The Widening Harvest

The Neolithic Transition in Europe: Looking Back, Looking Forward

Edited by

ALBERT J. AMMERMAN

AND

PAOLO BIAGI

ARCHAEOLOGICAL INSTITUTE OF AMERICA

BOSTON, MASSACHUSETTS

Colloquia and Conference Papers 6

2003

The Neolithic Transition in Portugal and the Role of Demic Diffusion in the Spread of Agriculture across West Mediterranean Europe

João Zilhão

My own involvement in the debate on the origins of agriculture in Europe is to a large extent accidental. A consideration of my empirical, theoretical, and social background may go a long way toward explaining not only why it happened at all, but also why I have come to advance the ideas on the subject that I currently sustain.

The focus of my archaeological research and the subject of my Ph.D. dissertation have been the Upper Paleolithic of Portugal (Zilhão 1995, 1997a). In going through past literature and in looking for and excavating new cave sites with deposits from this time period, several regularities quickly became apparent. For instance, although some examples are now known of sites where the surface of the sediment fill is Upper Paleolithic, most well-preserved contexts tend to be buried under thick Holocene sequences. In almost every single case, however, the early Holocene is represented by a hiatus, and there is direct contact between the early Neolithic and the late Upper Paleolithic. It is also almost always the case that Mousterian deposits underlie the Upper Paleolithic.

In this context, my dealing with the latter inevitably led to collecting empirical data of relevance for the understanding of the two major processes of European prehistory: the biological extinction of Neanderthals and their replacement by anatomically modern humans and the cultural extinction of

hunter-gatherer systems and their replacement by agropastoral economies. Since elements of an east-west diffusion are involved in both cases (regardless of whether what diffused were ideas, artifacts, genes, or people), the geographical position of Portugal in the far western end of Europe means that a good understanding of the latest Mousterian and the earliest Neolithic of our country is critical to a good understanding of such processes—namely with regard to the establishment of their chronological boundaries and of the rates of spread of the diffused elements. Given that these processes created the basic frame for the subsequent history of the continent and, as such, have occupied, in one way or another, the front stage of research in European prehistory, I could not avoid being pulled into the discussion of the Mesolithic–Neolithic transition in the west Mediterranean (Zilhão 1990, 1992, 1993, 1997b, 1998, 2000; Zilhão and Carvalho 1996).

The early 1980s, when I was excavating the early Neolithic levels of the cave site of Caldeirão (Zilhão 1992), were characterized by the major influence of the taphonomic perspective in Paleolithic studies (Binford 1983). Beginning in Lower Pleistocene Africa with the man-the-hunter or man-the-hunted controversy, this perspective quickly found its way into the archaeology of later periods, as exemplified by Joachim Hahn's pioneer work at the early Upper Paleolithic cave sites of southwestern Germany (cf. Hahn 1988). However, with few exceptions (Paola Villa's work at the Baume de Fontbrégoua; Villa and Courtin 1982), this taphonomic revolution stopped at the gates of the Neolithic. As a result, my 1993 article on the impact of site formation processes on then current views of the agricultural transition in west Mediterranean Europe was somewhat of a novelty. Why, at that specific moment in time, following the previous work by Fortea and Martí (1984–1985), I happened to be in the right position to show that the Mesolithic sheep of France and the very early dates for an autochthonous Neolithic in southern and eastern Spain were illusory realities created by the operation of different taphonomic agents that can be explained by many different factors.

In Portuguese universities, the late 1970s and early 1980s brought about the emancipation of archaeology as a scientific discipline separate from history. This was accompanied by an explosion in the number of courses, the number of students, and the number of professionals. Since new ground was being broken, allegiance to old schools of thought or old masters was materially impossible, and theoretical novelties spread fast in a milieu of mostly

self-trained practitioners molded in a time of great intellectual freedom following the political and social revolution of 1974–1975. In my own case, the effects of exposure to the literature on site formation processes were enhanced by the personal experience of having been an active speleologist throughout my youth. As such, I became familiar with caves as natural sites even before I began to look at them as potential containers for archaeological remains. Having often camped inside underground galleries and having learned about the ways other animals use caves contributed to the skepticism with which I approached the interpretation of the early Neolithic cave record of the western Mediterranean.

The 1980s also witnessed a renewed interest by both national and international teams in the scientific potential of the major Mesolithic shell-midden sites of central-littoral Portugal (Arnaud 1987, 1989, 1990; González Morales and Arnaud 1990; Jackes et al. 1997a, 1997b; Lubell and Jackes 1988; Lubell et al. 1994). Most of the research in question was processual in inspiration, leading to the collection of data on subsistence, diet, and health parameters of the last Iberian hunter-gatherers that were largely unavailable until then. An important mass of radiometric data was also accumulated. This has made it possible to look at both sides of the transition with a wealth of information that, in Europe, is matched or surpassed only in Scandinavia. As a result, several striking spatio-temporal features of the process became apparent.

