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Chronostratigraphy of the Middle-to-Upper Paleolithic Transition in the Iberian Peninsula

JOÃO ZILHÃO

University of Bristol
Department of Archaeology and Anthropology
43 Woodland Road. Bristol BS8 1UU. United Kingdom
Joao.Zilhao@bristol.ac.uk

The complex environmental history of Isotope Stage Three carries the implication that cave and rockshelter sites containing deposits from the time of the Middle-to-Upper Paleolithic transition must have been significantly affected by syn- and post-depositional disturbance processes. A detailed taphonomic critique of the stratigraphic successions, of the integrity of archeological levels, of the composition of industrial assemblages, and of the associations between samples selected for dating and the events or processes they are supposed to date is therefore an absolute requirement in assessing the tempo and mode of that transition. Once the evidence yielded by the key Iberian sites is passed through such a taphonomic filter, and the chronometric results obtained by different dating methods are reduced to a single, calendar timescale, and taken with due consideration of the inherent level of statistical uncertainty, a rather clear picture emerges. Regions located north of the Ebro divide follow the general European pattern, where the transition is a two step process featuring, first, the emergence out of local Middle Paleolithic roots of different Neandertal-associated early Upper Paleolithic technocomplexes (in the case of northern Iberia, the Châtelperronian, known from Morín, in the west, to l'Arbreda, in the east) and, second, the replacement of the latter by the Protoaurignacian, which takes place ca. 42 ka BP (in calendar years), i.e., at about the time when modern human populations are first recorded in Europe. South of the Ebro divide, a Neandertal-associated Middle Paleolithic survives for several millennia more, and is eventually replaced by the Evolved Aurignacian (Aurignacian II), an event that, from Alicante, in the east, to Portugal, in the west, takes place no later than ca.35 ka BP (in calendar years). The paleoenvironmental record suggests that this delayed survival of Middle Paleolithic Neandertals in southwestern Iberia is related to a prolonged period of ameliorated climatic conditions that, at least in littoral areas, may have favored the expansion of woodland landscapes.

KEYWORDS
NEANDERTAL, MODERN HUMAN, IBERIAN PENINSULA, EBRO, MIDDLE PALEOLITHIC, UPPER PALEOLITHIC, AURIGNACIAN.

La compleja historia medioambiental del estadio isotópico 3 lleva implícito que, en cuevas y abrigos, los depósitos correspondientes al período de transición entre Paleolítico Medio y Paleolítico Superior pueden haber sido significativamente alterados por procesos sin- y posdeposicionales. En consecuencia, para poder valorar correctamente el tiempo y el modo de dicha transición, es imprescindible realizar un estudio tafonómico detallado de las secuencias, de la integridad estra-

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tigráfica de los niveles arqueológicos, de la composición de los conjuntos industriales y de la relación existente entre muestras seleccionadas para datación y los acontecimientos o procesos que supuestamente deben datar. Pasando los yacimientos «clave» de la Península Ibérica por este filtro tafonómico y reduciendo los resultados cronométricos obtenidos a través de diversos métodos de datación a una escala temporal única, medida en años de calendario y teniendo en cuenta los correspondientes niveles de incertidumbre estadística, se obtiene una imagen bastante diáfana de lo que sucedió durante este período. Las regiones localizadas al norte de la divisoria del Ebro siguen el modelo europeo. Aquí, la transición es un proceso en dos etapas, empezando por la aparición de culturas asociadas, sin lugar a duda, a poblaciones neandertales y cuya tecnología, propia del Paleolítico Superior, está bien enraizada en tradiciones del precedente Paleolítico Medio (en el caso del norte peninsular, ese primer Paleolítico Superior es el Chatelperroniense, conocido desde Morín, en el oeste, hasta l'Arbreda, en el este); hace aproximadamente 42 000 años (fecha calibrada), es decir, en época que coincide con la aparición del hombre moderno en el registro fósil europeo, tales culturas son reemplazadas, a su vez, por el Proto-Auriñaciense. Al sur de la línea divisoria del Ebro, sin embargo, sobreviven durante varios milenios culturas del Paleolítico Medio que en diferentes yacimientos están asociadas a fósiles neandertales y que terminarán siendo reemplazadas por el Auriñaciense Evolucionado o Auriñaciense II; desde Alicante, en el este, hasta Portugal, en el oeste, esa substitución ocurre, como muy tarde, hace unos 35 000 años (fecha calibrada). El registro paleoambiental sugiere que la supervivencia prolongada de las culturas neandertales del Paleolítico Medio en el sudoeste de la Península Ibérica está relacionada con un largo periodo de mejora en las condiciones climáticas, las cuales, al menos en las zonas del litoral, pueden haber favorecido la expansión de los bosques.

PALABRAS CLAVE
NEANDERTAL, HOMBRE MODERNO, PENÍNSULA IBÉRICA, EBRO, PALEOLÍTICO MEDIO, PALEOLÍTICO SUPERIOR.

1. Introduction

Over the last decade of the twentieth century, it became widely accepted that a late survival of the Mousterian and associated Neandertal populations characterized the late Oxygen Isotope Stage 3 (OIS-3) prehistory of the southern and western parts of Iberia. Initially promoted on the basis of chronostratigraphic arguments by Vega (1990) and Villaverde and Fumanal (1990), this view was eventually formalized as the «Ebro frontier» model (Zilhão, 1993, 1997, 1998, 2000; d'Errico *et al.*, 1998; Zilhão and Trinkaus, 2002). Basically, the model surmised that, after ca. 36,500 radiocarbon years ago, a biocultural frontier separating Aurignacian modern humans north of the Cantabro-Pyrenean mountain chain from Late Mousterian Neandertals surviving elsewhere in Iberia had existed for at least some five millennia; at the explanatory level, the model also suggested that the patterns possibly related to the fact that, throughout at least part of Stage Three, the Ebro basin had functioned as a major biogeographical divide, much as it does in the present.

This notion of an «Ebro frontier» has had major implications for the understanding of the Middle-to-Upper Paleolithic transition (henceforth, simply the Transition) in Europe and western Asia and the correlative issue of the eventual replacement of Neandertals by anatomically modern populations of ultimate African origin. Despite generalized acceptance, including in publications written for a wider audience (Arsuaga, 2000), the reality of the empirical facts upon which it is based has not gone unchallenged. In some cases (cf. Vega, 2005), such challenges have been simple statements of authority unsupported by empirical arguments; in others (cf. Utrilla *et al.*, 2004), they derive from a misunderstanding of the concept of ecological frontier, and overlook the fact that all recent paleoenvironmental research has substantiated the marked difference that in fact existed in mid-OIS-3 times between Iberia south of the Ebro and the rest of Europe (Sánchez-Goñi *et al.*, 2000, 2002; Abreu *et al.*, 2003; d'Errico and Sánchez-Goñi, 2003; Moreno *et al.*, 2005; Roucoux *et al.*, 2005). Alternative critical readings of the chronometric evidence have also been put forward. Jöris *et al.* (2003), for instance, claim that, everywhere in southern Europe, the late Middle Paleolithic discontinues ca. 38,300 radiocarbon years ago, at a time when several appearances of the Aurignacian are also recorded throughout the area; put another way, there never would have been an «Ebro frontier», the apparent late survival of the Mousterian in parts of Iberia being simply an artifact of dating error.

Because we are working at the limits of reliability of radiocarbon, and because alternative dating methods (U-Th, TL, ESR) yield results that, in this time range, usually lack the precision required to address the issues, problems of dating technique and sample interpretation such as those discussed by Jöris *et al.* are indeed of paramount importance. As exhaustively discussed elsewhere (Zilhão and d'Errico, 1999, 2000, 2003a, 2003b), however, there is also a pervasive problem of sample association that is strictly archeological. Although it should be clear that the marked climatic instability that characterized OIS-3 times (cf. Van Andel and Davies, 2003) must have had a dramatic impact on the kinds of sites whence the empirical evidence used to assess the Transition tends to come (i.e., caves and rockshelters), issues of site taphonomy, surprisingly, tend to be missing from most summaries and discussions of the evidence. This review will focus on the assessment of such problems of stratigraphy and sample association and, given the current framework of the debate, it will address, on a site by site basis, only those dated sequences (fig. 1) upon which one can discuss the issues lying at the heart of current controversies: the entity of the Châtelperronian in northern Iberia; the chronology of the earliest Aurignacian, both north and south of the Cantabro-Pyrenean mountains; the suggestions of a long-term survival of Mousterian assemblages alongside the early Aurignacian in Cantabria and northern Catalonia; and the age and characteristics of the contexts upon which lies the notion of a delayed Mousterian south of the Ebro basin.

