HUNTERS OF THE GOLDEN AGE

THE MID UPPER PALAEOLITHIC OF EURASIA 30,000 - 20,000 BP

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26 Nature and culture in Portugal from 30,000 to 20,000 bp

The period 30-20 kyr did not see significant environmental changes in littoral Portugal, though landscapes became more open, and the overall land surface increased through lowering of the sea level. The beginning of this period witnessed the replacement of Neanderthals by modern humans, whose adaptations did not change significantly until the LGM, except in the technological domain. It is suggested here that changes in the size of social networks were behind the rapid and large-scale diffusion of new technological traits. The period at stake sees a long-term trend towards a more economic use of raw material, and a concomitant miniaturisation of tool kits.

1. Introduction

Almost everything we know about the Upper Palaeolithic of Portugal is based on the evidence collected since the nineteenth century, and particularly within the last 15 years, in Portuguese Estremadura. Unless where explicitly mentioned otherwise, all characterisations in this text should be taken as referring to this region which, from a structural point of view, corresponds to the portion between the present-day Tagus and Mondego rivers of the Western Border, one of the geotectonic units of the Iberian Peninsula. It is mainly composed of Mesozoic sediments affected by a series of orogenic episodes which produced the rising of several mountain ridges (all culminating around 600 m) that represent the continuation, inflected to the southwest, of the Iberian *Cordilheira Central*. To the south and southeast of these limestone reliefs lies the lower Tagus basin, filled mainly with continental sediments of Paleogenic and Neogenic age; to the west, they are separated from the Atlantic by a littoral platform leveled in Plio-Pleistocene times and continuing beyond the present coast line as an extensive continental platform (Ribeiro *et al.* 1979).

In spite of this internal geomorphological variation, the region is well differentiated from neighbouring regions by significant geographical barriers: to the north, the wide valley of the lower Mondego; to the east, the schist and granite mountains of central Portugal, rising very quickly above 700 m and culminating at 2000 m in the Serra da Estrela; and to the south and southeast, the lower basin and the estuary of the Tagus, the largest river of Iberia. Today, these geographic frontiers represent as many ecological ones: a zone of balance where mediterranean species equal or slightly dominate atlantic ones, the region is surrounded by phytoclimatic zones of markedly sub-atlantic (to the north and northeast) and sub-mediterranean (to the south and southeast) dominance (Albuquerque 1984) and can therefore be more simply described as the region of Western Iberia where the transition between the two worlds (Mediterranean and Atlantic) is realised.

2. Climate and environment

2.1 Interstadial environments

Throughout OIS 3, climatic conditions in Portuguese Estremadura seem to have been temperate. At the cave site of Lapa dos Furos, near Tomar, an archaeologically sterile level underlying a thin mousterian occupation had large amounts of land snails (including *Cepaea nemoralis*) associated with red deer bones. A sample of those snails was dated to *c.* 34.5 kyr bp (Table 1). This faunal association suggests a woodland environment, as is the case with that from layer K of the nearby cave site of Caldeirão, where bones of *Capreolus capreolus*, *Castor fiber* and *Sus scrofa* were recovered (Zilhão 1987, 1995a; Antunes 1989). Bone from the upper part of that layer has been AMS dated to *c.* 28 kyr bp (Table 1).

Direct data on vegetation come from palynological analyses of littoral peat bogs located north of Peniche (Fig. 1a). In accordance with the data collected in the caves from the Tomar region, these analyses indicate a landscape of heathland and pine on the coast and on the sandy soils of the interfluves, with oak woodlands covering the low altitude limestone massifs (Diniz 1993).

The cave site of Figueira Brava is located near Sesimbra, on the southern slope of the Serra da Arrábida, where the continental platform is very steep. It provided evidence related to the conditions prevailing at sea during slightly later times (Antunes 1990-91). *Patella* sp. shells from the mousterian occupation in level 2 were radiocarbon dated to *c.* 31 kyr bp, that is, to the beginning of OIS 2. The only publication available lists the fauna collected at the site without stratigraphic discrimination of the several taxa (levels 3 and 4, which underlie the dated level 2, are also

Table 1. Portuguese Estremadura (a). Radiocarbon dates from archaeological sites (35-20 Kyr bp).

SITE	LEVEL	MATERIAL	ARCHAEOLOGY	LAB no.	AGE bp	OBS.
Anecrial	1b-2a	Charcoal	Proto-Solutrean	ICEN-963	23,450/+1470/-1240	
Anecrial	2b	Erica charcoal	Proto-Solutrean	OxA-5526	21,560±220	
Anecrial	2b	Charcoal	Proto-Solutrean	ICEN-964	21,560±680	
Buraca Escura	C2C	*Equus*	Proto-Solutrean	OxA-5524	21,820±200	
Buraca Escura	C2E	*Capra*	Late Gravettian	OxA-5523	22,700±240	
CPM III	Middle	Charcoal	Late Gravettian	ICEN-423	23,490±280	b)
CPM III	Lower	Charcoal	Late Gravettian	ICEN-541	21,080±850	
CPM III	Lower	Charcoal	Late Gravettian	SMU-2475	22,710±350	
CPM III	Lower	Charcoal	Late Gravettian	ICEN-428	23,050±750	
Caldeirão	Fa top	*Cervus*	Solutrean	OxA-1938	20,400±270	c)
Caldeirão	Fa top	Charcoal	Solutrean	ICEN-295	21,200/+2300/-1800	
Caldeirão	H	*Capra*	Solutrean	OxA-1939	19,900±260	
Caldeirão	H	Bone	Solutrean	OxA-2511	20,530±270	
Caldeirão	I	*Cervus*	Proto-Solutrean	OxA-1940	22,900±380	d)
Caldeirão	Jb (profile)	Bone	Upper Palaeolithic	OxA-5542	26,020±320	
Caldeirão	K top	*Cervus*	Mousterian	OxA-5541	18,060±140	e)
Caldeirão	K top	*Cervus*	Mousterian	OxA-1941	27,600±600	
Caldeirão	K base (K5)	*Capra*	Mousterian	OxA-5521	23,040±340	f)
Casa da Moura	1b	*Canis lupus*	Carnivore den	TO-1102	25,090±220	g)
Columbeira	16	Carbonaceous sediment	Mousterian	Gif-2703	26,400±700	h)
Columbeira	20	Carbonaceous sediment	Mousterian	Gif-2704	28,900±950	h)
Figueira Brava	2	*Patella* sp.	Mousterian	ICEN-387	30,930±700	
Lapa dos Furos	4	Land snail shells	Mousterian	ICEN-473	34,580/+1010/-1160	
Lapa da Rainha	4	Bone	Solutrean	ICEN-789	25,580/+1820/-1490	i)

fossiliferous). It seems reasonable, however, to admit that the marine animals identified – *Pusa hispida* and *Pinguinus impennis* – come from the same level as the *Patella* shells. Given the modern distribution of those species, unknown south of the British Channel, ocean waters off the Portuguese coast must have been colder than at present.

Capra pyrenaica is also reported from Figueira Brava. If it does come from the same levels as the marine taxa, its presence might suggest that, at higher elevations (the Serra da Arrábida culminates at *c.* 500 m), the limestone massifs and mountains were open landscapes, even throughout the interstadial. Alternatively, this evidence may indicate that the trend towards a cooler climate was already well under way in Portugal by 31 kyr bp, in good accord with the presence of the arctic seal and the great auk in the faunal assemblage from level 2. The other large herbivores present (aurochs, horse, red deer) are not very indicative and largely ubiquitous. Although Antunes mentions the presence of mammoth, the anatomical basis for this attribution is not specified. It seems quite likely that the remains in question belong instead to *Elephas antiquus*, which is known to have survived in Portugal until *c.* 30 kyr bp (Cardoso 1993).

2.2 Palaeoenvironmental evidence *c.* 25 kyr bp

Data on the climate of the first part of the Pleniglacial are still relatively scarce. Along the beaches south of Oporto it has been possible to recover stumps and branches of *Pinus sylvestris* in peat deposits exposed during important tides (Fig. 1a). Radiocarbon dates for these remains, of what seems to have been an open pine forest covering the sandy soils of the Portuguese coast between the Douro and the Mondego rivers, range from *c.* 30 to *c.* 20 kyr bp (Granja and Carvalho 1995).

Cave sites with deposits from this time period, such as Salemas (north of Lisbon), Casa da Moura (east of Peniche) and Caldeirão, contain abundant remains of *Rupicapra*

Table 1 continued. Portuguese Estremadura (a). Radiocarbon dates from archaeological sites (35-20 Kyr bp).