First, it is now clear that all late Mesolithic and early Neolithic sites known in Iberia are located along the periphery of the Peninsula, for the most part right along the coast or, in the few cases of more inland locations, sufficiently close to major waterways leading to important estuarine areas. Second, north of the Mondego river, halfway between the northwestern and the southwestern ends of Iberia's Atlantic facade, recent research has confirmed that there are no Neolithic sites earlier than ca. 4700 B.C. (cal.), while elsewhere to the south and to the east the establishment of Neolithic economies may be as early as 5600 B.C. (table 11.1). Third, along the southern half of Portugal's west coast, the latest Mesolithic groups survived for as much as 500 years as hunter-gatherer enclaves with territories centered on the estuaries of the Tagus, the Sado, and the Mira Rivers, surrounded by Neolithic groups occupying territories located in the limestone massifs of central Estremadura, to the north, and the Algarve, to the south (fig. 11.1).

These well-established empirical patterns have major implications for the

Table 11.1. Radiocarbon Dates for the Earliest Neolithic in Iberia

Site	Region	Site Type	Provenience	Culture	Sample	Lab Number	Date B.P.	Comments	References
Buraco da Pala	Portugal	Rock shelter	Level IV, base	Impressed Ware	Wood charcoal	ICEN-935	5860 ± 140	Earliest context with cereal remains in Portugal	Sanches et al. 1993
			Level IV, base	Impressed Ware	Wood charcoal	GrN-19104	5860 ± 30		
Gruta do Caldeirão	Portugal	Cave	Layer Eb	Cardial	Wood charcoal	ICEN-296	6870 ± 210		Zilhão 1992, 1993
			Horizon NA2	Cardial	Animal bone collagen	OxA-1035	6330 ± 80	Direct date of Ovis aries bone	
			Horizon NA2	Cardial	Animal bone collagen	OxA-1034	6230 ± 80	Direct date of Ovis aries bone	
			Horizon NA2	Cardial	Human bone collagen	OxA-1033	6130 ± 90		
			Horizon NA1	Impressed Ware	Animal bone collagen	OxA-1037	5970 ± 120	Direct date of Bos taurus bone	
			Horizon NA1	Impressed Ware	Animal bone collagen	OxA-1036	5870 ± 80	Direct date of Bos taurus bone	
			Horizon NA1	Impressed Ware	Human bone collagen	TO-350	5810 ± 70		
Abrigo da Pena d'Água	Portugal	Rock shelter	Layer Eb (base)	Cardial	Wood charcoal	ICEN-1146	6390 ± 150		Zilhão and Carvalho 1996
Cabranosa	Portugal	Open air	Neolithic hearth	Cardial	Estuarine shells	Sac-1321	6930 ± 60	Corrected for reservoir effect: 6550 ± 70	Cardoso et al. 1996
Padrão	Portugal	Open air	Neolithic hearth	Cardial	Estuarine shells	ICEN-873	6920 ± 60	Corrected for reservoir effect: 6540 ± 70	Gomes 1994
			Neolithic hearth	Cardial	Estuarine shells	ICEN-645	6800 ± 50	Corrected for reservoir effect: 6420 ± 60	
Balma Margineda	Andorra	Cave	Level 3b base	Cardial	Wood charcoal	Ly-2839	6670 ± 120		Guilaine and Martzluff 1995
			Level 3b	Cardial	Wood charcoal	Ly-3289	6850 ± 150		
			Level 3a	Cardial	Wood charcoal	Ly-3288	6640 ± 160		
La Draga	Catalonya	Open air	Hearth E-6 (1990)	Late Cardial	Wood charcoal	GAK-1523	5710 ± 170		Tarrus et al. 1994
			Hearth E-6 (1990)	Late Cardial	Wood charcoal	UBAR-245	5920 ± 240		
			Hearth E-40 (1991)	Late Cardial	Wood charcoal	UBAR-311	5970 ± 110		
			Hearth E-56 (1991)	Late Cardial	Charred cereal seeds	UBAR-313	6010 ± 70		
			Hearth E-3 (1991)	Late Cardial	Charred cereal seeds	Hd-15451	6060 ± 40		
			Post E-106 (1991)	Late Cardial	Oak wood	UBAR-314	6410 ± 70		
			Hearth E-50 (1991)	Late Cardial	Wood charcoal	UBAR-312	6570 ± 460		
			Garbage area in H-30 (1991)	Late Cardial	Animal bone collagen	UBAR-315	6700 ± 710		
Cova del Frare	Catalonya	Cave	T22-23, level 5c	Cardial	Wood charcoal	I-13030	6380 ± 310		Martin 1986–1989, 1990
			Y35, level 5	Epicardial	Wood charcoal	MC-2298	5800 ± 130		