The Neandertal authorship of the Mousterian is indicated by the associated fossils, in the south as well as in the north, as confirmed by the recent direct dating of the El Sidrón material (Fortea *et al.*, 2003; Lalueza *et al.*, 2005). In the absence of diagnostic

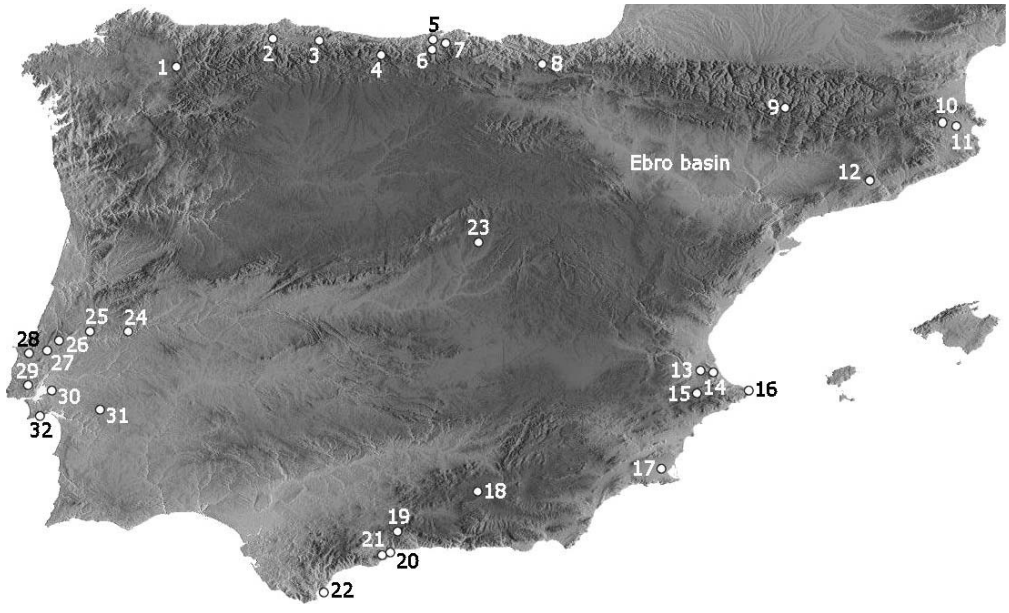

Fig. 1. Location of sites mentioned in the text. 1. A Valiña; 2. La Viña; 3. El Sidrón; 4. Esquilleu; 5. Morín; 6. El Castillo; 7. El Pendo; 8. Labeko Koba; 9. Fuentes de San Cristóbal; 10. Ermitons; 11. L'Arbreda and Reclau Viver; 12. Romaní; 13. Cova Negra; 14. Mallaetes; 15. Beneito; 16. Foradada; 17. Cabezo Gordo; 18. Carihuela; 19. Zafarraya; 20. Bajondillo; 21. Complejo del Humo; 22. Gorham's; 23. Jarama VI; 24. Foz do Enxarrique; 25. Furos and Caldeirão; 26. Oliveira; 27. Gato Preto; 28. Gruta Nova da Columbeira; 29. Salemas and Pego do Diabo; 30. Conceição; 31. Escoural; 32. Figueira Brava.

remains, the authorship of the early Aurignacian cannot be substantively addressed but, elsewhere in Europe, the earliest modern humans (the people from Oase, in Romania, Trinkaus *et al.*, 2003a, 2003b, n.d.) are directly dated to the time range of the Protoaurignacian; thus, it is reasonable to assume that the latter is a proxy for modern human dispersals even if significant admixture with local, archaic, cf. Neandertal populations was involved, as both the genetic and the fossil evidence increasingly suggest (Templeton, 2002, 2005; Trinkaus, 2005). This assumption is not contradicted by Garralda's (2005-2006) convincing diagnosis as «most-likely-Neandertal» of the human remains recovered in both the old and new excavations of El Castillo's level 18 (a «Transitional Aurignacian», according to Cabrera *et al.*, 2001, 2005). As will be discussed below, this finding is of little consequence because the level is a palimpsest containing a major Mousterian component, and the *in situ* biocultural transition it would putatively document is as chimerical as the cultural entity constructed from the lithic assemblage recovered therein.

Where issues of Aurignacian systematics are concerned, this review assumes the validity throughout southwestern Europe of traditional typology-based views, confirmed

by recent technological studies of the French material (Chiotti, 1999; Bon, 2000, 2002; Lucas, 2000; Bordes, 2002); as will be seen, the Iberian evidence comfortably fits this pattern. At the beginning of the sequence, the Protoaurignacian is characterized by the production of long, slender bladelets extracted from unidirectional prismatic cores in the framework of a single, continuous reduction sequence, and by Font-Yves points and Dufour bladelets of the Dufour subtype made on such blanks. An Early Aurignacian (or Aurignacian I) follows that features a lithic production system characterized by large blades, extracted from single platform prismatic cores and used as blanks for endscrapers and knives, and by the use of thick, carinated «scrapers»/cores for the extraction of straight or curved bladelet blanks that are rarely retouched but, when such is the case, bear a marginal, inverse or alternate retouch also of the Dufour subtype. The Evolved Aurignacian (or Aurignacian II), in turn, prefers thick «burins» (carinated or busked) and thick-nosed «scrapers» for this purpose, generating characteristic, small, twisted blanks retouched into a particular Roc-de-Combe subtype of Dufour bladelets. At the end of the sequence, a poorly known Late Aurignacian, better defined in uppermost level VI of the Abri Pataud sequence, features a re-emergence of the Dufour subtype, associated with a marked decline in the use of thick-nosed cores and with an extensive use of dihedral and on truncation «burins» for the production of those bladelets' blanks. Where bone tools are concerned, the split-based antler point is an index fossil of the Early Aurignacian and disappears in the Evolved and the Late Aurignacian, when it is replaced by other kinds of points made of ivory, bone or antler, all with massive bases and often, as in the Mladeč (Lautsch) type, featuring flat or oval cross-sections and an overall lozengic morphology.

Table 1 contains a list of the radiometric dates available at the time of writing, assembled from the sources cited in the text. Henceforth, raw radiocarbon results will be expressed, in years or thousands of years (ka), as ^{14}C BP, and calendar ages (U-Th, TL/OSL or calibrated radiocarbon ages) will likewise be expressed as cal BP. The discussion is framed in terms of the latter, for several reasons: 1) the significant underestimation of calendar ages by radiocarbon in this time range; 2) the impact on the calibration curve of the major oscillations in atmospheric ^{14}C production that characterize mid-OIS-3 times, generating patterns in raw radiocarbon results that disappear after calibration (for instance, Zilhão and d'Errico's and Jöris *et al.*'s above mentioned boundaries of ca. 36.5 ka ^{14}C BP and ca. 38.3 ka ^{14}C BP, apparently discrepant by 1800 years, actually translate into ca. 42.1 and ca. 42.8 ka cal BP, respectively, i.e., a difference of 700 years only that, in this range, given typical standard deviations and additional calibration uncertainties, the method really does not have the power to discriminate); 3) the need for correlation with paleoclimate proxies where time is measured in calendar years; and 4) the need of cross-validation with other dating methods. Radiocarbon calibration is effected through the CALPAL software, May 2005 version (Weninger and Jöris, 2005), using the SFCP age-model (Shackleton *et al.*, 2004), coupled with the U-Th data of Fairbanks *et al.* (2005).

Table 1. Radiometric dates for the Middle-to-Upper transition in Iberia (radiocarbon calibration after Weninger and Jöris, 2005). Observations: (a) Possibly intrusive; (b) Low confidence 1960s result; (c) Minimum age only, poor collagen preservation; (d) Aberrant; (e) Minimum age only, contaminated with modern organics; (f) Bulk sample from levels with a mixed artifact component; (g) Bulk sample from primarily paleontological site; (h) Bulk sample, probably contaminated with intrusive Holocene material.