SITE	LEVEL	MATERIAL	ARCHAEOLOGY	LAB no.	AGE bp	OBS.
Lapa da Rainha	5	Bone	Hyaena den	ICEN-790	20,330±330	i)
Pedreira de	2	Bone	Mousterian	ICEN-366	29890/+1130/-980	
Salemas						
Pego do Diabo	2a	Bone	Aurignacian	ICEN-490	23,080±490	j)
Pego do Diabo	2b	Bone	Aurignacian	ICEN-732	28,120/+860/-780	
Salemas	V.S.	Bone	Solutrean	ICEN-376	20,250±320	i)
Salemas	T.V.b	Bone	Mousterian	ICEN-379	24,820±550	i)
Terra do Manuel	2s	Charcoal	Late Gravettian	ETH-6038	21,770±210	
Vale Almoinha	5	Charcoal	Solutrean	OxA-5676	19,940±180	
Vale Almoinha	5	Charcoal	Solutrean	ICEN-71	20,380±150	

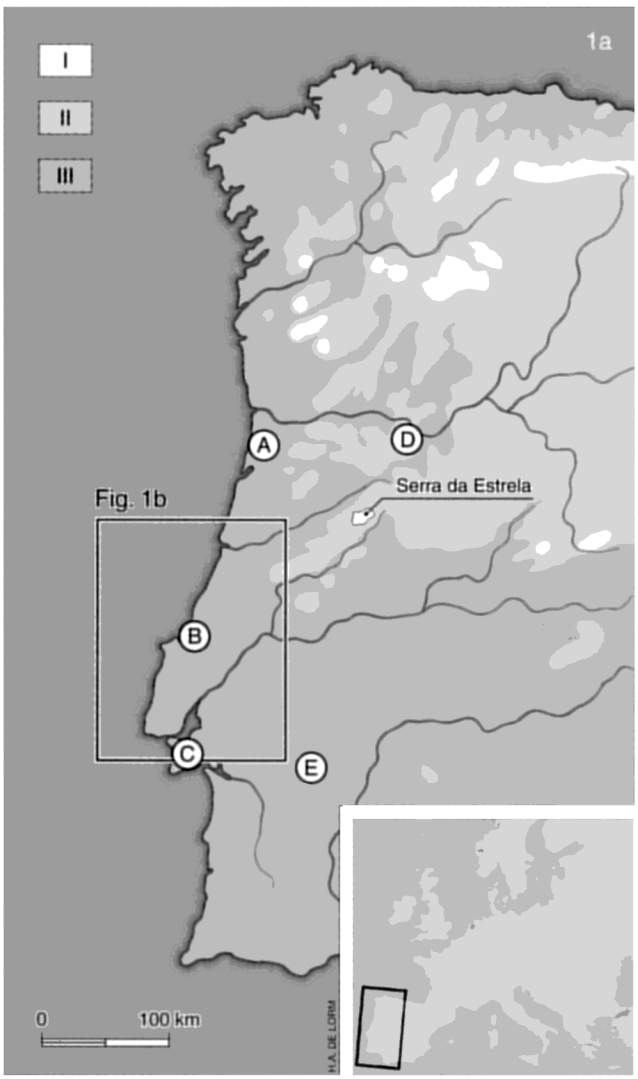
a) Data from: Delibrias *et al.* 1986; Antunes *et al.* 1989; Cardoso 1993; Aubry and Moura 1994; Marks *et al.* 1994; Straus 1989; Zilhão 1995a. CPM = Cabeço de Porto Marinho.
b) Date too old for unknown reasons (should be younger than the underlying Lower Level, whose ^{14}C age is between 22 and 23 Kyr bp).
c) The dated bone was probably a displaced piece, since its age is significantly older than the 18,840 ± 200 bp (OxA-2510) of the underlying level Fc and identical to that of the samples dated from level H.
d) The dated bone was probably a displaced piece, since its age is significantly older than that obtained elsewhere in Portugal for similar contexts.
e) Date too young, possibly due to very low collagen content (0,32%N; 3,66%C; 0,53%H).
f) Date too young, possibly due to very low collagen content (0,32%N; 2,39%C).
g) The sample came from residual deposits excavated by Straus (1989) and its result may be related to a gravettian component recognised in the artefact assemblage from Delgado's nineteenth century excavations (Zilhão 1995a).
h) Date too young, possibly due to the inadequate nature of the sample.
i) The association between the dated bones and the diagnostic archaeological materials is questionable.
j) Date too young, possibly due to contamination by later material (the aurignacian level is surface).

rupicapra, but *Capra pyrenaica* is also present (Zilhão 1987, 1995a; Cardoso and Antunes 1989; Cardoso 1993). Since today chamois lives in mountain woodlands, this association suggests that the climate was wet enough to allow for tree growth, but that forest cover was not as dense as to inhibit the presence of ibex populations, which may have lived at higher elevations or in areas of more rugged terrain.

Geochemical analysis of the Upper Pleistocene sequence from Caldeirão (Cruz 1990, 1993) indicates that the maximum of oceanic humidity is found in layer Jb, radiocarbon dated to *c.* 26 kyr bp. Another indication of relatively humid conditions is given by the fact that the rivers were accumulating extensive deposits of sand and gravel. This process must have begun or, at least, increased, precisely around 25-26 kyr bp, since the deposits in question contain rolled aurignacian and early gravettian artefacts (Zilhão 1995a). Last Glacial mountain glaciers existed in Serra da Estrela and in the northwestern mountains of the Serra da Peneda, Serra do Gerês and Serra da Cabreira (Fig. 1a), but no data exist on when they began to form. The evidence from the littoral lowlands suggests that such a process may have resulted from important snow precipitation in the high mountains of Central and Northern Portugal during the first part of the Pleniglacial.

2.3 Last Glacial Maximum environments

Global palaeoclimatic models predict that in Iberia average annual temperatures should have been *c.* 10°C lower than at present, while precipitation must have been some 50% lower (Gates 1976; Guiot *et al.* 1989). Winter sea surface palaeotemperatures are estimated to have been in the order of 3-4°C off the Portuguese coast (Duprat 1983) and, at Caldeirão, oceanic humidity as measured by the Na/K ratio reaches its lowest level in the sequence at around 18 kyr bp (Cruz 1990, 1993). In the interior Meseta, these changes must have brought about the development of a continental



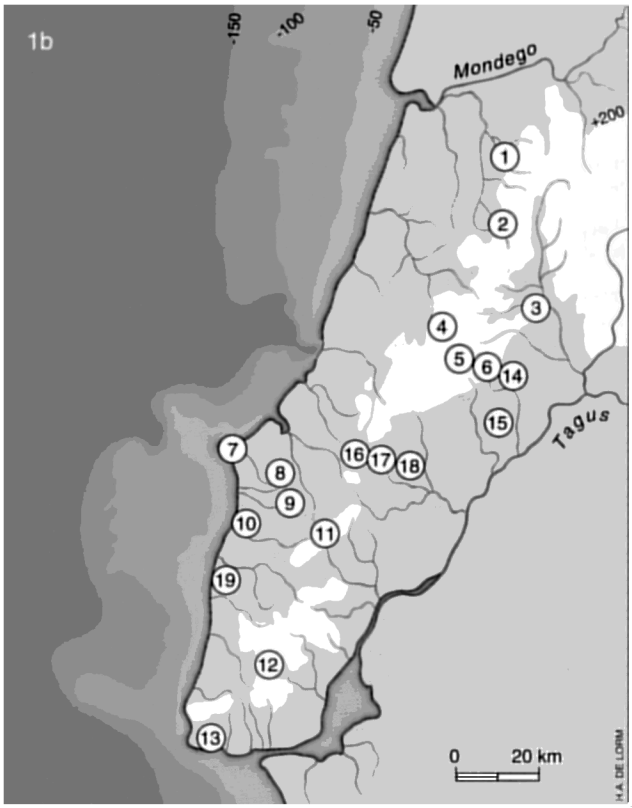


Fig. 1a and b. The sites with pre-20 kyr bp Upper Palaeolithic occupation presently known in Portuguese Estremadura and their paleoenvironmental context.
1a: A. OIS2 *Pinus sylvestris* forest; B. OIS 3 peat deposits with temperate flora; C. Early OIS 2 cold sea fauna; D. Open air sites: Mazouco, Côa Valley; Occupation sites: Salto do Boi (Cardina I); E. Cave art sites: Escoural; Occupation sites: Escoural, Monte da Fainha. I. mountain glaciers; II. > 700 m; periglacial areas (unvegetated mountain slopes; Meseta – continental steppe); III. < 700 m; compression of alpine, subalpine, boreal and temperate vegetation zones.
1b: Cave sites: 1. Ourão; 2. Buraca Grande, Buraca Escura; 3. Caldeirão; 4. Anecrial; 5. Picareiro; 6. Almonda; 7. Furninha; 8. Casa da Moura; 9. Lapa do Suão; 10. Lapa da Rainha; 11. Covão, Fontainhas, Furadouro; 12. Salemas, Pego do Diabo; 13. Poço Velho, Algar de Cascais. Open air sites: 14. Açude do Alvorão, Fonte Santa; 15. Casal do Cepo; 16. Casal do Felipe, Vales, Terra do Manuel, Terra do José Pereira, Vale Comprido; 17. Cabeço de Porto Marinho, Vascas, Gato Preto, Estrada da Azinheira, Vale de Porcos, Picos; 18. Passal; 19. Cova da Moura, Vala Almoinha.

steppe landscape. In the littoral lowlands of Western Iberia, the main climatic factors must have been the strong westerlies and the coldness of sea waters. Sand dunes whose accumulation began around 22 kyr bp are found along the present-day littoral and even in some interior regions, particularly in those with sandy bedrock, such as the Rio Maior basin. Here, the accumulation of eolian sands was also facilitated by extensive slope exposure, brought about by the process of river downcutting caused by eustatic response to lowered sea levels (Zilhão 1987, 1990, 1995a).

