sites to be about 10 km apart, we have found that sites located on good arable soil are frequently spaced at about 5 km intervals – each site thus having a potential exploitation radius of $2\frac{1}{2}$ km (e.g. Bulgarian neolithic sites described in Dennell & Webley (1975)). Also, in areas where potentially arable soils form small and irregularly distributed patches, sites are situated so that a greater proportion of the arable soils lie within the 1 km radius than within the 5 km radius.

PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY B BIOLOGICAL SCIENCES

For example, on the Tavoliere sites have on average 65 % potentially arable soils within 1 km and only 37 % within 5 km (Jarman & Webley 1975).

The potentially arable category of land use is defined by the following characteristics. First, it has easily worked, well drained soil of moderate to high fertility. Our studies show that tractability is of primary importance in the location of sites based on arable agriculture. The Romans made limited use of heavier, water-logged soils, but it was only in mediaeval times, long after the introduction of the metal plough, that heavier soils were used to any significant degree for arable crops (Wooldridge & Linton 1933; Finberg 1972). The limitations of technology in neolithic times made soil tractability a greater imperative. Soils of high fertility were only chosen when they were also easily worked and well drained, as in the case of loess soils. It is worth noting that both einkorn and emmer, the most common neolithic cereals, are especially tolerant of poor soils (Peterson 1965; Schiemann 1956).

Secondly, it is flat or moderately sloping. Cultivation of sharply dissected, steep terrain is sometimes impossible and frequently unlikely without excessive inputs of labour.

Thirdly, the land must lie within the appropriate climatic zone for cereal cultivation. Under the present European climatic régime, climatic factors tend to limit the growing of modern cereal varieties only at the extremes of their distribution. It should be noted that the more primitive cereals, particularly emmer, are extremely tolerant of a wide variety of climatic conditions (Carleton 1901; Peterson 1965; Schiemann 1956). Even the climatic fluctuations thought to have occurred during the Holocene are unlikely to have made cereal growth impossible on most parts of the European continent. However, there is an optimal range of climatic conditions under which each of the cereal species does best, and outside of which cereals form a less reliable economic resource. We shall describe economies from contrasting climatic zones – the Mediterranean and north temperate Europe – in which all the available evidence suggests that cereals were a staple resource. Obviously more research is needed to determine the conditions under which climate becomes a limiting factor.

Greece

Greece is a mountainous country. As in Italy (see Higgs, this volume, p. 159), the small areas of lowland must serve as winter pasture for the flocks and herds, whether imported domesticates or indigenous species, that spend their summers in the extensive uplands. Nevertheless, about 8000 years ago settlements began to appear on the plains of Thessaly and Macedonia in an area where no preferred sites previously existed. Excavations of these tell sites, such as Argissa and Dimini, have produced remains of cereals, legumes, and present-day domesticated animals (Theocharis 1973). Other plants and animals occur as well, but only sporadically and in small numbers. Emmer tends to dominate the plant samples, and caprines the faunal samples. Figure 5 shows the variation in 10 min site territories from that of Dimini with about 50 % potential arable and 50 % rough hill grazing, to that of Nea Rhaidestos with 100 % potential arable.

It is clear that cereal agriculture was of considerable significance to the economy of these sites. That animals were integrated into this economy is also obvious: some 10 min site territories include a high proportion of rough grazing and all 1 h site territories include some rough grazing; animal protein is desirable in the human diet; and animals would have been present in the plains in winter in any case. In addition there are numerous ethnographic examples where animals serve the function of insurance policies against food shortages – a means of

PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY B BIOLOGICAL SCIENCES

investing spare capital against times of greater need. Animals are not immune to unpredicatable disasters, but they are less subject to annual fluctuations than are cereal crops. In the Mediterranean today modern improved cereal varieties grown with the most sophisticated modern technology still suffer from fluctuations from the mean yield of about 30 %, yields in poor years being about half that of good years.