Site	Culture	Level	Sample type
Galicia			
A Valiña	Mousterian	III	Bone fragments
		III	Bone fragments
		III	Bone fragments
Asturias			
La Viña	Aurignacian	XIII-middle/upper	Charcoal
		XIII-lower	Charcoal
	Mousterian	XIII-basal	Charcoal
		XIV-upper	Charcoal
El Sidrón	Mousterian	Galería del Osario	Neandertal bone
		Galería del Osario	Neandertal tooth
		Galería del Osario	Neandertal tooth
Cantabria			
Esquilleu	Mousterian	III	Bone
		VI	Charcoal
		XIf	Charcoal
		XIII	Charcoal
		XVIII	Charcoal
Morin	Typical Aurignacian	7	Charcoal
		7	Charcoal
	Protoaurignacian	8A	Charcoal
		8A	Charcoal
		8A	Charcoal
		8A	Charcoal
		8	Charcoal
	Châtelperronian	"10"	Charcoal
		"10"	Charcoal
	Mousterian	11	Charcoal
El Castillo	Aurignacian	18 ("Aurignacian Delta")	*Palaeoloxodon antiquus* molar
		18 ("Aurignacian Delta")	*Palaeoloxodon antiquus* molar
	"Transitional Aurignacian"	18B1	Charcoal
		18B2	Charcoal
		18B2	Charcoal
		18B2	Charcoal
		18B2	Charcoal
		18C	Charcoal
		18C	Charcoal
		18C	Charcoal
		18C	Charcoal
		18C	Charcoal
	Mousterian	20B2	Charcoal
		20B2	Charcoal
Euskadi			
Labeko Koba	Typical Aurignacian	IV middle	Bone
		V middle	Bone
		V middle	Bone
	Protoaurignacian	VII lower	Bone
		VII upper	Bone
	Châtelperronian	IX upper	Bone
		IX lower	Bone
		IX lower	Bone
Aragon			
Las Fuentes de San Cristóbal	Mousterian (?)	O	Charcoal
		O	Charcoal
	Mousterian	P	Charcoal
Catalonia			
Ermitons	Mousterian	IV	Bone fragments
			Bone
Reclau Viver	Aurignacian	4.2-4.4 m	Bone fragments
		4.4-4.6 m (Sector III, horizon 23, Aurignacian B)	Bone
	Mousterian/Châtelperronian/Aurignacian	4.6-4.8 m	Bone fragments
		4.8-5.0m	Bone fragments
		5.2-5.4 m (Sector III, horizon 27, Aurignacian A)	Bone
L'Arbreda	Evolved Aurignacian	G	Charcoal
	Typical Aurignacian	H	Charcoal
		H (top)	Charcoal
		H (top) - CE103	Bone
	Protoaurignacian	H - BE111 (5.50-5.55 m)	Bone
		H - BE111 (5.50-5.55 m)	Charcoal
		H - BE111 (5.50-5.55 m)	Charcoal
		H - BE111 (5.50-5.55 m)	Charcoal
		H - BE111 (5.50-5.55 m)	Charcoal
	Mousterian	I - BE116 (5.75-5.80 m)	Charcoal
		I - BE116 (5.75-5.80 m)	Charcoal
		I - BE116 (5.75-5.80 m)	Charcoal
		I - BE116 (5.75-5.80 m)	Bone

Date	Method	Lab number	calBP	calBP+2s	calBP-2s	Obs.
31600±250	AMS 14C	GrA-3014	36570	37190	35950	
31730/+2880/-2110	14C	GrN-20833	36950	42750	31150	
34800/+1900/-1500	14C	GrN-17729	39730	43310	36150	
31860±680	AMS 14C	GifA-95463	37350	39470	35230	
36500±750	14C	Ly-6390	41870	42810	40930	
>47600	AMS 14C	GifA-95537	>51000	-	-	
>47700	AMS 14C	GifA-95521	>51000	-	-	
37300±830	AMS 14C	Beta 192066	42420	43400	41440	
38240±890	AMS 14C	Beta 192067	43010	44290	41730	
40840±1200	AMS 14C	Beta 192065	44560	46600	42520	
12050±130	AMS 14C	AA-29664	-	-	-	(a)
34380±670	AMS 14C	AA-37883	40230	42050	38410	
36500±830	AMS 14C	AA-37882	41670	43070	40270	
39000±300	AMS 14C	Beta-149320	43350	44370	42330	
49700±1600	AMS 14C	OxA-11414	53010	57850	48170	
27310±1490	14C	SI-955A	-	-	-	(b)
28665±840	14C	SI-955	-	-	-	(b)
27336±735	14C	SI-952A	-	-	-	(b)
27605±540	14C	SI-952	-	-	-	(b)
27685±1285	14C	SI-956	-	-	-	(b)
30805±2830	14C	SI-956A	-	-	-	(b)
36590±770	AMS 14C	GifA-96263	41950	42850	41050	
27777±560	14C	SI-951	-	-	-	(b)
42590±6580	14C	SI-951A	-	-	-	(b)
39770±730	AMS 14C	GifA-96264	43740	44960	42520	
42900±1400	AMS 14C	OxA-10187	46470	49350	43590	
>47300	AMS 14C	OxA-10188	>51000	-	-	
38500±1800	AMS 14C	AA-2406	43140	45360	40920	
37100±2200	AMS 14C	OxA-2473	41580	45480	37680	
37700±1800	AMS 14C	AA-2407	42360	45220	39500	
38500±1300	AMS 14C	OxA-2474	43170	44810	41530	
40700±1600	AMS 14C	OxA-2475	44610	47190	42030	
39500±2000	AMS 14C	GifA-89147	43860	46540	41180	
39800±1400	AMS 14C	OxA-2478	43870	45790	41950	
40000±2100	AMS 14C	AA-2405	44280	47320	41240	
40700±1500	AMS 14C	OxA-2476	44570	46990	42150	
41100±1700	AMS 14C	OxA-2477	44980	47880	42080	
39300±1900	AMS 14C	GifA-89144	43700	46160	41240	
43300±2900	AMS 14C	GifA-92506	47250	52490	42010	
21665±305	AMS 14C	Ua-3323	-	-	-	(c)
23365±350	AMS 14C	Ua-3035	-	-	-	(c)
30615±820	AMS 14C	Ua-3322	-	-	-	(c)
26910±500	AMS 14C	Ua-3320	-	-	-	(c)
31455±915	AMS 14C	Ua-3321	-	-	-	(c)
29750±740	AMS 14C	Ua-3325	-	-	-	(c)
26575±505	AMS 14C	Ua-3034	-	-	-	(c)
34215±1265	AMS 14C	Ua-3324	-	-	-	(c)
27200±1000	AMS 14C	OxA-8589	32250	34550	29950	
36050±550	AMS 14C	OxA-8524	41430	42730	40130	
36000±1900	AMS 14C	OxA-8590	40690	44170	37210	
36430±1800	14C	CSIC-197	41120	44380	37860	
33190±600	AMS 14C	OxA-3725	38490	40510	36470	
16200±500	14C	M-1020	-	-	-	(d)
30190±500	AMS 14C	OxA-3726	35410	36390	34430	
16560±600	14C	M-1015	-	-	-	(d)
18700±800	14C	M-1016	-	-	-	(d)
40000±1400	AMS 14C	OxA-3727	44000	45980	42020	
22590±290	14C	Gif 6421	-	-	-	(d)
25830±400	14C	Gif 6422	-	-	-	(d)
>33500	14C	Beta-46690	-	-	-	
37340±1000	AMS 14C	OxA-3729	42460	43660	41260	
35480±820	AMS 14C	OxA-3730	40790	42750	38830	
37700±1000	AMS 14C	AA-3779	42710	43990	41430	
37700±1000	AMS 14C	AA-3780	42710	43990	41430	
38700±1200	AMS 14C	AA-3782	43260	44800	41720	
39900±1300	AMS 14C	AA-3781	43900	45720	42080	
34100±750	AMS 14C	AA-3777	39780	42280	37280	
39400±1400	AMS 14C	AA-3776	43630	45430	41830	
41400±1600	AMS 14C	AA-3778	45190	48010	42370	
44560±2400	AMS 14C	OxA-3731	48200	53160	43240	