Charcoal collected in the solutrean levels from Caldeirão (Figueiral n.d. a) suggests that mixed boreal-temperate woodlands, with a good representation of mediterranean taxa (including *Olea*), existed in the more sheltered valleys of the limestone massifs. The landscape of pine woods and heathlands must have reached its maximum extension by then and the now submerged littoral platform (which extended the present land another 30 km to the west) corresponded, in all probability, to a *lande* (Mateus and Queirós 1993). Evidence from Lapa do Anecrial (located at the heart of the Limestone Massif, some 400 m above modern sea level) and from Cabeço de Porto Marinho (located in the Rio Maior basin, some 80 m above modern

Table 2. Last Glacial Maximum faunas. Species represented in Estremaduran caves (a).

	ARCHAEOLOGICAL SITES			PALAEONTOLOGICAL SITES		
	Caldeirão	Anecrial	Almonda (b)	Salemas	Fontainhas	Cascais
Horse *(Equus caballus)*	•				•	•
Wild boar *(Sus scrofa)*	•		•	•	•	
Red deer *(Cervus elaphus)*	•		•	•	•	•
Fallow deer *(Dama dama)*					•	
Aurochs *(Bos primigenius)*				•		•
Chamois *(Rupicapra rupicapra)*	•			•		
Hare *(Lepus capensis)*	•					
Birds	•		•			

a) After Zilhão (1987a, unpublished data) and Cardoso (1993)
b) Gallery of the Cistern

sea level), suggests a marked altitudinal gradient in the composition of the pine woods. Around the former (Figueiral n.d. b), they were made up of *Pinus sylvestris* (an indication of the descent to very low altitudes of the vegetational communities that, in the Iberian mountains of today, are characteristic of the Alpine stage) and, around the latter, of *Pinus pinaster/pinea* (Figueiral 1993).

Last Glacial Maximum faunas (Table 2) are known from archaeological (such as Salemas and Caldeirão) and palaeontological sites (such as Algar de Cascais and Gruta das Fontainhas). They do not differ significantly from those documented in Figueira Brava at the beginning of OIS 2 (Cardoso 1993). Sea mammals are naturally absent from those inland sites and chamois seems to be still abundant, at least at Caldeirão. None of the cold adapted species of large mammals (bison, woolly rhino, musk ox, mammoth, reindeer) found in the Meseta or in the littoral areas north of the Cantabro-Pyrenean mountains has so far been securely identified in Portugal. The same is true of rodents: the assemblage recovered at Caldeirão featured the same species found today in the region (Póvoas *et al.* 1992).

3. Human adaptations

3.1 Population replacement: the Ebro frontier

Radiocarbon dating of mousterian levels in the cave sites of Figueira Brava, Pedreira de Salemas, Caldeirão and Lapa dos Furos (Table 1) indicates that, in littoral Portugal, Middle Palaeolithic industries were manufactured until *c.* 28-30 kyr bp (Antunes *et al.* 1989; Antunes 1990-91; Zilhão 1991, 1993, 1995a). Younger ^{14}C ages, up to *c.* 25 kyr bp, have also been obtained at Columbeira and Salemas (Table 1). The laboratory considers the Columbeira results unreliable (Delibrias *et al.* 1986), due to the nature of the sample, and it has been shown that level T.V.b of Salemas lacks stratigraphic integrity (Zilhão 1995a). Raposo (1993, 1995) reports U/Th dates for three tooth samples from the mousterian open air site of Foz do Enxarrique (located at Ródão, on the Tagus, near the Spanish border): averaging 33,600 ± 500 bp, these results independently confirm the existence of Middle Palaeolithic industries in Portugal after 35 kyr bp. A similar late survival of the Mousterian has been suggested for Southern Spain, based on sedimentological and biostratigraphic arguments (Vega Toscano 1990; Villaverde and Fumanal 1990), derived from the sites of Cova Negra (Valencia) and Cariguela (Andalucia). This idea was recently confirmed at Zafarraya cave, also located in Andalucia, where a mousterian sequence containing Neanderthal remains has been dated by ^{14}C to 29.8 ± 0.6, at the top, and by U/Th to 33.4 ± 2 kyr bp, at the bottom (Hublin *et al.* 1995).

The earliest Upper Palaeolithic is the Aurignacian. In the region of Valencia (Spain), an aurignacian level has been radiocarbon dated to *c.* 30 kyr bp at the cave site of Mallaetes (Fortea and Jordá 1976). In Portugal, the only date available is that obtained for the base of level 2 at the cave site of Pego do Diabo, north of Lisbon: *c.* 28 kyr bp (Table 1). The material culture also indicates that these occurrences pertain to a late Aurignacian. In Iberia, no split-based bone points or other items typical of the early Aurignacian have so far been found south of the Ebro. Its chronostratigraphic position must be occupied, therefore, by the Late Mousterian, as is also suggested by the long and rich cave sequences spanning the

Fig. 2. The Ebro frontier. Aurignacian I assemblages with split based bone points are unknown south of the Cantabro-Pyrenean mountains, where the corresponding stratigraphic position is occupied by a late Mousterian manufactured by Neanderthals. This spatial segregation may have lasted for as much as 10,000 years, until *c.* 28-30 kyr bp, when late aurignacian tool kits appear in Portugal and Southern Spain.

Middle/Upper Palaeolithic divide (Cariguela, Beneito and Caldeirão; Vega Toscano 1990; Iturbe *et al.* 1993; Zilhão 1993, 1995a) which all lack 'Aurignacian I' deposits.

In these circumstances, it would seem that the valley of the Ebro functioned for more than 5000 years as a major bio-cultural frontier (Fig. 2): to the north, Western Europe was occupied, since at least *c.* 36.5 kyr bp, and maybe as early as 40-38 kyr bp (as suggested by the dates obtained for El Castillo and Arbreda: Cabrera and Bischoff 1989; Bischoff *et al.* 1989), by anatomically modern humans with an Upper Palaeolithic material culture; to the south, the rest of Iberia continued to be occupied, until *c.* 30-28 kyr bp, by Neanderthals with a Middle Palaeolithic material culture. Biocultural replacement seems to have taken place quite suddenly (at least in comparison with the previous millennia of apparently stable geographical segregation), although recent finds suggest that local Neanderthals were absorbed, rather than driven into extinction, by the modern immigrants (Duarte *et al.* 1999).

This pattern raises several important questions:

- why did anatomically modern humans, whose East-West spread over North and Central Europe was almost instantaneous (at the available scale of resolution), stop at the Ebro?
- why did they finally cross the border and why did they do it at that specific time?
- why was the replacement of Iberian Neanderthals by anatomically modern humans so fast (as it had been the case everywhere else in Europe before)?

Simplistic models of a biologically based intellectual superiority of anatomically modern humans (Stringer and Gamble 1993) cannot explain this punctuated process. On the other hand, the fact that Iberian Neanderthals maintained their traditional culture so long after modern humans had reached the Pyrenean region, falsifies the explanation of the Châtelperronian and similar Central European cultures put forward by such models – that they were a byproduct of the inevitable acculturation of Neanderthals brought about by their contact with contemporaneous groups of moderns occupying neighbouring territories. Thus, on present evidence, it would seem that the most parsimonious way of interpreting those cultures is that, in West and Central Europe, at the time of contact, Neanderthals were already going through their own 'Upper Palaeolithic revolution' (Gilman 1984).