Cueva de Chaves	Aragón	Cave	Level I	Cardial	Wood charcoal		GRN-12685	6770 ± 70		Baldellou e Castán 1985; Baldellou e Utrilla 1985; Bernabeu 1989
			Level I	Cardial	Wood charcoal		GRN-12683	6650 ± 80		
			Level I	Cardial	Wood charcoal		CSIC-378	6460 ± 70		
			Level I	Cardial	Wood charcoal		GRN-12686	5210 ± 340	Unacceptable, too young	
			Level II	Epicardial	Wood charcoal		CSIC-379	6230 ± 70		
			Level II	Epicardial	Wood charcoal		CSIC-380	6120 ± 70		
Cova de les Cendres	Valencia	Cave	H19a	Cardial	Wood charcoal		Beta-116624	8310 ± 80	AMS on Quercus; contamination	Bernabeu et al. 1999
			VIIa	Cardial	Animal bone collagen		Beta-107405	6280 ± 80	AMS on Ovis aries bone	
			H19	Cardial	Wood charcoal		Beta-116625	20,430 ± 170	AMS on Pinus nigra; contamination	
			VII	Cardial	Wood charcoal		Beta-75220	6730 ± 80	Selected (P. nigra + Juniperus excluded)	
			VIe	Cardial	Wood charcoal		Ly-4302	7540 ± 140	Non-selected, contaminants included	
			H18	Cardial	Wood charcoal		Beta-75219	6420 ± 80	Selected (P. nigra + Juniperus excluded)	
			H17, fireplace	Cardial	Wood charcoal		Beta-75218	6260 ± 80	Non-selected, only from fireplace	
			H15a	Epicardial	Wood charcoal		Beta-75217	6150 ± 80	Selected (P. nigra + Juniperus excluded)	
			H15	Epicardial	Wood charcoal		Beta-75216	6010 ± 80	Selected (P. nigra + Juniperus excluded)	
Cova de l'Or	Valencia	Cave	Levels 16–17, 153–163 cm	Cardial	Wood charcoal		GANOP-C13	6720 ± 380	Contains abundant remains of cereals and domestic ovicaprids	Martí 1978; Martí et al. 1980; Bernabeu 1989
			Levels 14–15, 140–153 cm	Cardial	Wood charcoal		GANOP-C12	6630 ± 290		
			Level 6, 95–100 cm	Epicardial	Wood charcoal		GANOP-C11	5980 ± 260		
El Retamar	Andalucia	Open air		Cardial	Estuarine shells		Beta-90122	6780 ± 80	Corrected for reservoir effect: 6400 ± 90	Lazarich et al. 1997
Kobaederra	Euskadi	Cave	Level II	Neolithic	Wood charcoal		UBAR-472	5200 ± 110	Earliest context with domesticates in Cantabria	Zapata et al. 1997
			Level III	Neolithic	Wood charcoal		UBAR-471	5820 ± 240		

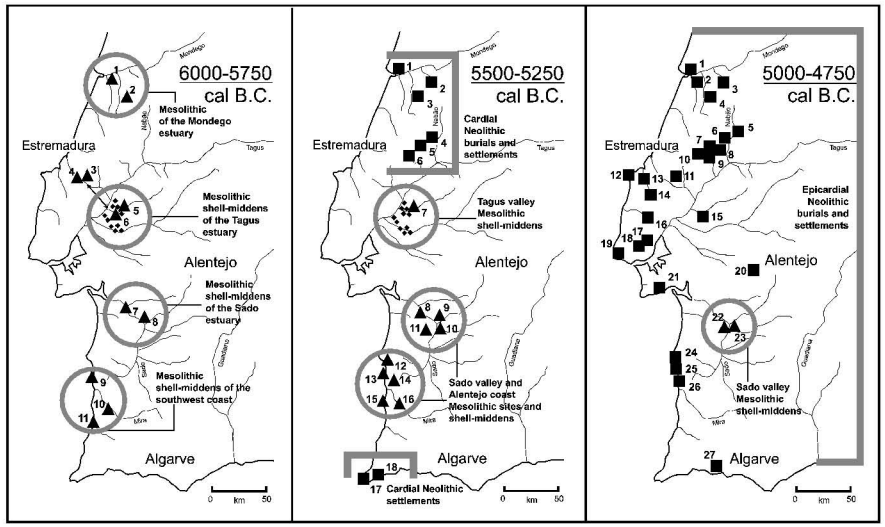


Fig. 11.1. Chronology and distribution of late Mesolithic and early Neolithic sites across the transition to agriculture in Portugal

interpretation of the transition in Iberia (Zilhão 2000). At the onset, it would seem that the interior regions of the peninsula (where no lakes exist and where large sections of even the largest rivers are susceptible to drying up in the summer months) became devoid of archaeologically visible populations after the end of the Pleistocene. By the time of the Atlantic climatic optimum, subsistence systems had become extremely dependent on aquatic resources, explaining current site distribution patterns as well as the consistently nitrogen-enriched isotopic composition of all late Mesolithic skeletons that have been analyzed. This may have been a result of interior forests having become too dense and too poor in resources to sustain year-round human occupation of the interior Meseta. In Portugal, this retreat to the waterside seems to have taken place even within the 50 km wide strip of coastal hills and lowlands between the Tagus and the Mondego Rivers. Inhabited during Boreal times, the interior plateaus of the limestone massif of central Estremadura seem to have become deserted at the onset of the Atlantic—with only a few caves and rock shelters at the mouth of major karstic springs located along the periphery of the massif containing some evidence of a highly logistical late Mesolithic use.