Table 1. Radiometric dates for the Middle-to-Upper transition in Iberia (radiocarbon calibration after Weninger and Jöris, 2005). Observations: (a) Possibly intrusive; (b) Low confidence 1960s result; (c) Minimum age only, poor collagen preservation; (d) Aberrant; (e) Minimum age only, contaminated with modern organics; (f) Bulk sample from levels with a mixed artifact component; (g) Bulk sample from primarily paleontological site; (h) Bulk sample, probably contaminated with intrusive Holocene material. *(continued)*

Site	Culture	Level	Sample type
Romaní	Gravettian?	2	Charcoal
	Late Aurignacian?	2	Charcoal
	Protoaurignacian?	2	Charcoal
		2	Charcoal
		2	Charcoal
		2	Charcoal
		2	Charcoal
		2 top	Travertine carbonates
		2 base	Travertine carbonates
Valencia			
Cova Negra	Mousterian	IV	Sediments
		IV	Sediments
		V	Stalagmite
		V	Stalagmite
		V	Stalagmite
Mallaetes	Aurignacian	XII	Charcoal
Beneito	Evolved Aurignacian	B8 (squares 3B/3C/5C/1C/1D/2D, -223 cm)	Bone
		B8/BAS (squares 1-3-5B/C, -262 cm)	Charcoal
	Aurignacian	C4 (square 5D, -331 cm)	Charcoal and sediments
		C4 (square 5D, -333 cm)	Charcoal
	Mousterian	D1 (squares 3E/3F, -376 cm)	Charcoal
		D1 (square 5D, -376 cm)	Charcoal
		D3 (squares 3E/3F, -424 cm)	Charcoal
Foradada	Aurignacian	Sector I, V	Charcoal
		Sector I, V	Charcoal
		Sector I, VI	Charcoal
	Undiagnostic	Sector I, VII	Charcoal
	Aurignacian	Sector II, II	Charcoal
		Sector II, II	Charcoal
Murcia			
Cabezo Gordo	Mousterian	2e	Burnt bone
		50 cm below 2e	Calcite
Andalucia			
Carihuela	Mousterian	lowermost VI	Organics in charred sediments
Zafarraya	Mousterian	Nivel E, Conjunto II, Unidad UG42	Charcoal
		Nivel D, Conjunto Ic, Unidad UD22	*Equus caballus* molar
		Nivel D, Conjunto Ic, Unidad UE23	*Equus caballus* molar
		I8	173g of bone fragments
		I3-I7	230g of bone fragments
		i3-I7	*Capra ibex* tooth
		I8	*Capra ibex* tooth
		D	*Capra ibex* tooth
Bajondillo	Aurignacian	11	Sediments & charcoal
		11	Sediments & charcoal
		11	Burnt flint
		11	Burnt flint
	Mixed MP/UP	13	Sediments & charcoal
		13	Burnt flint
	Mousterian	14	Charcoal
		14	?
		14	Burnt flint
Gibraltar			
Gorham's	Early Upper Paleolithic	Context 7 combustion zone (Context 15)	Charcoal
[N.B. - In Pettitt *et al.*(2002)		Context 9	*Pinus* sp. charcoal
OxA-7792 is the number for		Context 9	*Pinus* sp. charcoal
the Context 24 date, and		Context 9	*Pinus* sp. charcoal
there is no OxA-7857]		Context 9	*Pinus* sp. charcoal
		Context 11	Burnt bone
		Context 13a	*Pinus* sp. charcoal
		Waechter's layer D	Charcoal
		Waechter's layer D	Charcoal
	Mousterian	IV, back of the cave	*Pinus* sp. charcoal, cone scale
		Trench 7 m inside from main area	*Pinus* sp. charcoal
		Context 16 hearth (Context 24)	Charcoal
		Context 18	Charcoal
		Context 18	Charcoal
		Context 19	Shrub charcoal
		Context 19	*Pistacea* charcoal
		Context 19	*Juniperus/Tetraclinus* charcoal
		Context 19	*Juniperus/Tetraclinus* charcoal
		Context 22	Charcoal
		Context 22D	*Pinus* sp. charcoal
		Waechter's layer G	Charcoal
		Waechter's layer G	Charcoal
Castilla y León			
La Ermita	Mousterian	5a-b	Bone
Castilla-La Mancha			
Jarama VI	Mousterian	2 (intrusive feature), square H4	Charcoal
		2.1, square D4	Charcoal
		2.2, square F4	Charcoal

Date	Method	Lab number	calBP	calBP+2s	calBP-2s	Obs.
23160±490	AMS 14C	NZA-1818	27950	29030	26870	
28440±650	AMS 14C	NZA-1817	33170	35330	31010	
35400±810	AMS 14C	AA-8037A	40750	42690	38810	
36590±640	AMS 14C	NZA-2311	42000	42700	41300	
36740±920	AMS 14C	AA-6608	41980	43140	40820	
37290±990	AMS 14C	AA-7395	42430	43610	41250	
37900±1000	AMS 14C	AA 8037B	42840	44180	41500	
36300±1300	14C	USGS-2839	41140	43660	38620	
35000±500	14C	USGS-2840	40620	42300	38940	
53000±8000	TL	-	53000	69000	37000	
50000±8000	TL	-	50000	66000	34000	
28900±5600	14C	C-847	33330	45090	21570	
>28700	14C	C-848	-	-	-	
>28700	14C	C-849	-	-	-	
29690±560	14C	KN-I/926	34770	36150	33390	
10520±110	14C	Gif-8079	-	-	-	(a)
38200/+2000/-1600	14C	Gif-8307	43340	45560	41120	
26040±890	14C	Gif-7650	30610	32010	29210	
33900±1100	AMS 14C	AA-1388	39360	42560	36160	
30160±680	AMS 14C	Gif-TAN-89283	35260	36720	33800	
38800±1900	AMS 14C	AA-1387	43340	45700	40980	
25750±410	AMS 14C	Gif-TAN-89229	-	-	-	(d)
27190±150	AMS 14C	Beta-103782	31380	31580	31180	
29440±190	AMS 14C	Beta-103781	34690	35430	33950	
29950±200	AMS 14C	Beta-103783	35280	35800	34760	
33900±310	AMS 14C	Beta-132349	40080	41920	38240	
26610±460	AMS 14C	Beta-132350	31080	31620	30540	
28300±170	AMS 14C	Beta-132351	32850	34050	31650	
34450±600	AMS 14C	OxA-10666	40310	42010	38610	
<56000/+13000/-10000	U-Th	UAB, sample M5	-	-	-	
45200±1200	AMS 14C	Beta-74381	48280	51220	45340	
30900±1300	AMS 14C	OxA-7120	36170	39470	32870	
30200±460	AMS 14C	OxA-8024	35450	36330	34570	
26300±440	AMS 14C	OxA-8411	30890	31450	30330	
31800±550	14C	Gif/LSM-9140-I	37250	39150	35350	
29800±600	14C	Gif-9140-II	34870	36330	33410	
26970±5160	U-Th	-	26970	37290	16650	
31700±3600	U-Th	-	31700	38900	24500	
33400±2000	U-Th	-	33400	37400	29400	
33690±1195	AMS 14C	Ua-17150	39220	42520	35920	
32770±1065	AMS 14C	Ua-18050	38360	41180	35540	
26013±2777	TL	MAD-2482	26013	31567	20459	
28019±2334	TL	MAD-2559	28019	32687	23351	
37005±1790	AMS 14C	Ua-28270	41610	44870	38350	
28532±5319	TL	-	28532	39170	17894	
>40000	AMS 14C	Ua-16859	-	-	-	
ca.34,000	AMS 14C	?	-	-	-	
28551±2909	TL	-	28551	34369	22733	
28680±240	AMS 14C	OxA-7792	33650	34870	32430	
29250±650	AMS 14C	OxA-7077	34100	36020	32180	
29800±700	AMS 14C	OxA-7075	34800	36500	33100	
30200±700	AMS 14C	OxA-7074	35300	36800	33800	
30250±700	AMS 14C	OxA-7076	35360	36820	33900	
29100±340	AMS 14C	OxA-7388	34260	35380	33140	
29250±750	AMS 14C	OxA-7110	34010	36190	31830	
27860±300	14C	GrN-1363	32350	33630	31070	
28700±200	14C	GrN-1455	33720	34800	32640	
32330±390	AMS 14C	OxA-10230	37780	39460	36100	
34600±900	AMS 14C	OxA-10295	40230	42310	38150	
32280±420	AMS 14C	OxA-7857	37740	39480	36000	
23800±600	AMS 14C	OxA-7979	28730	30110	27350	
42200±1100	AMS 14C	OxA-7791	45770	47970	43570	
31900±1400	AMS 14C	OxA-8541	37400	40600	34200	
46700±1900	AMS 14C	OxA-8526	50260	55280	45240	
43800±1300	AMS 14C	OxA-8525	47140	50100	44180	
42800±2100	AMS 14C	OxA-8542	46570	50410	42730	
45300±1700	AMS 14C	OxA-6075	48620	52640	44600	
51700±3300	AMS 14C	OxA-7790	54650	62030	47270	
47700±1500	14C	GrN-1473	51300	55580	47020	
49200±3200	14C	GrN-1556	52570	59690	45450	
31100±500	AMS 14C	OxA-4603	-	-	-	(c)
23380±500	AMS 14C	Beta-56640	28260	29460	27060	
29500±2700	AMS 14C	Beta-56638	34690	28730	40650	
32600±1800	AMS 14C	Beta-56639	38210	34030	42390	