In this framework, the fact that Neanderthals did not have parietal art, if confirmed by future research, may have a

socioecological rather than a biological basis, since such has also been the case with previous, coeval and subsequent modern populations in many parts of the world. For the same reasons, the fact that Iberian Neanderthals, living south of the Ebro, never became Upper Palaeolithic can be interpreted as a simple manifestation, in the realm of human adaptations, of the laws of unequal development. A similar situation occurred in the African Magreb, where the Middle Palaeolithic aterian complex, a product of anatomically modern humans (Genet-Varcin 1979: 244-248; Phillipson 1985: 92-93; Stringer and Gamble 1993: 130-131), survived until after 30 kyr bp (Texier *et al.* 1988 report a TL age of *c.* 28 kyr bp for the Moroccan site of Chaperon-Rouge I).

A possible explanation for the Iberian pattern, with implications for the rest of Europe, is that:

- modern humans entered Europe and rapidly replaced the local Neanderthal populations (in all probability with occasional interbreeding), due to factors related to population biology (greater fertility of the moderns, or lack of immunity of the Neanderthals against new diseases, for instance);
- in the process, moderns adapted to the tundra/steppe/boreal forest environments of interstadial Central and Northern Europe, following essentially the same economic (large herbivore hunting) and technical (blade debitage) paths of their local predecessors (their Neanderthal cousins);
- moderns stopped at the Ebro because, during the interstadial, it represented a major geographical and ecological barrier (judging from the little evidence available, environments to the south, in most of Iberia, would have been dominated by temperate woodlands);
- the different environmental conditions (and their social correlates, for instance as far as population density is concerned) and the relative isolation of Iberian populations located south of the Ebro, also explain why local Neanderthals did not become 'Upper Palaeolithic', contrary to what had been the case with their biological brothers to the north a few millennia earlier;
- moderns crossed the frontier as the trend towards colder conditions began to compress the human range at its northern end and as it began to extend southwards, into Iberia, the kinds of environments to which they had previously become adapted;
- once the border was crossed, the replacement of Neanderthals followed at the same rapid pace and for the same reasons as 10,000 years before in the rest of Europe.

3.2 Settlement and subsistence

The geographical distribution in Portugal of late Middle Palaeolithic, early Upper Palaeolithic and solutrean sites is broadly identical. Almost all the sites are located in Estremadura, but the interior regions were also settled. South of the Tagus, such a settlement is documented by the cave site of Escoural, which contains a mousterian/aurignacian/solutrean sequence (Araújo and Lejeune 1995; Zilhão 1995a). North of that river, it is documented, for the Mousterian, by Foz do Enxarrique and, for the Last Glacial Maximum, by the cluster of open air art sites recently found in the Côa valley, which include gravettian, solutrean and magdalenian occupations (Zilhão 1995b, 1995c, 1997; Zilhão *et al.* 1995). Thus, the present dearth of sites from this chronological range in the interior regions of Portugal and in the Meseta in all likelihood results from a combination of factors related to differential preservation and history of research.

Archaeozoological studies of Upper Palaeolithic faunas are now under way, but no results are yet available. In caves, the number and species diversity of carnivores decreases markedly between 30 and 20 kyr bp, which may reflect either a more intensive use of the sites and their vicinity by humans, or a slow process of extinction, in particular as regards the large species (hyena and cave lion, for instance). Herbivore remains accumulated by man seem to comprise horse, red deer and aurochs in broadly similar proportions, with ibex and chamois also well represented at particular sites. Exploitation of aquatic resources is documented at Figueira Brava and probably continued throughout the early Upper Palaeolithic, but is not apparent in the sites known due to their distance from coeval coast lines.

Based on the characteristics of lithic assemblages, most sites can be grouped, functionally, into three major categories (Zilhão 1995a):

- large open air sites located close to raw material sources, where byproducts of debitage (cores, decortication blades) predominate and endproducts of blade debitage and finished tools on blade/bladelet blanks (non-cortical blades and bladelets, retouched bladelets, points on blade blanks) are vastly underrepresented;
- small cave sites with low density occupation deposits, where byproducts of debitage are almost entirely absent and discarded retouched tools are overrepresented (and, sometimes, are even more abundant than debitage and residues);
- large open air sites located at varying distances from raw material sources, but where practically every single step of the lithic production system (acquisition of raw cobbles, debitage of prismatic cores for blank production, abandonment of unfinished or used tools) is well documented.

In the Aurignacian and the early Gravettian, only the first and second categories have been recognised; in the late Gravettian and the Solutrean, the first category disappears and is replaced by the third. At present, it would seem that

the best way to explain this change is that, to a great extent, it is a consequence of changes occurring not at the level of settlement-subsistence strategies but at the technological level. The earliest Upper Palaeolithic industries are based on a large blade technology and it would seem that, as a consequence, raw material tended to circulate essentially as blanks. Late gravettian and solutrean industries are based on blade/bladelet technologies, in the framework of which certain kinds of blank production and transformation could still be spatially separated (which seems to be the case, for instance, with particular point types such as the solutrean foliates) but, more often, raw material (particularly when destined for bladelet tool production) would tend to circulate as cores. As a result, specialised 'workshop/production for export' sites, like those known in earlier times, would not make sense any longer and are indeed not found in the archaeological record. On the other hand, it cannot be excluded that some kind of residential activity was also taking place in the predominantly workshop sites of the Aurignacian and the early Gravettian. The more rigid dichotomy between production and consumption that seems to have characterised them implies that residential sites from these periods, located at significant distances from raw material sources, should be characterised by assemblages mostly made up of discarded blades and blade tools and where both cores and residues from their preparation and decortication should be entirely lacking or be present only in very small numbers. However, the prediction that such a hypothetical fourth category of sites must exist has not yet received empirical confirmation.

In the framework of this model of raw material circulation, the large majority of open air sites known can be interpreted, particularly in the later part of the period under analysis, as residential camps. Those that have been the object of modern excavations (such as Cabeço de Porto Marinho or Fonte Santa) presented a pattern of small separate concentrations forming a more or less extensive archaeological surface or level. Whether these palimpsests correspond to the remains of contemporaneous occupations by several individual social units (families) or a horizontal stratigraphy of several contiguous penecontemporaneous occupations is not yet clear. The general impression, however, is one of discrete occupations by small groups over a long period of time. Thus, settlement-subsistence strategies, although having a clear logistic component, may have been more forager-oriented than among today's arctic or subarctic hunter-gatherers such as the Nunamiut studied by Binford (1983). A closer ethnographic parallel may be that of the Selk'nam (Ona) from Tierra del Fuego (Chapman 1986). These guanaco hunters lived under environmental conditions analogous to those reconstituted for Last Glacial Portugal, and are known to have preferred to move the camp to the kill instead of moving the kill to the camp. The fact that human bones belonging to children and adolescents have been found at several Portuguese Upper Palaeolithic cave sites also indicates, on the other hand, that the uses given to at least some of those sites may not have been exclusively logistic: as well as functioning as shelter for task groups temporarily away from the residential camp, or for occasional refuge during long-distance trips, they may also have served, for instance, as single family summer camps.

3.3 Technological trends

Apart from a trend towards thinner blanks and, concomitantly, a more economic use of raw material, which will culminate in the Magdalenian (Fig. 3), no other clear directional changes seem to exist. Bone tools (only preserved in cave environments) are scarce and not much can be said about them other than stating that massive sagaie points, some made on the penian bones of carnivores, were recovered in the early Upper Palaeolithic deposits of Casa da Moura and Salemas, and that slender points, some with lateral grooves, have been found in the Upper Solutrean (Aubry and Moura 1994; Cardoso and Gomes 1994; Zilhão 1995a).

Culture-stratigraphic units dated to the Last Glacial Maximum tend to be characterized by weapon systems containing lithic points. In three of those units, the points (Fig. 4) are virtually identical in size (4-5 cm long) and weight (2-3 g) and were probably used as sagaie tips (broken specimens often show typical impact fractures). The differences between them relate to the technology of blade extraction and the mode of retouch, allowing the recognition of as many index fossils: the Casal do Felipe point typical of the *Fontesantense* (which probably dates to *c.* 23 kyr bp); the *pointe à face plane* typical of the Middle Solutrean (around 20.5 kyr bp); and the two kinds of shouldered points (mediterranean and franco-cantabrian) typical of the Upper Solutrean (which, on present evidence, seems to begin around 20 kyr bp). Other lithic point types (the Vale Comprido point, of the Proto-Solutrean, *c.* 21.5 kyr bp: Zilhão and Aubry 1995, and the laurel leaf of the Middle Solutrean) were larger, and may have been used to arm the tip of more robust pieces of thrusting equipment (spears, for instance). Terminal gravettian (proto-magdalenian) industries, dated to *c.* 22 kyr bp, however, seem to represent a temporary comeback to a weaponry system identical to that used in earlier Upper Palaeolithic times (exclusively based on bone/wood points armed with lithic barbs).