The earliest artifactually defined Neolithic settlement of Portugal is found

in exactly those limestone areas that had become abandoned by late Mesolithic hunter-gatherer groups. There are several reasons to believe that this earliest Neolithic settlement is associated with, or triggered by, the arrival of agropastoral seafaring colonist groups originating in Mediterranean Spain. Baroquely decorated Cardial wares similar to those from Valencia (Bernabeu 1989; Bernabeu et al. 1993; Martí et al. 1980, 1987; Martí and Juan-Cabanilles 1987; Martí and Hernandez 1988) are known in several Portuguese sites. The associated lithics feature polished axes and heat pretreated flint, both technologies being unknown in the late Mesolithic but well documented in the earliest Neolithic of Valencia. The dead were collectively buried in caves not used for habitation, and the artifacts associated with the burials include ceramic vessels and beads made of *Cypraea* and *Glycymeris* shells. These religious practices clearly set the earliest Neolithic groups of Portugal apart from contemporary hunter-gatherers living in the estuaries of the Tagus and the Sado, where individual burial in pits excavated into the shell-midden debris of habitation sites is the norm. Furthermore, neither the ceramic vessels nor the shell-beads characteristic of Cardial burials have ever been found in the graves of the Mesolithic. Domesticates are unknown in the latter, but sheep are present in the artifactually defined early Neolithic burial contexts, which, from the point of view of human skeletal isotopy, are also characterized by markedly terrestrial diets—very different from those of contemporary Mesolithic people.

Coupled with the spatial patterning of the process, these contrasts in material culture and ideology make it extremely difficult to accept the alternative explanation that, in Portugal, the transition is the local adoption of agriculture by hunter-gatherers that had imported the several elements of the Neolithic package through long-distance exchange networks. This may well be the case, however, in northwestern Iberia and in the Cantabrian strip, where the transition takes place several hundred years later—at a time when the expansion of farming groups had already begun the reoccupation of the interior areas of the peninsula, and where some degree of continuity in settlement and burial practices seems to exist (Arias 1991, 1992, 1994; Arias et al. 2000; González Morales 1992, 1996; Zapata et al. 1997). In southern Portugal, this expansion is signaled by the coincidental extinction, ca. 4800 B.C., of the last hunter-gatherer groups. Documented in the Sado valley site of Amoreira, their interaction with encroaching farmers is suggested by the presence of a few Epicardial sherds in the otherwise purely Mesolithic shell midden deposits (Arnaud 1986).

At the continental scale, the Portuguese pattern has several implications. First, given the currently accepted radiometric results for the advent of the Neolithic in Liguria, it permits the calculation of the rate of spread of agropastoral systems across the west Mediterranean (fig. 11.2). Taking the earliest radiometric results currently available for Portugal—ca. 5400 B.C. cal.—as trustworthy indicators of the arrival of the first Neolithic settlers to the far western end of their European range, that rate is ca. 5 km/year. If, however, future dating shows that such a first arrival actually happened a couple hundred years earlier, or if the radiocarbon chronology available for the eastern half of the region (almost entirely obtained on bulk charcoal samples) is shown to be skewed by an old wood effect (Whittle 1990; Zilhão 1993), the rate may actually be twice as high: ca. 10 km/year. Given that ceramic vessels do not appear in the Middle East until ca. 6800 B.C. cal., the rate at which pottery spread across the northern shores of the whole of the Mediterranean basin, in turn, can be calculated, in km/year, to lie between 3.8 and 4.5, depending on whether one accepts a date of 5400 or 5600 B.C. cal. for the earliest Portuguese ceramics. Even the lowest value, however, is far above the 1 km/year suggested 30 years ago by Ammerman and Cavalli-Sforza in their wave of advance model for the spread of the Neolithic as a process of demic diffusion (Ammerman and Cavalli-Sforza 1973, 1984).

This recognition has several implications. Figure 11.3 shows the values obtained for the different parameters involved in the calculation of the annual rate of advance of the front r, using Ammerman and Cavalli-Sforza's equation $a=6r^2/M$, where a is the annual rate of population growth and M the generational rate of migratory activity caused by the settlement relocation of individuals over short distances. Ethnographic observations indicate that, in agricultural societies, the maximum value of M is ca. 2,000 km²/generation. Demographic models indicate, in turn, that the logistic growth curves necessary to trigger a process of population expansion cannot occur with values of $a < 0.3\%$. Population growth rates with values above 3% (which would already imply that population doubled every 23 years) are practically impossible; the most likely rate of population growth experienced by farmers at the front of the wave is in the range of 1–2%.