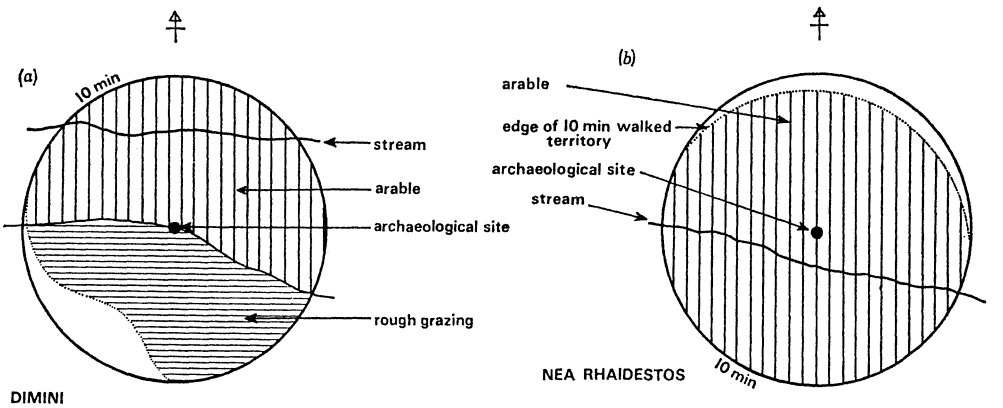

FIGURE 5. Ten-minute territories of (*a*) Dimini and (*b*) Nea Rhaidestos.

The two resources could be successfully integrated by a number of systems ranging from complete village transhumance to stock transference to the existence of two separate populations – one transhumant herders, the other sedentary farmers. The precise method used at any one time is less important than the fact that the lowland provided an environment where the two could be integrated into an economy with greater long-term extractive potential than either separately.

Southern Poland

The upper Vistula basin in southern Poland is also surrounded by vast areas of grazing: the Carpathians to the south and the North European plain to the north. The winters here are milder than those of the surrounding country, and this area must have served as winter pasture for both indigenous species and domesticates. Numerous mesolithic sites are found in this region, but they are concentrated on the poor sandy soils between and around the areas of loess-based soils (Kozłowski 1969).

About 6500 years ago Linearbandkeramik villages began to appear in these loess areas. Predominant among the plant remains from these sites were cereals and legumes, the most common cereal being emmer. Among the domestic animals, cattle were the most numerous (Kulczycka-Leciejewiczowa 1970). Figure 3 shows the variation in 1 km site territories from Presławice with 45 % potential arable to Wysiólek Niegardowski with 85 % potential arable, the remainder being wet pastures in stream valleys. The potentially arable land is primarily rolling hills covered by easily worked, well drained loess soils.

Here as in Greece it is evident that arable agriculture was of great importance to the economies of these sites. Also as in Greece, animal husbandry is integrated into the total exploitation pattern. In this case cattle are more important than caprines, as one would expect, as they are better able to make use of the wet grazing available in the territories than are caprines.

It has often been suggested that the Linearbandkeramik sites were occupied as part of a system of shifting cultivation. On the basis of the site territories and an estimate of their

exploitation potential, it appears that shifting cultivation would not have been necessary and would probably have been wasteful of resources. Shifting cultivation is usually associated with a particular set of agricultural conditions, especially high rainfall and very fragile soils. These conditions do not exist on the European loesslands. These soils have been cultivated in historic times under short-fallow and continuous cropping systems and are known to maintain their fertility over long periods of time. The most common neolithic cereal is emmer. Tests undertaken by the U.S. Department of Agriculture (Carlton 1901) and observations of agricultural botanists (Percival 1921; Peterson 1965; Schiemann 1956) suggest that emmer is not an exacting crop: it neither requires soils of high fertility nor does it extract nutrients from the soil to the same extent as other cereals. Legumes form part of most neolithic botanical samples. They may not have been grown in a formal rotation system with cereals, but if the two crops were ever grown on the same plots, the effect would have been the same. All the elements necessary for a short-fallow system are present. There can have been little reason for the preferred settlement of high-fertility loess soils if such a system were not practised.

Zone of low arable potential

A distinction was made above between two patterns of exploitation in the lowlands (figure 2): arable-based economies in the regions of high arable potential, such as those just described, and animal-based economies in regions of low arable potential, such as the North European plain and most of the Mediterranean littoral zone. Most of the regions belonging to the second group are bounded on one side by the sea. Our studies have shown, however, that in general the economic influence of marine resources has been slight (for example, see Bailey 1975). They have been exploited recurrently throughout prehistory, but it is only in exceptional cases that they have been a staple economic resource.