The Aurignacian and the Gravettian are characterised by pointed microliths. They are obtained:

- through alternate semi-abrupt retouch of blanks extracted either from prismatic cores or from thick dihedral, truncated and carinated 'burins' in the Aurignacian

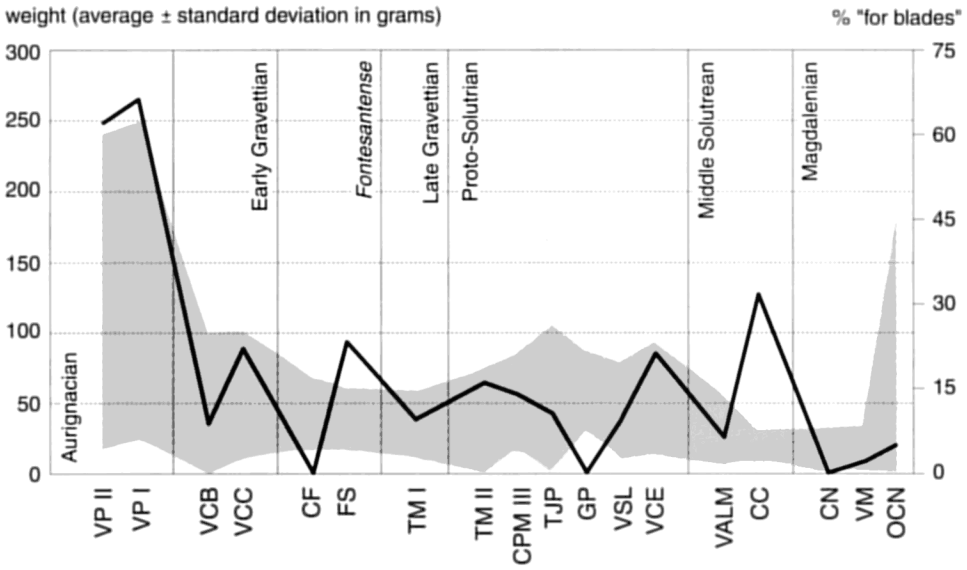


Fig. 3. The trend towards a more economic use of flint in the Portuguese Upper Palaeolithic, as illustrated by prismatic cores. The size of abandoned cores decreases markedly after the Aurignacian, as does the percentage of those where scars of blade-size removals are observable. This trend culminates in the Magdalenian. (Grey dotted area: weight (average ± standard deviation); solid black line: % of cores 'for blades')

VPII= Vale de Porcos II; VPI= Vale de Porcos I; VCB= Vale Comprido-Barraca; VCC= Vale Comprido-Cruzamento; CF= Casal do Felipe; FS= Fonte Santa; TMI= Terra do Manuel I; TMII= Terra do Manuel II; CPMIII= Cabeço de Porto Marinho III; TJP= Terra do José Pereira; GP= Gato Preto; VSL= Vales da Senhora da Luz; VCE= Vale Comprido-Encosta; VALM= Vale Almoinha; CC= Casal do Cepo; CN= Cerrado Novo; VM= Vale da Mata; OCN= Olival da Carneira.

(Dufour bladelets of the Dufour subtype, as defined by Demars and Laurent 1989);
- through unilateral direct abrupt retouch of blanks extracted either from prismatic cores or from thick multiple truncated 'burins' in the Gravettian (micro-gravettes).

These points are generally associated with several types of obtuse microliths which, in the Aurignacian and in the Proto-Solutrean, are often made on blanks extracted from carinated or nosed 'endscrapers':
- Dufour bladelets of Roc-de-Combe subtype (Demars and Laurent 1989), in the Aurignacian;
- backed bladelets in the Gravettian;
- backed and truncated bladelets in the late Gravettian;
- marginally, unilaterally, retouched bladelets in the Proto-Solutrean.

Lithic points in the size ranges documented for the culture-stratigraphic units mentioned in the preceding paragraph are not known in well-dated or well-defined aurignacian and gravettian assemblages, although a few isolated finds of larger Gravette points are known from cave sites excavated in the nineteenth century. They may be characteristic of an as yet undifferentiated phase (Middle Gravettian?) or, instead, correspond to a type commonly used and discarded only at logistical sites. Whether the morphological difference between obtuse and pointed microliths of the Aurignacian and the Gravettian had any functional content is not yet clear. They may have been used to arm different types of weapons or different parts of the same weapon (pointed as perforating tips, obtuse as tearing barbs), but it may also be that, more simply, they were all interchangeably used only as barbs for sagaie bone/wood points.

In industries with lithic points and lacking retouched bladelets (such as the *Fontesantense* and the Middle Solutrean), the role of lithic barbs was probably played by unretouched bladelets and chips. In other words, the bone point plus lithic barbs component was also present in the weapon systems of those times, although it is not visible when analysis is restricted to the typology of retouched tool kits. The deliberate extraction of such unretouched barbs from different types of quartz cores represents, for instance, a major industrial activity in the Proto-Solutrean (Fig. 5). This popularity of quartz in assemblages from such a flint-rich area as the Rio Maior basin can only be interpreted as a cultural preference, which was also manifested in the use of rock crystal, always present in the same assemblages, albeit in very small numbers.

Symmetrically, in the late gravettian and proto-solutrean assemblages excavated at Salto do Boi, in the Côa valley, rock crystal was common but flint was rare and heavily economised, suggesting that, in this part of the country, it represented a scarce and valued raw material obtained from very distant, probably Estremaduran, sources (Zilhão *et al.* 1995). This pattern may also indicate that the onset of the Last Glacial Maximum brought about an intensification of

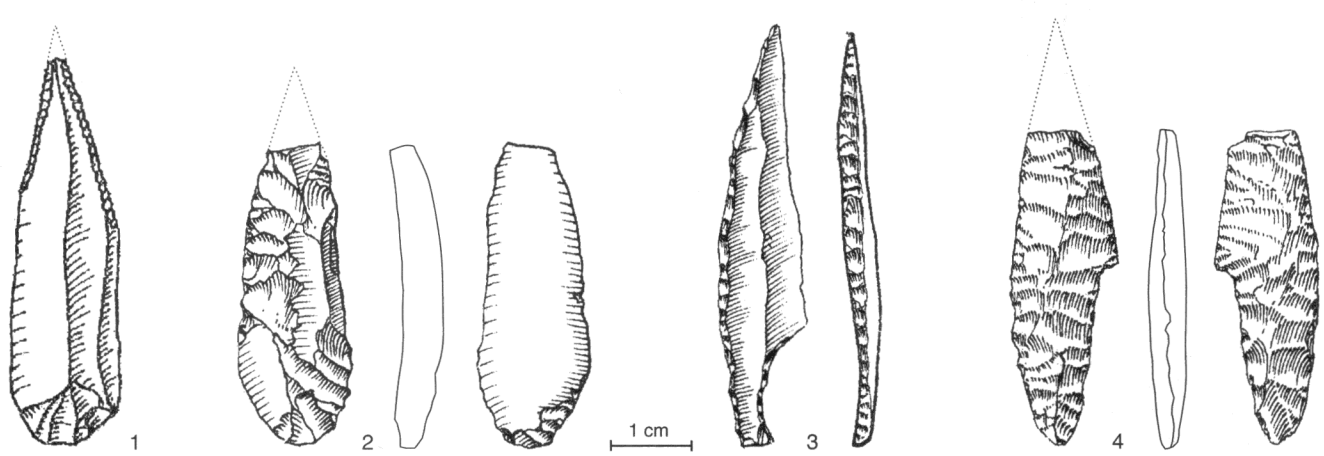


Fig. 4. Last Glacial Maximum lithic points from Portugal. Although varying in overall morphology, retouch and technique of blank extraction, their modules remain essentially stable, suggesting a similar function. Broken specimens often show typical impact fractures indicating a use as sagaie tips. Changes in the characteristics of the lithic points and the nature of inferred hafting methods do not seem to support the notion of an increased efficiency of the weapon system (an Ice Age 'arms race'). 1. Casal do Felipe point (index fossil of the *Fontesantense*, *c.* 23 kyr bp); 2. *pointe à face plane* (Middle Solutrean, *c.* 20.5 kyr bp); 3. Mediterranean shouldered point and 4. Franco-Cantabrian shouldered point (Upper Solutrean, 20-18 kyr bp).

exchange relations between the littoral limestone areas, rich in flint, and the granitic areas of the interior, where rock crystal is abundant.

Heat pretreatment of the flint is documented for the production of foliates in the Middle and Upper Solutrean, but not as a technique of core preparation for ordinary blade debitage. It is not known in subsequent magdalenian industries.