Table 1. Radiometric dates for the Middle-to-Upper transition in Iberia (radiocarbon calibration after Weninger and Jöris, 2005). Observations: (a) Possibly intrusive; (b) Low confidence 1960s result; (c) Minimum age only, poor collagen preservation; (d) Aberrant; (e) Minimum age only, contaminated with modern organics; (f) Bulk sample from levels with a mixed artifact component; (g) Bulk sample from primarily paleontological site; (h) Bulk sample, probably contaminated with intrusive Holocene material. *(continued)*

Site	Culture	Level	Sample type
Portugal			
Foz do Enxarrique	Mousterian	C	*Equus* sp. tooth enamel
Lapa dos Furos	Sterile, under Mousterian	4	*Cepaea nemoralis* shells
Caldeirão	Upper Paleolithic	Jb	Bone
	Mousterian (?)	Ktop	*Cervus elaphus* phalanx
	Mousterian	K	*Cervus elaphus* distal metapodial
		K	*Capra ibex* left scapula
		K	Burnt bone
Oliveira	Mousterian	8	Burnt bone
		8	Burnt bone
		9	Burnt bone
		9	Burnt bone
Gato Preto	Evolved Aurignacian	C	Burnt flint
Columbeira	Mousterian	7 (16 of J. Roche)	Carbonaceous earth
		8 (20 of J. Roche)	Carbonaceous earth
Salemas	Mousterian	T.V.b	Bone fragments
Pedreira de Salemas	Mousterian	2	Bone fragments
Pego do Diabo	Late Aurignacian	2a	Bone fragments
		2b	Bone fragments
	Mousterian	3	Bone fragments
Conceição	Above Mousterian	C	Eolian sands
	Below Mousterian	E	Fluviatile sands
Figueira Brava	Mousterian	2	*Patella* shells
Escoural	Mousterian	60-70 cm	*Equus* sp. tooth enamel

2. Sites and sequences

2.1. Galicia

Châtelperronian status has been claimed for material excavated in A Valiña cave. The archeological level (III, according to Fernández *et al.*, 1995, or IV-north, according to Llana and Soto, 1991, and Villar and Llana, 2001) consists of a 25 cm thick loamy deposit with abundant limestone fragments found half-way through an otherwise sterile sequence recognized to a depth of ca. 1.5 m below the surface extant at the time of digging. The diagnosis was made on the basis of the presence in the rather poor lithic assemblage recovered (52 formal tools only, among which denticulates dominate) of a small distal fragment of a curved backed piece made of quartz; this evidence, however, is clearly insufficient to warrant the proposed taxonomic assignment, especially since the remaining artifacts would fit comfortably in any Middle Paleolithic occupational context.

The associated faunal assemblage includes skeletal remains of at least one adult hyena, as well as abundant coprolites. In addition, carnivore damage is a common feature of the other faunal remains recovered, although a few cut-marked bones are reported by Pumarejo (1991). These facts suggest that the bone assemblage results mostly from hyena behavior, not human activity. Consequently, the three radiocarbon bone dates available are of limited significance for the human settlement of the region; the hyena uses of the site to which the dates probably relate could have taken place before, during or after the brief human

Date	Method	Lab number	calBP	calBP+2s	calBP-2s	Obs.
33600±500	U-Th	SMU-224/225/226	33600	34600	32600	
34580/+1160/-1010	14C	ICEN-473	39990	42570	37410	
26020±320	AMS 14C	OxA-5542	30800	31280	30320	
27600±600	AMS 14C	OxA-1941	32370	34070	30670	(a)
18060±140	AMS 14C	OxA-5541	-	-	-	(c)
23040±340	AMS 14C	OxA-5521	-	-	-	(c)
25220±200	AMS 14C	OxA-8670	-	-	-	(c)
31900±200	AMS 14C	GrA-10200	36850	37370	36330	
32740±420	AMS 14C	OxA-8671	38030	39510	36550	
38390±480	AMS 14C	GrA-9760	43000	43960	42040	
40420±1220	AMS 14C	Beta-111967	44240	46160	42320	
38100±3900	TL	BM-GPR4/GPR11	38100	45900	30300	
26400±700	14C	Gif-2703	-	-	-	(e)
28900±950	14C	Gif-2704	-	-	-	(e)
24820±550	14C	ICEN-379	-	-	-	(f)
29890/+1130/-980	14C	ICEN-366	34650	37250	32050	(g)
23080±490	14C	ICEN-490	-	-	-	(h)
28120/+860/-780	14C	ICEN-732	32970	35290	30650	
18630±640	14C	ICEN-491	-	-	-	(c)
27200±2500	OSL	QTLS-CNC11	27200	32200	22200	
74500/+11600/-10400	OSL	QTLS-CNC12	74500	97700	63700	
30930±700	14C	ICEN-387	36070	37310	34830	
48900/+5800/-5500	U-Th	SMU-250	48900	60500	37800	

incursions documented by the lithics, and the undiagnostic characteristics of the latter allow neither a narrowing down nor an extension of the potential interval (between ca. 43.4 and 31.2 ka cal BP) indicated by radiocarbon.

2.2. Asturias

No Châtelperronian level has been identified in the stratigraphic succession excavated at the Asturian rockshelter of La Viña. The significance of this absence, however, is obscured by the fact that an erosional hiatus separates the Mousterian in levels XIV and XIII-base from the basal Aurignacian in level XIII-inf (Fortea, 1995, 1999); given available radiocarbon dates of >51 ka cal BP (AMS, on charcoal) for the uppermost Mousterian, and of ca. 42 ka cal BP (conventional, on a single 60 g piece of carbonized wood) for the lowermost Aurignacian, the time covered by the hiatus can be estimated at ca. 10,000 years.

No detailed descriptions exist for the La Viña lithics, but preliminary reports mention the presence of Dufour bladelets in level XIII-inf, albeit in small numbers. A split-based bone point was recovered at the base of overlying level XIII, and a mixed charcoal sample from the middle and upper part of level XIII provides a *terminus ante quem* of ca. 37.5 ka cal BP for the deposition of that point. This age is in turn a *terminus post quem* for the deposition of levels XII, rich in thick-nosed «scrapers», and XI, rich in carinated «burins». Therefore, although pending confirmation from more detailed publication of the evidence,

the basic elements of the paradigmatic four-stage Aurignacian sequence seem to be represented at La Viña.