Animal-based economies everywhere in Europe are faced with a seasonal inequality of grazing resources – in the Mediterranean caused by an alternation between rainy and dry seasons, in north temperate Europe between warm and cold. Animal populations are limited to the number that can be supported during the lean season, unless the shortage can be overcome. Higgs (this volume, p. 159) has described mobile economies which maintain high stocking rates by transhumance, the utilization of two different areas with seasonally complementary grazing. Where complementary grazing does not exist within an economic distance for transhumance, a sedentary economy can maintain a high stocking rate by producing and storing fodder for the lean season. In prehistoric times this probably entailed the collection by man of suitable animal foods during the season when they were abundant. Simmons & Dimbleby (1974) have recently suggested that ivy may have been used in this way in mesolithic times. Many neolithic sites with animal-based economies are located near wet pastures which could have been under-grazed during the summer and either used for foggage, that is, the pasturing of cattle on grass left standing through the winter, or cut as hay. Pressure on winter resources can also be reduced by an increased killing rate from late autumn through the winter, thus maintaining an overall high stocking rate, but with a minimum number of animals being overwintered.

Alternatively, a lower stocking rate can be tolerated and productivity of the annually exploited territory can be raised by integrating a complementary seasonal resource, such as winter sealing in the Baltic, or a storeable resource, such as cereals. The extreme of the latter has already

PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY B BIOLOGICAL SCIENCES

been seen in regions of high arable potential where cereals come to dominate the exploitation pattern.

The territories examined in the following examples are larger than those for sites with arable-based economies. The mobility of animals allows the economic exploitation of a larger area than in the case of arable agriculture. Lowland pastoralists commonly graze their livestock over a distance of about 4–6 km.

Northern Poland

The north Polish littoral zone is part of the North European plain. It is flat to gently undulating, the nearest major topographic feature being the Carpathian mountain chain 500 km to the south. It is a region of extensive coastal marsh and lakelands. The soils are primarily infertile sandy podsols. Neither pottery nor the modern domesticated animals appear until the late Neolithic, and then sites are sparsely distributed compared to those in the loesslands to the south. Cereals have not yet been discovered at these sites. Cattle and pig dominate the faunae.

Figure 4 shows the range in composition of land use in 6 km site territories from about 30 % ow-lying wet pastures at Zielenica to 50 % at Gleznowo. When good arable land occurs within site territories, it is not found within the critical 1 km radius, but at the very edge of the one-hour territory (*ca.* 4.5 km). The remainder of the territories are composed of marginal arable or rough grazing on sandy uplands. The uplands today support either poor arable crops or woodland. Not only is the soil acid and of low fertility, but spring droughts and glazed frosts in winter contribute to low and uncertain cereal yields. The cereal best adapted to these conditions and the one most common in the area today is rye, but it has not yet been found on archaeological sites in this region earlier than the Iron Age. It seems more likely therefore that, in prehistoric times, the sandy uplands were used as grazing rather than as arable.

The wet pastures are flooded seasonally, and there is a high water table close to the surface during the rest of the year. During the summer the wet pastures are highly productive and will support up to two to three head of cattle per hectare (Rieley & Jasnowski 1972; Jasnowski, personal communication). In winter, however, they freeze over and cannot be grazed. The sandy uplands have a much lower grazing capacity than the marshlands even at the height of the growing season, and there is a similar sharp decline in winter productivity. Furthermore, the uplands suffer from periodic glazed frosts which prevent grazing altogether. In both wet pastures and upland grazing there is therefore a corresponding discrepancy between summer and winter grazing potential. Clearly the exploitation pattern must have provided an alternative resource, either within the 1 h territory or by extending the annual territory. Complementary winter grazing simply does not exist within a feasible distance and so transhumance cannot solve the problem. If the livestock must remain in the littoral zone all year, then during the winter months they will require not only more fodder than is available on the uplands, but also alternative fodder during those times when glazed frosts cover the uplands. The only means of meeting these requirements is to reserve a portion of the summer wet grazing as foggage or to cut it as hay for the lean season.

Sites lying on the Baltic coast are also located near wet pastures, as for example Tolmicko (figure 6). Animal bones from these sites show the importance of seal in addition to the cattle and pig which were found on the sites further inland. It is evident that cattle are still an important resource, as preferred sites are always associated with wet pastures. The available

PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY B BIOLOGICAL SCIENCES

wet pasture in the coastal site territories is less extensive than at the inland sites. It appears that lower numbers of cattle were kept and that their smaller contribution to the exploitation pattern was compensated for by the integration of some winter season sealing, an activity known from historical ethnographic reports.