3.4 Territories

Data on ethnographically documented hunter-gatherers (such as the Selk'nam; Chapman 1986) and on the carrying capacity of Last Glacial environments in Cantabrian Spain (Straus 1986) and in Greece (Bailey *et al.* 1986) suggest that, in Portuguese Estremadura, Upper Palaeolithic population densities probably were in the range of 0.05 inhabitants per km^2. Individual bands made up of the magic number of 25 individuals would have exploited territories of some 400-500 km^2 each, corresponding broadly to the area of each of the drainages of the main rivers that, from the central spine of limestone hills, mountains and plateaus, flow southeast into the Tagus or northwest into the sea (Fig. 6a). The number of bands inhabiting this geographically homogeneous region (whose surface area, including the now submerged littoral platform, would have been of some 12,000 km^2; Fig. 6b), might have allowed, therefore, the development of large and cohesive social networks, possibly representing one or more differentiated ethnic groups.

Preliminary data on the circulation of raw materials and the distribution of certain material culture features suggest that it may be possible, at least for the later part of the period under analysis (22-20 kyr bp), to discriminate more circumscribed territories (Fig. 6a). Flint from the littoral area of Cambelas, for instance, has so far been found only in the southern part of the region, between Lisbon (as shown by finds from Salemas) and Rio Maior (where it was present at Terra do Manuel). The use of flat schist pebbles as blanks for foliate production seems to be restricted to sites in the Almonda drainage, further to the north. At Caldeirão, a particular type of adornment (perforated deer phalanxes) was found in great numbers in the solutrean levels, but is unknown in all other cave sites of Portuguese Estremadura. The social significance of these distributions, however, remains to be clarified.

The existence of long-distance exchange networks connecting Portuguese Estremadura to the rest of southwestern Europe is implied by the temporal coincidence of basic technological changes: from Aurignacian to Gravettian and from Gravettian to Solutrean. Particular developments (such as the *Fontesantense*, with its characteristic Casal do Felipe points), however, are clear evidence that such parallel developments should be

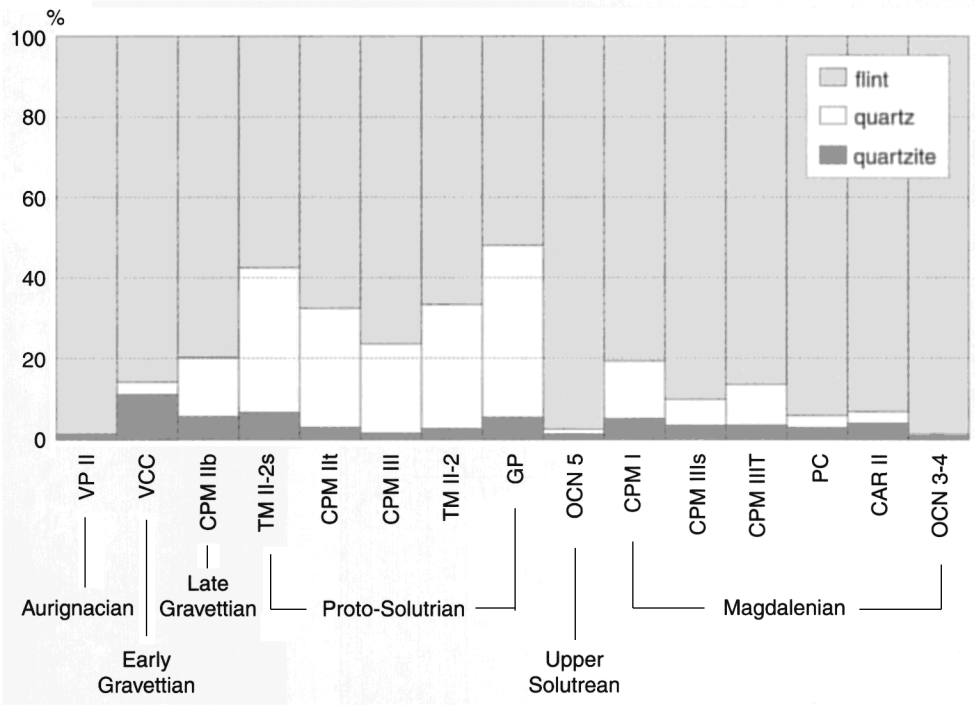


Fig. 5. The use of quartz in the Upper Palaeolithic of the Rio Maior basin. In such a flint-rich area, the weight of this raw-material in proto-solutrean assemblages can only be interpreted as a cultural preference and is of a level of magnitude that enables its use as a distinctive chronostratigraphic marker.
A similar preference is documented in contemporaneous sites from other areas of Estremadura, such as Lapa do Anecrial and Açude do Alvorão.

VPII= Vale de Porcos II; VCC= Vale Comprido-Cruzamento; CPMIIb= Cabeço de Porto Marinho II base; TMII-2s= Terra do Manuel II, level 2s; CPMIIt= Cabeço de Porto Marinho II top; CPMIII= Cabeço de Porto Marinho III; TMII-2= Terra do Manuel II, level 2; GP= Gato Preto; OCN5= Olival da Carneira, level 5; CPMI= Cabeço de Porto Marinho I; CPMIIIS= Cabeço de Porto Marinho IIIS; CPMIIIT= Cabeço de Porto Marinho IIIT; PC= Pinhal da Carneira; CARII= Carneira II; OCN3-4= Olival da Carneira, levels 3-4.

understood as resulting from the interaction of local historical trajectories, not as the manifestation of large-scale population movements (migrations). The intermediate geographical position of the region also explains well the co-occurrence of upper solutrean lithic types that, elsewhere in Iberia, are mutually exclusive: the backed and shouldered and barbed and tanged points typical of Valencia and Andalucia, on the one hand; and the elaborately retouched shouldered points typical of Cantabria and Aquitaine, on the other.

3.5 Art

Adornments (marine shell beads, for the most part) are the only items of mobiliary art that have been recovered, so far, in secure contexts of early Upper Palaeolithic and solutrean age.

The cave site of Escoural (Glory *et al.* 1965; Santos *et al.* 1980; Lejeune 1995) features a parietal art containing black and red animal paintings that are stylistically archaic. These paintings are themselves covered by thin, as yet undated, stalagmitic films. Given that the only archaeologically documented Upper Palaeolithic uses of the cave date from aurignacian and solutrean times (Zilhão 1995a), it seems likely, therefore, that this parietal art was executed between 30 and 20 kyr bp.

All other manifestations of palaeolithic rock art known in Portugal are in the open air. They are located in the Douro basin, the most important being the recently found cluster of sites in the Côa valley. Stylistically, a significant proportion of the petroglyphs found here could date to the early Upper Palaeolithic period (Baptista and Gomes 1995; Lorblanchet 1995; Zilhão 1995b, 1995c, 1997).

4. Conclusion

Available evidence can be summarised as indicating that, in littoral Portugal, the global trend towards colder and more arid conditions did not bring about significant changes in vegetational communities and animal populations during the period between 30 and 20 kyr bp. The most important environmental change must have been the increase in territory caused by the marine regression. Landscapes may also have become more open, with extensive heathlands representing the dominant type of vegetation cover. For groups of hunters whose economy relied on the exploitation of large herbivores that, in these conditions, found improved pasture and space, the *global climatic deterioration* may have turned out to represent, thus, a *local environmental amelioration.*