Given that, west of the Balkans, the Neolithic always appears as the full package of domesticates plus pottery, let us assume the most conservative estimate of ca. 4 km/year obtained for the spread of ceramics from the Middle East to Portugal as the best approximation for the rate of spread of

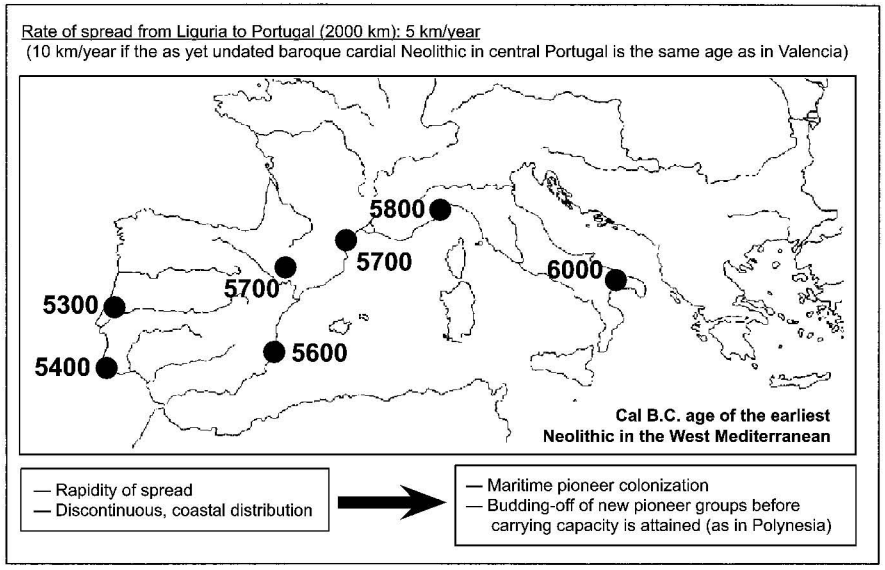
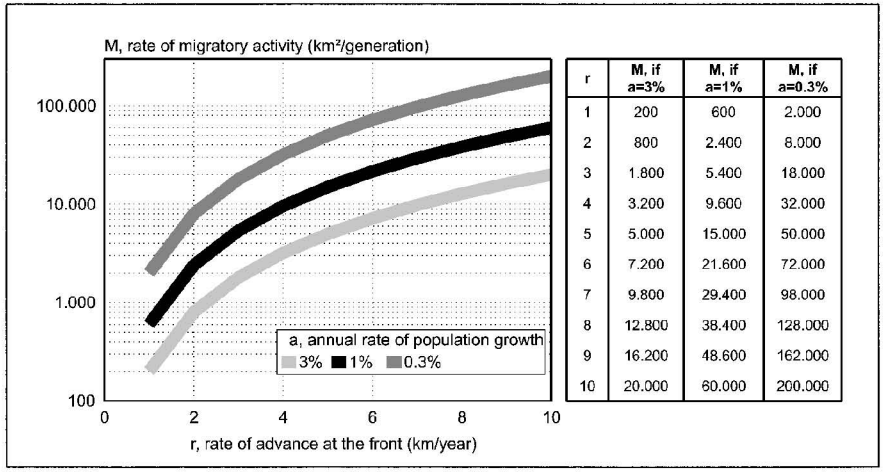


Fig. 11.2. Calibrated radiocarbon age of the earliest Neolithic in west Mediterranean Europe



r	M, if a=3%	M, if a=1%	M, if a=0.3%
1	200	600	2.000
2	800	2.400	8.000
3	1.800	5.400	18.000
4	3.200	9.600	32.000
5	5.000	15.000	50.000
6	7.200	21.600	72.000
7	9.800	29.400	98.000
8	12.800	38.400	128.000
9	16.200	48.600	162.000
10	20.000	60.000	200.000

Fig. 11.3. Rates of migratory activity implied by observed rates of advance of the Neolithic package for different values of annual growth of the frontier populations

agropastoral systems across the west Mediterranean. The combination of this rate with the ethnographically observed maximum migratory activity would imply an annual rate of population growth of 4.8%, well above the limit of practical or possible human growth rates (more so, if the rate of advance is

set at 10 km/year, in which case the corresponding value would be 30%). If values of 1% are used, then the rate of migratory activity will range between 9,600 and 60,000 km²/generation depending on whether the rate of advance is estimated at 4 or 10 km/year.

The implication of these values is that either agriculture did not spread through demic diffusion processes or that demic diffusion did not proceed through a mechanism of short-distance relocation of settlements, as previously occupied places became saturated and adjacent land had to be incorporated in the system to accommodate population growth. Since the evidence from Portugal reviewed above seems to refute the first term of this alternative, it remains that different mechanisms of demic diffusion must have been at work.