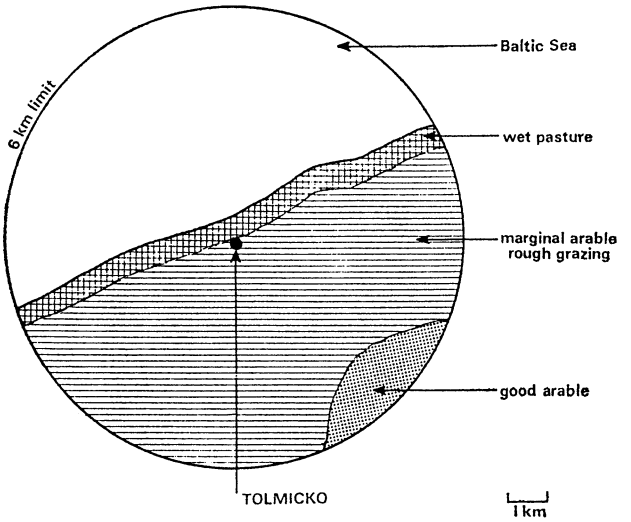

FIGURE 6. Six-kilometre site territory of Tolmicko.

Nordfriesland

In Nordfriesland, on the North Sea coast of West Germany, site territories are again composed of a high percentage of wet pastures (figure 7). In this area, however, small patches of good arable land sometimes occur in association with wet pastures. These patches form preferred settlement areas. Arable agriculture does not, however, dominate the exploitation pattern. Patches of good arable are only exploited if they lie adjacent to wet pasture and can be integrated into the livestock exploitation to help alleviate winter shortages.

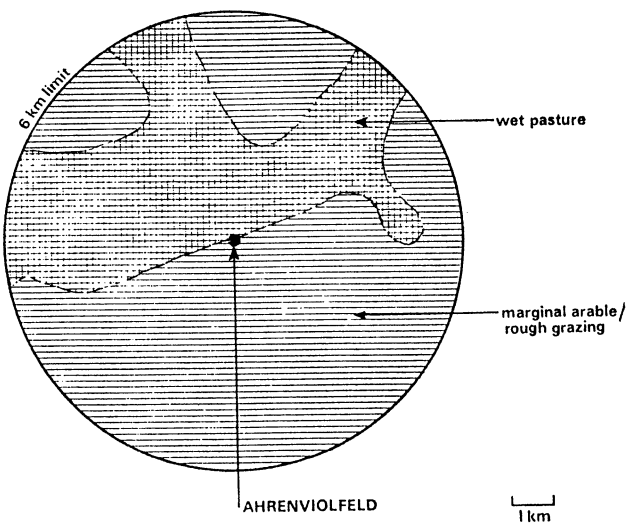

FIGURE 7. Six-kilometre site territory of Ahrenviolfeld.

Southern France

In the Mediterranean most of the lowland of low arable potential is suitable only as winter pasture for transhumant livestock. In a few areas, however, coastal marshes provide abundant summer plant growth suitable for cattle grazing. For example, the territory of the neolithic site of La Madeleine in southern France contains coastal marsh, that is, wet pastures, and upland rough grazing separated by a narrow strip of poor arable (figure 8). Larger amounts of marginal arable land are available within the 1 h site territory, but the site itself is located at the point of least available arable, at the junction of the wet pastures and rough grazing. The fauna is dominated by caprines, but also includes cattle and pigs (Phillips 1971). The cattle would have undoubtedly made use of the wet pastures whether or not the other species did as well. This coastal marsh, though highly productive as a summer pasture, cannot be used as a winter grazing resource. The upland garrigue is not suitable for cattle grazing at any time of year.

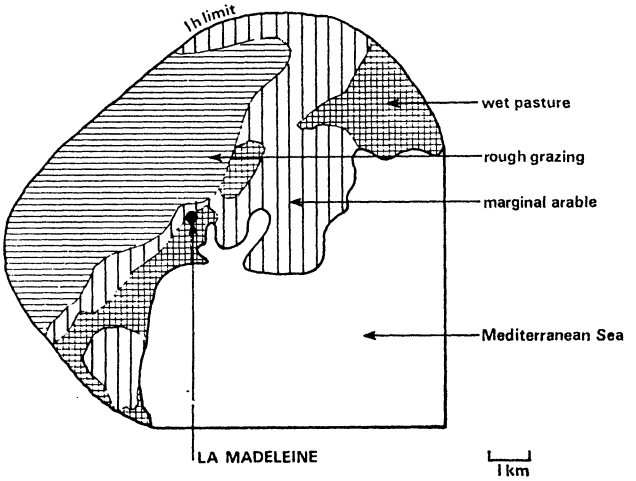

FIGURE 8. One-hour site territory of La Madeleine.