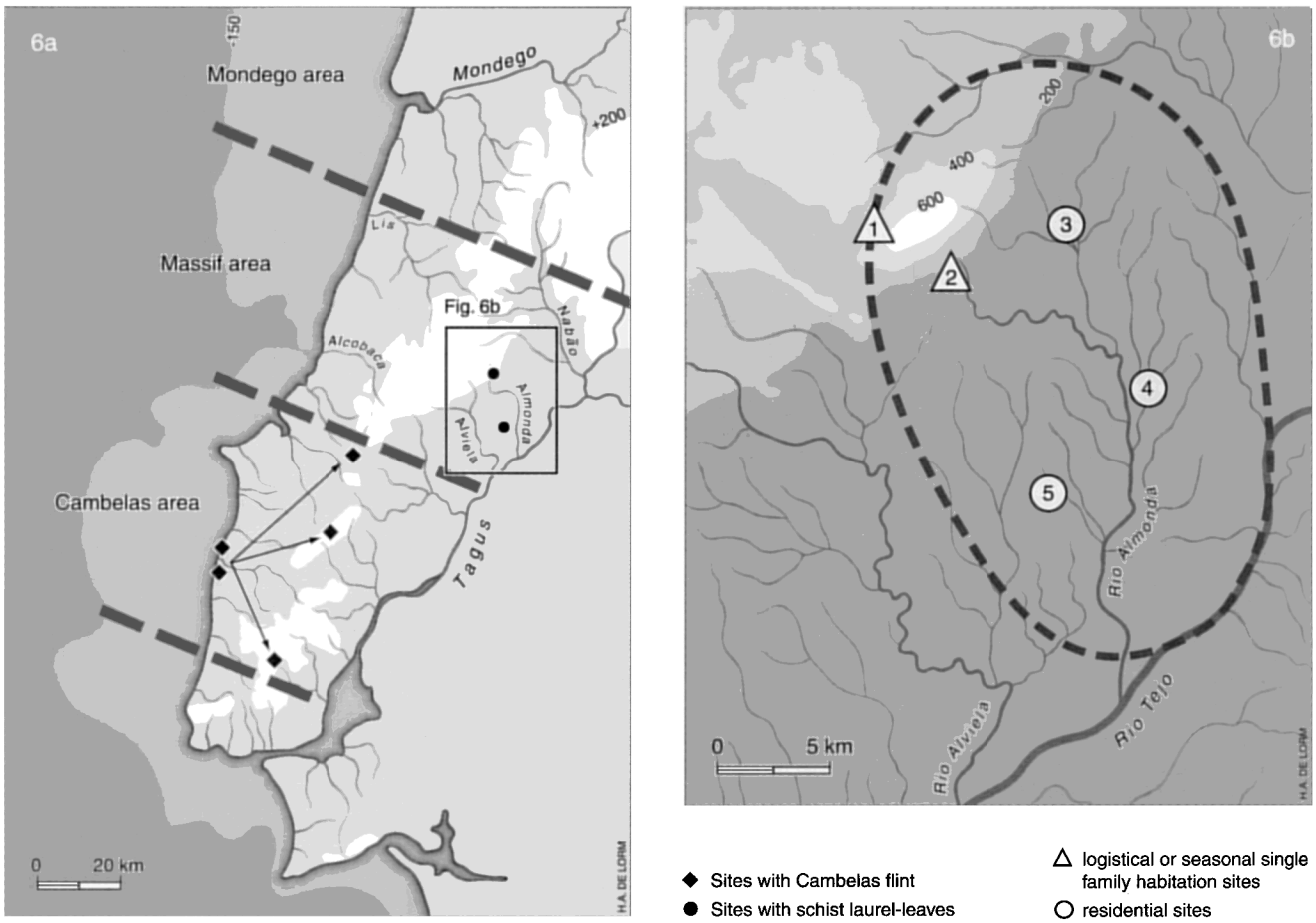


Fig. 6a and b. A model for the organization of the human settlement of Portuguese Estremadura in Last Glacial Maximum times, based on ethnographical information from Tierra del Fuego and on paleoecological data from Last Glacial Cantabria and Epirus. The frontiers between the three hypothetical raw material procurement areas in figure 6a could represent ethnical boundaries. Individual bands would exploit smaller territories, in the size range of the Almonda drainage, foraging from camp sites located in the lowlands and using caves in the central spine of limestone mountains and plateaus as logistical or seasonal shelters. The hypothetical territory of the 'Almonda band' (*c.* 450 km^2) in figure 6b is identical to that of the *haruwen* of the Selk'nam and Haush of Tierra del Fuego (1= Lapa do Picareiro; 2= Gruta do Almonda; 3= Açude do Alvarão; 4= Fonte Santa; 5= Casal do Cepo).

The beginning of the period coincides broadly with a population replacement event involving the absorption or extinction of the autochtonous Neanderthal populations. The settlement and subsistence strategies of the anatomically modern human groups that succeeded them do not seem to change significantly until the Last Glacial Maximum. At the technological level, however, important changes do occur. Since they are simultaneous to and follow parallel lines with those occurring elsewhere in ecologically very different regions of Western Europe, it does not seem possible to explain such changes as a direct response to climatic and environmental change. It also does not seem possible to explain them as the outcome of selective pressures favouring an increased efficiency of the hunting technology – the Ice Age arms race imagined by Straus (1991). That solutrean points would, in this regard, behave better than those from the Gravettian, is something that remains undemonstrated and does not seem likely in the first place.

An alternative approach to the Portuguese pattern and, more broadly, to southwestern Europe as a whole, conceives of natural selection as acting, during the Upper Palaeolithic, mostly through the mediation of the social realm (Zilhão 1995a). In this analytical framework, it is the expansion and shrinking of exchange networks, as well as the modifications that eventually occur in their composition, that are invoked as the main explanations for the wide and rapid diffusion

and adoption, over vast geographical areas, of new technological traits that are in themselves, from the point of view of adaptation, essentially neutral. At the level of direct interaction with the natural environment, however, it also seems possible to identify, at least in Portugal, a long-term trend towards a more economic use of raw materials, bringing about, as a consequence, an increasing miniaturisation of tool kits that will culminate later, in the Magdalenian.

references

Albuquerque, J.P.M. 1984 *Carta Ecológica de Portugal.* Lisboa: Comissão Nacional do Ambiente.

Antunes, M.T. 1989 Castor fiber na Gruta do Caldeirão. Existência, distribuição e extinção do castor em Portugal, *Ciências da Terra* 10, 23-40.

Antunes, M.T. 1990-91 O Homem da Gruta da Figueira Brava (ca. 30 000 bp). Contexto ecológico, alimentação, canibalismo, *Memórias da Academia das Ciências de Lisboa. Classe de Ciências* 31, 487-536.

Antunes, M.T., J.M.P. Cabral, J.L. Cardoso, J. Pais, A.M. Soares 1989 Paleolítico médio e superior em Portugal: datas 14C, estado actual dos conhecimentos, síntese e discussão, *Ciências da Terra* 10, 127-138.

Araújo, A.C., M. Lejeune 1995 *Gruta do Escoural: necrópole neolítica e arte rupestre paleolítica.* Lisboa: Instituto Português do Património Arquitectónico e Arqueológico.

Aubry, Th., M.H. Moura 1994 Paleolítico da Serra de Sicó, *Trabalhos de Antropologia e Etnologia* 34(3-4), 43-60.

Bailey, G.N., C.S. Gamble, H.P. Higgs, C. Roubet, D.A. Sturdy, D.P. Webley 1986 Palaeolithic investigations at Klithi: preliminary results of the 1984 and 1985 field seasons, *The Annual of the British School of Archaeology at Athens* 81, 7-35.

Baptista, A.M., M.V. Gomes 1995 Arte rupestre do Vale do Côa. 1. Canada do Inferno. Primeiras impressões, *Trabalhos de Antropologia e Etnologia* 35(4), 349-422.

Binford, L. 1983 *In Pursuit of the Past.* London: Thames and Hudson.

Bischoff, J.L., N. Soler, J. Maroto, R. Julià 1989 Abrupt Mousterian/Aurignacian boundary at c. 40 ka bp: Accelerator ^{14}C dates from l'Arbreda Cave (Catalunya, Spain), *Journal of Archaeological Science* 16, 563-576.

Cabrera, V., J.L. Bischoff 1989 Accelerator ^{14}C dates for Early Upper Paleolithic (Basal Aurignacian) at El Castillo Cave (Spain), *Journal of Archaeological Science* 16, 577-584.

Cardoso, J. 1993 *Contribuição para o conhecimento dos grandes mamíferos do Plistocénico Superior de Portugal.* Oeiras: Câmara Municipal de Oeiras.

Cardoso, J., M.T. Antunes 1989 Rupicapra rupicapra (Mammalia) in the Late Pleistocene of Portugal, *Ciências da Terra* 10, 81-96.

Cardoso, J., M.V. Gomes 1994 Zagaias do Paleolítico Superior de Portugal, *Portugalia* 15, 7-31.

Chapman, A. 1986 *Los Selk'nam. La vida de los onas.* Buenos Aires: Emecé Editores.

Cruz, A.J.C. 1990 A influência atlântica no clima da Estremadura portuguesa durante o Paleolítico Superior: os resultados geoquímicos da Gruta do Caldeirão, *Finisterra* 25, 49, 156-168.

1993 *Estudo geoquímico de preenchimentos sedimentares de grutas da Estremadura com vestígios de ocupação humana pré-histórica.* Lisboa: Universidade de Lisboa (Doctoral dissertation).

Delibrias, G., M.-T. Guillier, J. Labeyrie 1986 GIF natural radiocarbon measurements X, *Radiocarbon* 28(1), 9-68.

Demars, P.-Y., P. Laurent 1989 *Types d'outils lithiques du Paléolithique supérieur en Europe.* Paris: CNRS.

Diniz, F. 1993 Aspectos de vegetação e do clima de formações quaternárias entre Óbidos e Peniche. In: *El Cuaternario en España y Portugal* 1, 337-344, Madrid: Asociacion Española para el Estudio del Quaternario.

Duarte, C., J. Mauricio, P.B. Pettitt, E. Trinkaus, H. Van der Plicht, J. Zilhão 1999 The Early Upper Palaeolithic Human Skeleton from the Abrigo do Lagar Velho (Portugal) and Modern Human Emergence in Iberia, *Proceedings of the National Academy of Sciences USA* 96, 7604-7609.