It is interesting to note that, with a population growth of 1% a year, the system would expand throughout an area of ca. 60,000 km² in six generations, if the rate of advance of the front was 4 km/year, or in one generation only, if the front advanced at a rate of 10 km/year (fig. 11.3). Those 60,000 km² are precisely the area covered by the 40–50 km wide coastal strip between the Mondego River, in Portugal, and the Cape of Nao, the southern limit of the Gulf of Valencia. The similarities in the style of pottery decoration observed between the two extremes of this range can be taken as evidence of a swift expansion with maintenance of cultural traditions over the relatively short time involved. Given the low resolution of radiocarbon, chances are, anyway, that, when the 95% confidence intervals of the dates are considered, the process will tend to appear to our eyes as an event, regardless of whether its duration was only 25 years or as much as 150 years.

In order for such a considerable area to be covered in such a short time, however, migratory activity must be much more intense than one is allowed to model under the gradualist assumptions of the wave of advance model. Under reasonable estimates of annual population growth, the observed rate of spread of the Neolithic across Mediterranean Europe requires the operation of long-distance settlement relocation episodes. At the same time, it implies such low population densities across the whole of the settled range that considerably large voids must be postulated between each node of the settlement network as, in fact, is made apparent in the mutually exclusive, "enclave" nature of contemporary late Mesolithic and early Neolithic territories observed in central Portugal. The coastal placement of the earliest Neolithic and its discontinuous geographical distribution—most apparent

in the Portuguese case but which has also been suggested for eastern Provence, France (Binder 2000)—suggests that the most likely alternative mechanism of demic diffusion is maritime pioneer colonization.

At the same time, the rapidity of spread indicates that individual long-distance colonization events were taking place well before saturation levels were attained at the point of origin. Why this is so remains to be clarified but it is likely that the answer is purely historical: that is, it must be sought in the concrete features of the events that triggered the eastward and westward expansion of agropastoral economies from their Middle Eastern core areas. In Anatolia, the process seems to have coincided with the collapse of the PPNB, for which there are strong indications of a stratified society and a strong influence of cult practices. In contrast, the succeeding Neolithic societies of western Anatolia and southeastern Europe lack any archaeological evidence of specially built temples and of social ranking in settlement or in burial (Özdogan 1997).

Özdogan also suggested that these egalitarian rural societies have their origins in the migration of groups carrying to the west all aspects of their culture except central authority. This hypothesis can be extended to suggest that the driving force behind the expansion of the Neolithic across the Mediterranean may have been a social imperative rooted in a tradition going back to the events leading to the collapse of the PPNB: the imperative to fission before groups get too large and conditions arise for the development of social inequality. In short, agriculture may have been brought to Europe by pioneers escaping from dominance in ranked societies and striving to maintain egalitarianism through the application of strict controls to group size. Along the shores of the north Mediterranean, this tendency to fission and move on would have been further reinforced because opportunities for settlement and expansion around initial enclaves were limited by physical geography and by the presence of local hunter-gatherer groups.

Social and cultural imperatives have also been postulated to explain the similar process of colonization of the Pacific islands by seafaring agriculturalists spreading out to occupy new territory well before carrying capacity was attained at the point of origin—in this case, in the framework of ranked societies (Irwin 1992; Kirch 1984). The greatest merit of these kinds of explanations lies in that explanatory value is given to human volition, and history is represented as the outcome of the interplay of actions carried out by individuals and social groups, not as the simple product of the operation

of abstract laws or as the inevitable result of some kind of absolute environmental or demographical pressures.

To conclude in the spirit of the introduction, I must also state that my preference for these kinds of high-level explanations also needs to be understood in the framework of a personal and social background. Mention was made before of the environment of great intellectual freedom that existed in Portugal during my formative years. I was fortunate enough to belong to a generation that, at the time, was sufficiently old to participate actively in the events that radically changed our country in the years 1974–1975, but also sufficiently young to avoid being imprinted by the Stalinist/Maoist caricatures of Marxism that so much influenced previous generations. If that experience taught me an enduring lesson, it was that of the validity of the most basic and most radical contribution of Karl Marx to social sciences: people make their own history, and they must have made their own prehistory too.

REFERENCES

Ammerman, A.J., and L.L. Cavalli-Sforza. 1973. "A Population Model for the Diffusion of Early Farming in Europe." In *The Explanation of Culture Change: Models in Prehistory*, edited by C. Renfrew, 343–57. London.

———. 1984. *The Neolithic Transition and the Genetics of Population in Europe*. Princeton.

Arias, P. 1991. *De cazadores a campesinos: La transición al neolítico en la región cantábrica*. Santander.

———. 1992. "Estrategias económicas de las poblaciones del Epipaleolítico avanzado y el Neolítico en la región cantábrica." In *Elefantes, ciervos y ovicaprinos: Economía y aprovechamiento del medio en la Prehistoria de España y Portugal*, edited by A. Moure Romanillo, 163–84. Santander.