2.3. Cantabria

2.3.1. Cueva del Esquilleu

This interior montane cave site of western Cantabria features important Mousterian occupations focused on the hunting of ibex (Baena *et al.*, 2005). The bottom of the known sequence (fig. 2), recognized over ca. 1.5 m, is capped by denticulate-rich levels XX-XIX. Level XIX is a compact, brecciated deposit whose carbonate incrustation reflects a sedimentation hiatus related with a temperate/humid episode which, given the AMS charcoal date of ca. 53 ka cal BP for overlying level XVIII, could well be Greenland Interstadial (GIS) 14, dated to ca. 54.4 ka cal BP in the GISP2 ice core (Shackleton *et al.*, 2004). Levels XVIII-XVII feature a laminar Levallois reduction scheme, but levels XVI-XI are predominantly Quina-related; two dates place level XIII ca. 43.5 ka cal BP and level XIf ca. 41.7 ka cal BP. Levallois-flake schemes using a high quality quartzite characterize levels IX-VIII, but only discoidal reduction techniques are used in levels VII-III (Baena and Carrión, 2002); level VI

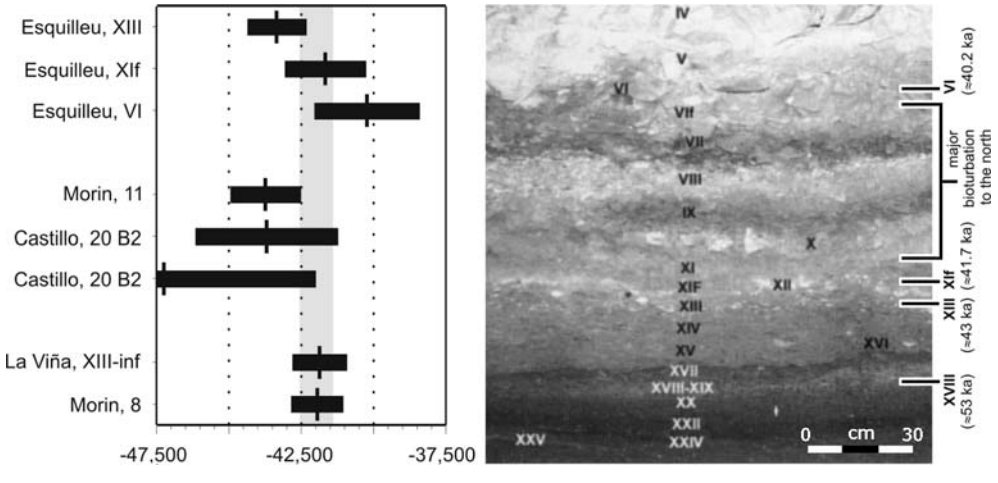

Fig. 2. Esquilleu. Left: calibrated radiocarbon dates compared with reliable results for the latest Mousterian (Morín 11 and Castillo 20) and the earliest Upper Paleolithic (La Viña XIII-inf and Morín 8) of the Cantabrian strip; in this and all following graphs, the light gray band represents the 2σ range of a calibrated date of 36,500 ± 500 ^{14}C BP, the pan-European chronological horizon for the emergence of the Aurignacian. Right: stratigraphic profile (after Baena *et al.*, 2005, modified); note the apparent increase in sedimentation rate across levels affected by major bioturbation in adjacent squares.

is dated to ca. 40.2 ka cal BP on charcoal, and level III yielded a bone date of ca. 12 ka ^{14}C BP. Overlying levels II-I are disturbed and yielded post-Mousterian materials, including a sagaie bone point and a bladelet core, but no indication exists that the site was used in Early Upper Paleolithic (EUP) times.

These radiometric results imply a tenfold increase in the sedimentation rate, from 3 cm/millennium between levels XVIII and XIII, to 30 cm/millennium between levels XIf and VI. As noted by the excavators, such a major increase may be related to the fact that the levels become coarser upwards from levels XIII-XII; in particular, *éboulis sec* levels IV-III seemingly correspond to the collapse of the cave entrance (a process that may have begun in level VI times, given the large boulders therein). If so, the material in the package of deposits comprised between levels VI and III must be essentially contemporaneous, and the absence of techno-typological changes across this part of the sequence is consistent with such a notion. One must also bear in mind that the single bone date for level III documents the incorporation of intrusive material in these open-textured deposits, and that extensive bioturbation affected the sequence at elevations corresponding to levels X-VI, i.e., those immediately underlying the *éboulis*. Thus, it is possible that the high sedimentation rate in the upper part of the Esquilleu sequence may actually be an artifact of the presence in these deposits of younger, contaminating charcoal introduced by animal burrowing.

Baena *et al.*(2005) argue that the uppermost Mousterian of Esquilleu falls in the time range of nearby Aurignacian sites but, as noted above, there is no reason to think that level III is not of broadly the same age as level VI, which overlaps the result for level XIf. The apparent contemporaneity of these levels with the earliest regional Aurignacian, therefore, is more likely to be an artifact of the poor resolution of dating techniques than the reflection of a real plurimillennial coexistence between a delayed Middle Paleolithic surviving in interior, montane areas of Cantabria and an EUP settlement of littoral lowland areas located within walking distance.

2.3.2. Cueva del Pendo

Following González Echegaray (1980) and Bernaldo de Quirós (1982), it became common practice until the present (cf., for instance, Mellars, 1999, and Davies, 2003) to cite the excavations carried out between 1953 and 1957 by Martínez Santaolalla at this cave as having exposed a paradigmatic stratigraphy for the Transition in Europe. It was argued, specifically, that the site featured the interstratification of a Châtelperronian deposit (level VIII of profile 1) in an Aurignacian sequence (levels VIIIa and VIIIb, below, and VII, above). Such claims ignored Hoyos and Laville's (1982) conclusions that 1) the supposed «Châtelperronian» level was clearly in secondary position, 2) the geometry and sedimentological characteristics of the excavated fill suggested cycles of accumulation and erosion by karstic inundation, and 3) other stratigraphic anomalies and inversions were possible if not likely.

These points have since been fully confirmed (Montes and Sanguino, 2001; Montes *et al.*, 2005). El Pendo is a large cave with a ca. 30 m wide entrance located at the bottom of an uvala drained by a stream. The deposits exposed in the 1950s, located at the foot of the huge *éboulis* cone accumulated at the porch, are entirely the result of post-depositional, often high-energy colluvial and fluvial processes. As a result, every single level features a variegated mix of archeological materials; in fact, at the bottom of the stratigraphic trench excavated in 1994-97 (Cut 3), 5 m below the purported interstratification, and underlying deposits containing hundreds of Mousterian-like flakes and cores, there was a clearly Upper Paleolithic sagaie bone point. The random results obtained with the ESR and U-Th dating of animal teeth collected at different elevations in Cut 3 confirm the secondary nature of the accumulation, and the entirely mixed nature of these deposits.

2.3.3. Cueva del Castillo

Also located in central Cantabria, this cave site has been of central importance to the last 15 years of Transition controversies because of the very early age claimed for Aurignacian level 18 on the basis of ten AMS charcoal results for its three sublevels, B1, B2 and C (Cabrera and Bischoff, 1989; Cabrera and Bernaldo de Quirós, 1996; Cabrera *et al.*, 1993, 1996a, 1996b, 1997a, 1997b, 2001; Zilhão and d'Errico, 1999, 2003b). Their calibrated mid-points range from ca. 41.6 to ca. 45.0 ka cal BP, but they have rather large standard deviations and, hence, taken as a group, the results are statistically identical. Accordingly, the practice developed of treating them as different samplings of a single, chronologically homogeneous charcoal source, and of averaging them to obtain a mean age, such as that of 39,600 ± 1300 ^{14}C BP (i.e., ca. 43.7 ka cal BP) proposed by Cabrera and Bischoff (1989) on the basis of the three initial results.

However, the results for B1 and B2 tend to be younger than those for C, which, stratigraphically, they clearly overlie. In fact, the ensemble of results forms two clusters: those for B1 and B2 (except one), ca. 41.6-43.2 ka cal BP; the other B2 result and all those for C, ca. 43.9-45.0 ka cal BP (fig. 3). The younger cluster encompasses the range of the reliable results obtained elsewhere in the Vasco-Cantabrian region for the earliest Aurignacian, whereas the age interval corresponding to the older cluster falls largely outside that range and is identical to that of the region's latest Mousterian, as represented by underlying level 20 and by Morín level 11. These comparisons suggest that level 18 is not homogeneous and that its multi-component nature has been masked by the large standard deviations of the radiocarbon results.