Duprat, J. 1983 *Les foraminifères planctoniques du Quaternaire terminal d'un domaine pericontinental (Golfe de Gascogne, Côtes Ouest-Ibériques, Mer d'Alboran): Ecologie-Biostratigraphie.* Bordeaux: Université de Bordeaux I (Doctoral dissertation).

Figueiral, I. 1993 Cabeço de Porto Marinho: une approche paléoécologique. Premiers résultats, *Estudios sobre Cuaternario* 1993, 167-172.

n.d. a *Gruta do Caldeirão. Resultados da análise antracológica.* Unpublished report.

n.d. b *Lapa do Anecrial. Dados preliminares da análise antracológica.* Unpublished report.

Fortea, J., F. Jordá 1976 La Cueva de Les Mallaetes y los problemas del Paleolítico Superior del Mediterráneo Español, *Zephyrus*, 26-28, 129-166.

Gates, W. 1976 Modeling the Ice Age Climate, *Science* 191, 1138-1144.

Genet-Varcin, E. 1979 *Les hommes fossiles.* Paris: Boubée.

Gilman, A. 1984 Explaining the Upper Palaeolithic Revolution. In: M. Spriggs (ed.), *Marxist Perspectives in Archaeology*, 115-126, Cambridge: Cambridge University Press.

Glory, Abbé, M. Vaultier, M.F. Santos 1965 La grotte ornée d'Escoural (Portugal), *Bulletin de la Société Préhistorique Française* 62, 110-117.

Granja, H.M., G.S. Carvalho 1995 As datações pelo radiocarbono e o Plistocénico-Holocénico da zona costeira do NO de Portugal (síntese de conhecimentos). In: *3ª Reunião do Quaternário Ibérico. Actas*, 383-393, Coimbra: Universidade de Coimbra.

Guiot, J., A. Pons, J.-L. Beaulieu, M. Reille 1989 A 140,000-year continental climate reconstruction from two European pollen records, *Nature* 338, 309-313.

Hublin, J.-J., C. Barroso Ruiz, P. Medina Lara, M. Fontugne, J.-L. Reyss 1995 The Mousterian site of Zafarraya (Andalucia, Spain): dating and implications on the paleolithic peopling processes of Western Europe, *Comptes-Rendus de l'Académie des Sciences de Paris* 321(IIa), 931-937.

Iturbe, G., M.P. Fumanal, J.S. Carrion, E. Cortell, R. Martinez, P.M. Guillem, M.D. Garralda, B. Vandermeersch 1993 Cova Beneito (Muro, Alicante): uma perspectiva interdisciplinar, *Recercques del Museu d'Alcoi* 2, 23-88.

Lejeune, M. 1995 L'art pariétal de la grotte d'Escoural. In: A.C. Araújo and M. Lejeune (eds), *Gruta do Escoural: necrópole neolítica e arte rupestre paleolítica*, 123-233, Lisboa: Instituto Português do Património Arquitectónico e Arqueológico.

Lorblanchet, M. 1995 *Les grottes ornées de la Préhistoire. Nouveaux regards*. Paris: Éditions Errance.

Marks, A.E., N. Bicho, J. Zilhão, C.R. Ferring 1994 Upper Pleistocene Prehistory in Portuguese Estremadura. Results of Preliminary Research, *Journal of Field Archaeology* 21, 53-68.

Mateus, J., P. Queirós 1993 Os estudos de vegetação quaternária em Portugal; contextos, balanço de resultados, perspectivas. In: Associação Portuguesa para o Estudo do Quaternário, *O Quaternário em Portugal. Balanço e Perspectivas*, 105-131, Lisboa: Colibri.

Phillipson, D. 1985 *African Archaeology*. Cambridge: Cambridge University Press.

Póvoas, L., J. Zilhão, J. Chaline, P. Brunet-Leconte 1992 La faune de rongeurs du Pléistocène Supérieur de la Gruta do Caldeirão (Tomar, Portugal), *Quaternaire* 3(1), 40-47.

Raposo, L. 1993 Paleolítico. In: A. Coelho da Silva (ed.), *Pré-História de Portugal*, 41-111, Lisboa: Universidade Aberta.

1995 Ambientes, territorios y subsistencia en el Paleolítico Medio de Portugal, *Complutum* 6, 57-77.

Ribeiro, A., M.T. Antunes, M.P. Ferreira, R. Rocha, A.F. Soares, G. Zbyszewski, F. Moitinho de Almeida, D. Carvalho, J. Monteiro 1979 *Introduction à la géologie générale du Portugal*. Lisboa: Serviços Geológicos de Portugal.

Santos, M.F., M.V. Gomes, J.P. Monteiro 1980 Descobertas de arte rupestre na Gruta do Escoural (Évora, Portugal). In: *Altamira Symposium*, 205-243, Madrid: Ministerio de Cultura.

Straus, L.G. 1986 Late Würm adaptive systems in Cantabrian Spain: the case of Eastern Asturias, *Journal of Anthropological Archaeology* 5, 330-368.

1989 New chronometric dates for the Prehistory of Portugal, *Arqueologia* 20, 73-76.

1991 The original arms race: Iberian perspectives on the Solutrean phenomenon. In: *Feuilles de pierre. Les industries à pointes foliacées du Paléolithique supérieur européen. Actes du Colloque de Cracovie 1989*, 425-447, Liège: ERAUL.

Stringer, C., C. Gamble 1993 *In Search of the Neanderthals*. London: Thames and Hudson.

Texier, J.-P., J. Huxtable, E. Rhodes, D. Miallier, M. Ousmoi 1988 Nouvelles données sur la situation chronologique de l'Atérien du Maroc et leurs implications, *Comptes Rendus de l'Académie des Sciences de Paris* II, 307, 827-832.

Vega Toscano, L.G. 1990 La fin du Paléolithique moyen au sud de l'Espagne: ses implications dans le contexte de la Péninsule Ibérique. In: C. Farizy (ed.), *Paléolithique moyen récent et Paléolithique supérieur ancien en Europe (Colloque International de Nemours, 9-11 mai 1988)*, 169-176, Mémoires du Musée de Préhistoire de l'Ile de France 3.

Villaverde, V., M.P. Fumanal 1990 Relations entre le Paléolithique moyen et le Paléolithique supérieur dans le versant méditerranéen espagnol. In: C. Farizy (ed.), *Paléolithique moyen récent et Paléolithique supérieur ancien en Europe (Colloque International de Nemours, 9-11 mai 1988)*, 177-183, Mémoires du Musée de Préhistoire de l'Ile de France 3.

Zilhão, J. 1987 *O Solutrense da Estremadura portuguesa. Uma proposta de interpretação paleoantropológica*. Lisboa: Instituto Português do Património Cultural.

1990 The Portuguese Estremadura at 18 000 BP: the Solutrean. In: O. Soffer and C. Gamble (eds), *The World at 18 000 BP. Vol. 1. High Latitudes*, 109-125, London: Unwin Hyman.

1991 Le Solutréen du Portugal: environnement, chronologie, industries, peuplement, origines. In: *Feuilles de pierre. Les industries à pointes foliacées du Paléolithique supérieur européen. Actes du Colloque de Cracovie 1989*, 485-501, Liège: ERAUL.

1993 Le passage du Paléolithique moyen au Paléolithique supérieur dans le Portugal. In: V. Cabrera (ed.), *El Origen del Hombre Moderno en el Suroeste de Europa*, 127-145, Madrid: Universidad Nacional de Educación a Distancia.

1995a *O Paleolítico Superior da Estremadura portuguesa*. Lisboa: Universidade de Lisboa (Doctoral dissertation).

1995b L'art rupestre paléolithique de plein air. Vallée du Côa (Portugal), *Dossiers d'Archéologie* 209, 106-117.

1995c The age of the Côa valley (Portugal) rock-art: validation of archaeological dating to the Palaeolithic and refutation of 'scientific' dating to historic or proto-historic times, *Antiquity* 69, 883-901.

Zilhão, J. (ed.) 1997 *Arte Rupestre e Pré-história do Vale do Côa. Trabalhos de 1995-1996. Relatório científico ao governo da República Portuguesa elaborado nos termos da resolução do Conselho de Ministros no. 4/96, de 17 de Janeiro*. Lisboa: Ministério da Cultura.

Zilhão, J., Th. Aubry 1995 La pointe de Vale Comprido et les origines du Solutréen, *L'Anthropologie* 99(1), 125-142.

Zilhão, J.,
Th. Aubry,
A.M. Faustino de Carvalho,
G. Zambujo,
F. Almeida

1995 O sítio arqueológico paleolítico do Salto do Boi (Cardina, Santa Comba, Vila Nova de Foz Côa), *Trabalhos de Antropologia e Etnologia* 35(4), 471-497.

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