———. 1994. "El Neolitico de la región cantábrica: Nuevas perspectivas." *Trabalhos de Antropologia e Etnologia* 34(1–2):93–118.

Arias, P., J. Altuna, A. Armendariz, J.E. González, J.J. Ibañez, R. Ontañon, and L. Zapata. 2000. "La transición al Neolítico en la región cantábrica. Estado de la cuestión." In *3º Congresso de Arqueologia Peninsular. Actas*. Vol. 3, *Neolitização e Megalitismo da Península Ibérica*, edited by P. Arias, P. Bueno, D. Cruz, J. Enriquez, J. Oliveira, and M.J. Sanches, 115–33. Porto.

Arnaud, J.M. 1986. "Cabeço das Amoreiras—São Romão do Sado." *Informação Arqueológica* 7:80–2.

———. 1987. "Os concheiros mesolíticos dos vales do Tejo e do Sado: Semelhanças e diferenças." *Arqueologia* 15:53–64.

———. 1989. "The Mesolithic Communities of the Sado Valley, Portugal, in Their Ecological Setting." In *The Mesolithic in Europe*, edited by C. Bonsall, 614–31. Edinburgh.

———. 1990. "Le substrat mésolithique et le processus de néolithisation dans le sud du Portugal." *In Rubané et Cardial*, edited by D. Cahen and M. Otte, 437–46. Liège.

Baldellou, V., and A. Castán. 1983. "Excavaciones en la Cueva de Chaves de Bastaras (Casbas—Huesca)." *Bolskan* 1:9–37.

Baldellou, V., and P. Utrilla. 1985. "Nuevas dataciones de radiocarbono de la prehistoria oscense." *Trabajos de Prehistoria* 42:83–95.

Bernabeu, J. 1989. *La tradición cultural de las cerámicas impresas en la zona oriental de la Península Ibérica*. Valencia.

Bernabeu, J., J.E. Aura, and E. Badal. 1993. *Al Oeste del Eden: Las primeras sociedades agrícolas en la Europa Mediterránea*. Madrid.

Bernabeu, J., M. Pérez,, and R.M. Martínez. 1999. "Huesos, Neolitización y Contextos Arqueológicos Aparentes." In *Actes del II Congrés del Neolític a la Península Ibèrica, Universitat de València*, edited by J. Bernabeu and T. Orozco, 589–96. Valencia.

Binder, D. 2000. "Mesolithic and Neolithic Interaction in Southern France and Northern Italy: Current Research and Hypotheses." In *Europe's First Farmers*, edited by T.D. Price, 117–82. Cambridge.

Binford, L. 1983. *In Pursuit of the Past*. London.

Cardoso, J.L., J.R. Carreira, and O.V. Ferreira. 1996. "Novos elementos para o estudo do Neolítico antigo da região de Lisboa." *Estudos Arqueológicos de Oeiras* 6:9–26.

Fortea, J., and B. Martí. 1984–1985. "Consideraciones sobre los inicios del Neolítico en el Mediterráneo español." *Zephyrus* 37–38:167–99.

Gomes, M.V. 1994. "Menires e cromeleques no complexo cultural megalítico português—trabalhos recentes e estado da questão." In *O Megalitismo no Centro de Portugal: Actas do Seminário*, 317–42. Viseu.

González Morales, M. 1992. "Mesolíticos y Megalíticos: La evidencia arqueologica de los cambios en las formas productivas en el paso al megalistismo en la Costa Cantábrica." In *Elefantes, ciervos y ovicaprinos: Economía y aprovechamiento del medio en la Prehistoria de España y Portugal*, edited by A. Moure Romanillo, 185–202. Santander.

———. 1996. "La transición al Neolítico en la Costa Cantábrica: La evidencia arqueológica." In *Actes. I Congrés del Neolític a la Península Ibérica* 2:879–85. Gavà.

González Morales, M., and J. Arnaud. 1990. "Recent Research on the Mesolithic of the Iberian Peninsula." In *Contributions to the Mesolithic in Europe*, edited by P.M. Vermeersch and P. Van Peer, 451–61. Leuven.

Guilaine, J., and M. Martzluff. 1995. *Les excavacions a la balma de la Margineda (1979–1991)*. Andorra.

Hahn, J. 1988. *Das Geissenklösterle I*. Stuttgart.

Irwin, G. 1992. *The Prehistoric Exploration and Colonisation of the Pacific*. Cambridge.

Jackes, M., D. Lubell, and C. Meiklejohn. 1997. "Healthy But Mortal: Human Biology and the First Farmers of Western Europe." *Antiquity* 71:639–58.

———. 1997. "On Physical Anthropological Aspects of the Mesolithic-Neolithic Transition in the Iberian Peninsula." *Current Anthropology* 38:839–46.

Kirch, P. V. 1984. *The Evolution of the Polynesian Chiefdoms*. Cambridge.