In this respect, one must bear in mind that the sampling was carried out in the exterior part of the site, currently under excavation. Since this area yielded no diagnostic Aurignacian artifacts, the notion that the dating results are a homogeneous ensemble entirely related to the Aurignacian rests on correlations of the exterior stratigraphy with that recognized in the interior area excavated by Obermaier almost one century ago. The

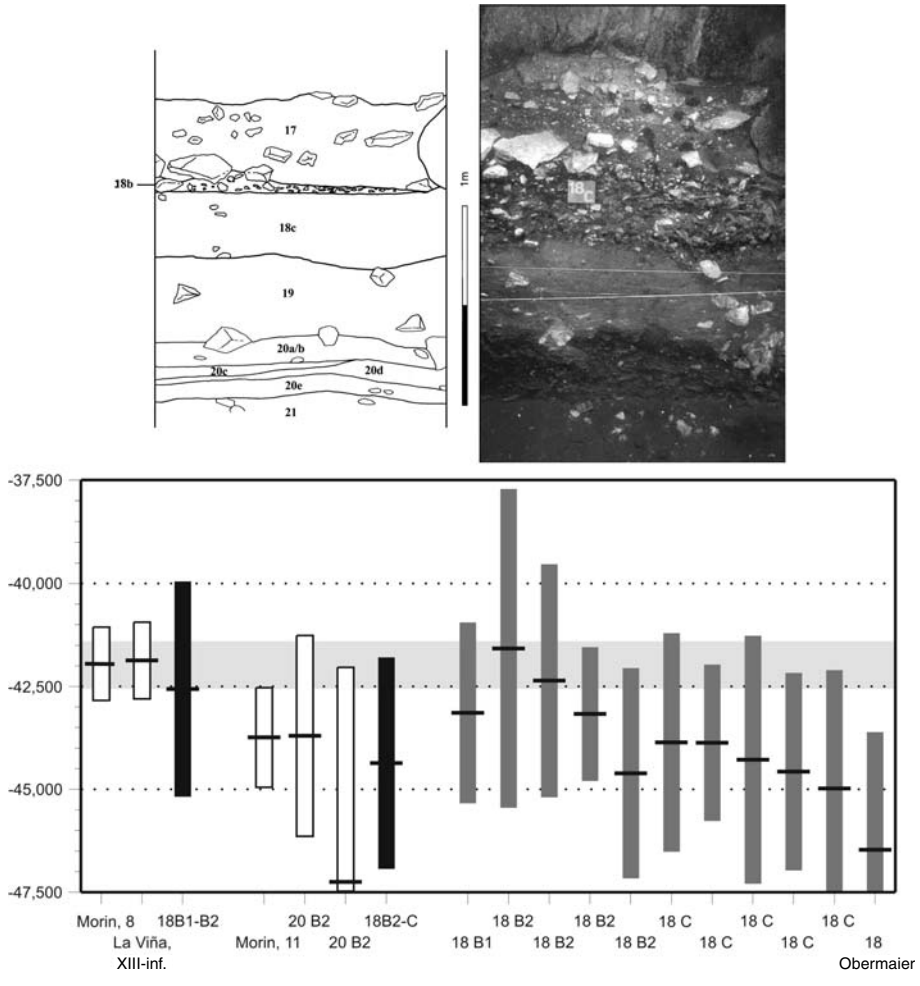

Fig. 3. El Castillo. Above: stratigraphy of the Transition levels (after Maíllo *et al.*, 2004); note that sublevel 18C stratigraphically underlies 18B, as is also apparent in Cabrera and Bischoff's (1989) sample provenience schemes. Below: calibrated radiocarbon dates (dark gray bars), compared with the averages (black bars) for the two apparent clusters (younger, four B1-B2 dates; older, six from B2-C) and the reliable results (white bars) for the latest Mousterian and the earliest Upper Paleolithic of the Cantabrian strip.

latter did feature an «Aurignacian Delta» in lateral continuity with exterior level 18 but, originally, those deposits, ca. 1 m thick, had been designated as «Mousterian Alpha». The change came upon the finding of the first split-based bone points, but Obermaier always maintained that the level had an upper part rich in such points and a lower part rich in sidescrapers; in sum, his «Aurignacian Delta» was in fact a Middle-Upper Paleolithic palimpsest.

Given that Obermaier defined his levels as the entire thickness of deposits sandwiched between any two sterile units, this conclusion should come as no surprise; in fact, palimpsests of originally separate, successive culture-stratigraphic units were thus created at other points in the sequence, most notably the «Magdalenian Beta» level, a deposit up to 1.80 m thick that probably contained three different industrial components covering several thousand years of the regional Magdalenian sequence (Utrilla, 1996). Zilhão and d'Errico (1999) suggested that 1) the «Magdalenian Beta» was a good analogue for the «Aurignacian Delta», 2) the latter incorporated a Mousterian as well as, possibly, a Châtelperronian component, and 3) the same applied to level 18 of the exterior area, where a much reduced thickness and the location under a major collapse of the overhang implied significant compaction and an enhanced difficulty in disentangling the different components.

Two lines of evidence support these suggestions: first, according to Cabrera and Bernaldo de Quirós (1996) and Cabrera *et al.* (2001), a backed point of atypical Châtelperronian type made out of fine-grained quartzite was found near the base of 18B2 (and Obermaier had found another); second, the multi-component nature of the «Aurignacian Delta» is now confirmed by dates on two deciduous elephant molars, likely from the same individual, of ca. 46.5 and >51 ka cal BP (Stuart, 2005). Cabrera *et al.* (2001) describe Upper Paleolithic-like tools (endscrapers, burins, borers) from exterior level 18 and, although none are diagnostic, it is possible that some may relate to the Aurignacian; however, in their counts, the different «archaic» types (sidescrapers, denticulates, etc.) are twice as numerous as endscrapers in the C as well as in the B sublevels, which suggests that the large majority of this material relates to the pre-Aurignacian components of the palimpsest.

Given the patterning in the radiocarbon dating results, this conceivably Aurignacian material may well be associated with the younger cluster of results, and the level's dominant Middle Paleolithic component with the older. Put another way, it is possible that sublevels B1-B2 of the modern excavations broadly correspond to the Aurignacian occupation in the upper part of Obermaier's «Aurignacian Delta», whereas the Mousterian occupation in the lower part of the latter would correspond to sublevel C. This view of the site's stratigraphy is easy to reconcile with the reported presence of Upper Paleolithic-like objects in sublevel C, and of Middle Paleolithic objects in sublevels B1-B2; given the thinness of the latter over significant portions of the excavated area, ordinary, small-scale post-depositional vertical displacement, combined with the absence of a clear boundary between B2 and C, suffice to explain such presences.

Although it is nowadays widely recognized that El Castillo cannot be used to sustain the notion that, in Cantabrian Spain, the Aurignacian had become fully constituted as such significantly earlier than elsewhere in Europe, a different issue is whether the assemblage succession in levels 20, 18 and 16 documents a gradual emergence of a full-blown Aurignacian of «normal age» out of an ancestral, local Middle Paleolithic technology, as implicit in Cabrera *et al.*'s (2001, 2005) latest diagnosis of level 18 as a «Transitional Aurignacian» akin to the Châtelperronian, the Uluzzian or the Bachokirian. The «mosaic» aspect of the assemblage upon which this notion rests, however, is most parsimoniously

explained by that level's multi-component nature. Cabrera *et al.* (2000) and Maíllo *et al.* (2004) do document a true prismatic bladelet core technology in underlying Mousterian levels 21 and 20, and argue that such findings confirm the putative industrially intermediate nature of level 18. However, well defined, albeit marginal prismatic core bladelet productions are known to exist in other Mousterian assemblages of southern Europe otherwise characterized by traditional Levallois and discoidal flake reduction strategies, such as Champ Grand, in France (Slimak, 1999; Slimak and Lucas, 2005), or the Oliveira cave in Portugal (see below); therefore, Cabrera *et al.*'s diagnosis is not warranted, as extensively argued by Zilhão and d'Errico (2003b), and more recently corroborated by Maroto *et al.* (2005).

In conclusion, both the stratigraphic and the dating evidence yielded by El Castillo lack the resolution necessary to address the issue of what happened in the time interval which saw the Aurignacian replace its Cantabrian predecessors. As a result of erosion and depositional hiatuses, or of the poor vertical resolution of Obermaier's excavations, whatever sediments, bones or artifacts accumulated at the site during that interval eventually became part of a palimpsest whose different constituents can only be recognized on the basis of technological and typological arguments; because such criteria cannot be used to individually relate each charcoal sample to a particular cultural component, the archeological meaning of available radiocarbon results is ambiguous, and their value to assess the chronology of the Transition is rather limited.