Therefore, the only winter grazing for cattle would have been the marginal arable land, an area of about equal extent, but of inferior productivity, to the coastal marsh. If summer stocking rates were to be maintained throughout the winter, a hay crop from the marsh would have been necessary to supplement the winter fodder, a practice documented for historic times. The integration into the economy of transhumant caprines, which could make use of the winter grazing on the upland garrigue, provided an alternative winter resource and raised the productivity of the area as a whole.

CONCLUSIONS

Preferred sites first occur in abundance with the earliest evidence for cereal agriculture in the zone of high arable potential. From the first appearance of cereals onwards, these areas have been continuously and densely inhabited, regardless of the typological affinities of the associated artefacts (see for example the site distribution maps in Kruk 1973). It says much for the know-how and sophistication of the early communities of cereal farmers that their settlement was not a random process of trial and error, but was an informed expansion into areas which

have subsequently proved to be those best suited to cereal agriculture. Recent surveys in the Regensburg area suggest that the focus of primary settlement was specifically in the relatively small areas of highest agricultural potential.

There is evidence to suggest that the economic response to population growth in these areas has been the same throughout the prehistoric and historic periods. This has consisted of an intensification, that is an increase in yield per unit area, within the zone of primary settlement, combined with the integration of marginal, often brittle environments, into the pattern of exploitation. In mediaeval times both processes are well documented. Lennard (1922) has shown a gradual increase in cereal yields from the 13th to the 15th centuries; and there is evidence from various sources of the expansion of arable onto land previously used only for grazing or woodland. For neolithic times, analyses of German Linearbandkeramik site distributions with respect to soil type (Sielmann 1972) show that only a small percentage of the earliest settlements lie on non-loess soils. In a later phase settlements continue to be numerous on the loess soils, but an increasing number also occur on non-loess soils. Similar evidence exists for other periods. It appears, however, that in the long term these marginal environments have been unable to support intensive exploitation and their eventual collapse has led to a drastic decrease in population and a contraction of settlement back to the more stable habitation zones.

In the zone of low arable potential, cereals are relatively unimportant; the modern domesticated animal species either do not appear until late or they occur at first only in small numbers associated with the indigenous species; and population densities tend to be low throughout the prehistoric and historic periods. Only during times of exceptionally high population pressure have the limited potentially arable lands been intensively cultivated.

The continuity in basic patterns of exploitation in the lowlands is well illustrated by a consideration of present-day land use in Poland (Osborne 1967). The southern Polish loesslands are still devoted to high productivity wheat and barley cultivation. Much of the middle and lower Vistula valley was drained and converted into high quality arable in the 13th and 14th centuries. But the bulk of central and northern Poland remains primarily devoted to animal husbandry with fodder crops and pasture dominating agricultural production.

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Discussion

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(*a*) The fact stressed by Mrs Jarman that the ground cultivated by farmers was concentrated in the immediate area of settlements was of course to some degree a matter of logistics. On the other hand the situation was self-reinforcing in the sense that the soil in the immediate propinquity of the settlement would be enriched by organic residues. Indeed the sites of settlement and their immediate surroundings remain rich in phosphates long after their abandonment, so much so that phosphate analysis, originally devised for agriculture, has for some time been used by archaeologists as a tool for discovering the position and extent of early settlements.† The local enrichment of the soil due to the discarding of organic refuse is likely to have played a significant part in the process of plant domestication, since the seeds of wild plants brought to settlements for food would fall on soils of greatly enhanced fertility. The convenience of having patches of preferred plants growing close at hand more luxuriantly than in their normal habitats is something unlikely to have escaped the notice of primitive man.

(*b*) Although for purposes of exposition it was doubtless convenient to separate highland from lowland economies, it must be recognized that these were in fact complementary and that products passed from one to another. It was through the formalization of such interchanges that markets developed, such as can still be seen today for example at Ioannina in Epirus. The mountain peoples came down to replenish their equipment. In exchange the lowland population obtains upland products like cheeses and the products of handcrafts that can easily be carried on by migratory peoples. Social and political territories normally comprehended more than one economic territory, just as the territories exploited by human communities normally comprehended several ecological niches.

† The method now in general use was pioneered in Sweden. See Aarhenius, O. 1931 Markanalysen i arkeologiens tjänst, *Geol. Fören Stockholm*, **53**; Florin, S. 1958 *Stenalderstoplatserna vid Mogetorp, Östra Vra och Brockvarn*, pp. 24–28 and 76–79. Stockholm.

PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY B BIOLOGICAL SCIENCES