Lazarich, M., J. Ramos, V. Castañeda, M. Pérez, N. Herrero, J. M. Lozano, E. García, S. Aguilar, M. Montañés, and C. Blanes. 1997. "El Retamar (Puerto Real, Cádiz): Un asentamiento neolítico especializado en la pesca y el marisqueo." In *II Congreso de Arqueología Peninsular: Tomo I–Paleolítico y Epipaleolítico*, edited by R. Balbín and P. Bueno, 49–58. Zamora.

Lubell, D., and M. Jackes. 1988. "Portuguese Mesolithic–Neolithic Subsistence and Settlement." *Rivista di Antropologia* Suppl. 66:231–48.

Lubell, D., M. Jackes, H. Schwarcz, M. Knyf, and C. Meiklejohn. 1994. "The Mesolithic–Neolithic Transition in Portugal: Isotopic and Dental Evidence of Diet." *Journal of Archaeological Science* 21:201–6.

Martí, B., V. Pascual, and M.D. Gallart. 1980. *Cova de l'Or (Beniarres, Alicante)*. Valencia.

Martí, B., J. Fortea, J. Bernabeu, M. Perez, J.D. Acuna, F. Robles, and M.-D. Gallart. 1987. "El Neolitico antiguo en la zona oriental de la Peninsula Iberica." In *Premières communautés paysannes en Méditerranée Occidentale*, edited by J. Guilaine, J. Courtin, J.-L. Roudil, and J.-L. Vernet, 607–19. Paris.

Martí, B., and M.S. Hernandez. 1988. *El Neolític Valencià: Art rupestre i cultura material*. Valencia.

Martí, B., and J. Juan-Cabanilles. 1987. *El Neolític Valenciá: Els primers agricultors i ramaders*. Valencia.

Martin Colliga, A. 1986–1989. "Reflexión sobre el estado de la investigación del Neolítico en Cataluña y su reflejo en la cronología radiométrica." *Empúries* 48–50:84–102.

———. 1990. "El Neolitico antiguo en Cataluña: Trayectoria de su investigacion." In *Autour de Jean Arnal*, edited by J. Guilaine and X. Gutherz, 37–54. Montpellier.

Özdogan, M. 1997. "The Beginning of Neolithic Economies in Southeastern Europe: An Anatolian Perspective." *Journal of Mediterranean Archaeology* 5:1–33.

Sanches, M.J., A.M. Soares, and F.M. Alonso. 1993. "Buraco da Pala (Mirandela): Datas de carbono 14 calibradas e seu poder de resolução: Algumas reflexões." *Trabalhos de Antropologia e Etnologia* 33(1–2):223–43.

Tarrus, J., J. Chinchilla, and A. Bosch. 1994. "La Draga (Banyoles): Un site lacustre du Néolithique ancien cardial en Catalogne." *Bulletin de la Société Préhistorique Française* 91:449–56.

Villa, P., and J. Courtin. 1982. "Une expérience de piétinement." *Bulletin de la Société Préhistorique Française* 79:117–23.

Whittle, A. 1990. "Radiocarbon Dating of the Linear Pottery Culture: The Contribution of Cereal and Bone Samples." *Antiquity* 64:297–302.

Zapata, L., J.J. Ibañez, and J. González. 1997. "El yacimiento de la cueva de Kobaederra (Oma, Kortzubi, Bizkaia): Resultados preliminares de las campañas de excavación de 1995–1997." *Munibe* 49:51–63.

Zilhão, J. 1990. "Le processus de néolithisation dans le centre du Portugal." In *Rubané et Cardial*, edited by D. Cahen and M. Otte, 447–59. Liège.

———. 1992. *Gruta do Caldeirão: O Neolítico Antigo*. Trabalhos de Arqueologia 6. Lisbon.

———. 1993. "The Spread of Agro-Pastoral Economies across Mediterranean Europe: A View from the Far West." *Journal of Mediterranean Archaeology* 6:5–63.

———. 1995. "O Paleolítico Superior da Estremadura portuguesa." Ph.D. thesis, Universidade de Lisboa.

———. 1997a. *O Paleolítico Superior da Estremadura portuguesa*, 2 vols. Lisbon.

———. 1997b. "Maritime Pioneer Colonization in the Early Neolithic of the West Mediterranean: Testing the Model Against the Evidence." *Porocilo o raziskovanju paleolitika, neolitika in eneolitika v Sloveniji* 24:19–42.

———. 1998. "On Logical and Empirical Aspects of the Mesolithic–Neolithic Transition in the Iberian Peninsula." *Current Anthropology* 39:690–8.

———. 2000. "From the Mesolithic to the Neolithic in the Iberian Peninsula." In *Europe's First Farmers*, edited by T.D. Price, 144–82. Cambridge.

Zilhão, J., and A.M.F. Carvalho. 1996. "O Neolítico do Maciço Calcário Estremenho. Crono-estratigrafia e povoamento." In *Actes. I Congrés del Neolític a la Península Ibérica*, 659–71. Gavà.