2.3.4. Cueva Morín

González Echegaray and Freeman (1971, 1973) and Bernaldo de Quirós (1982) provide the standard descriptions of the chronostratigraphic succession excavated in the 1960s at this other Santanderine cave site. Following their typological analyses, the levels of relevance for the Transition would be level 10, Châtelperronian, and levels 9 to 5-lower, Aurignacian.

Level 10 does feature several Châtelperron points (fig. 4) in a typologically clear Upper Paleolithic context with numerous burins and endscrapers; however, items of Aurignacian (at least one Dufour bladelet, possibly some of the endscrapers) and Mousterian (sidescrapers) affinities are also reported. Given the level's thinness (only 2-5 cm), this presence may simply result from an imprecise delimitation of its boundaries at the time of excavation; an alternative view (Laville and Hoyos, 1994; Sanguino *et al.*, 2005) is that «level 10» lacks any sedimentological entity whatsoever and simply corresponds to the soliflucted and cryoturbated contact zone between levels 11 (Mousterian) and 9 (Aurignacian). No matter which explanation is preferred, it is clear that the artifact collection is not homogeneous (contra Maíllo, 2005) and that the conventional charcoal date (SI-951A, 42,590 ± 6580 ^{14}C BP) obtained in the 1960s, already of little utility because of its very large standard deviation, is stratigraphically meaningless. However, the finds of typical points prove that Châtelperronian people used the site during the interval separating the deposition of

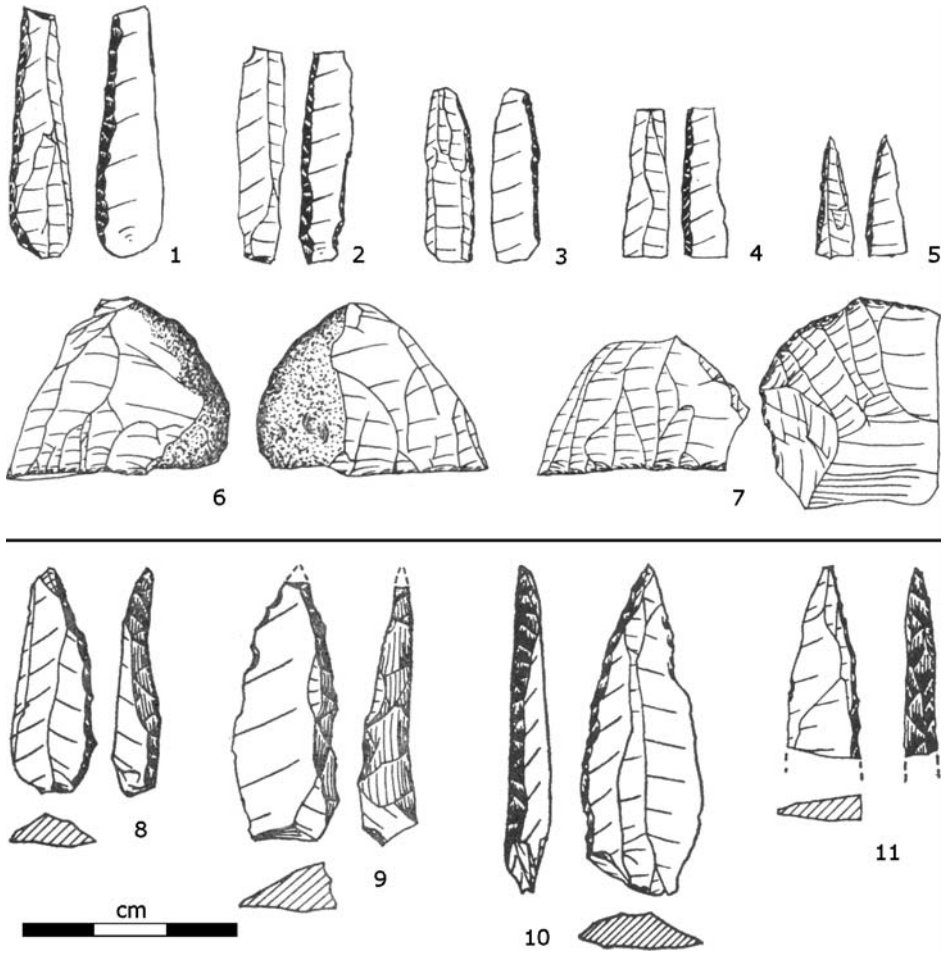

Fig. 4. Morín, diagnostic lithics (after González Echegaray and Freeman, 1971, 1973, modified). Above, level 8, Protoaurignacian: 1-4. Dufour bladelets; 5. Font-Yves point; 6-7. Prismatic bladelet cores. Below, Châtelperron points: 8-9. From level 9; 10-11. From level 10.

levels 11 and 9, and the AMS date of ca. 43.7 ka cal BP obtained for level 11 on charcoal sampled from the profile (Maíllo *et al.*, 2001) provides a secure *terminus post quem* for that occupation.

Given the disturbance documented at the Mousterian/Aurignacian interface, the fact that sidescrapers, denticulates and notches are the most abundant tool-types in the equally rather thin (5-8 cm) level 9 suggests that this assemblage is also mixed, and this is confirmed by the presence of Châtelperron points. Therefore, only the assemblage in 25 cm thick level 8 can be used to assess the lithic production system of the earliest Aurignacian

occupation of the cave (Maíllo, 2002-2003, n.d.) (fig. 4). Technologically, this level is characterized by the exploitation of prismatic cores which, once exhausted for blades, continued to be reduced for bladelets; typologically, the dominant feature is that Dufour bladelets of the Dufour subtype are 20% of the 581 formal tools, otherwise dominated by flakes and blades with continuous retouch.

An AMS charcoal date of ca. 42 ka cal BP (Maíllo *et al.*, 2001) confirms the diagnosis of level 8 as truly Protoaurignacian, and provides a *terminus post quem* for the overlying sequence: an Early Aurignacian with carinated «scrapers» in levels 7 and 6 (to which must have belonged the split-based bone points from the earlier twentieth-century excavations of the Conde de la Vega del Sella), followed, in level 5-lower, by an Evolved Aurignacian with thick-nosed «scrapers», Dufour bladelets of the Roc-de-Combe subtype, and massive-based bone points (Bernaldo de Quirós, 1982). The Morín sequence thus fully conforms to the classical chronostratigraphic sequence of the Aquitaine basin; the conventional radiocarbon results available for level 7, obtained early in the history of the method, seemingly contradict this assertion, but it is uncontroversial that those results are no more than very rough, underestimated assessments of the true age of the deposits.

2.4. Euskadi

Excavated in 1987-1988 in the framework of a salvage operation (Arrizabalaga and Altuna, 2000; Arrizabalaga *et al.*, 2003), Labeko Koba is a small cave site in the outskirts of the town of Arrasate (Gipuzkoa). It yielded a stratigraphic succession featuring Aurignacian levels (VII-IV) above a Châtelperronian (level IX-base) whose integrity is warranted by the intervening sterile (level VIII) or near sterile deposits (level IX-upper, which yielded five flakes only) (fig. 5). The Châtelperronian assemblage consists of 62 pieces of debitage and tools, all flint, plus 14 cobbles, two of which used as hammerstones. This small size reflects an episodic use of the site by humans, at a time when hyenas were its most frequent dwellers; the assemblage is dominated by blades (including crested pieces) and bladelets, several of which are retouched, and includes three clear Châtelperron points and a bone point fragment.

In level VII, the cave was more intensively visited by humans, who alternated at the site with bears. The lithic assemblage features >6000 pieces (including 886 formal tools) and is overwhelmingly dominated by blades and bladelets, extracted from prismatic cores in the framework of a single, continuous reduction sequence, as in Morín level 8. No carinated or thick-nosed «scrapers» exist, and the numerous Dufour bladelets (289, i.e., 33%) are long and straight, of the Dufour subtype; their blanks may also come from the exploitation of several cores of the nucleiform «burin» kind, set up on thick, partly cortical flakes. These characteristics suffice to define level VII as unmistakably Protoaurignacian. Overlying level VI was rather poor, with only 15 retouched tools, but contained one split-based bone

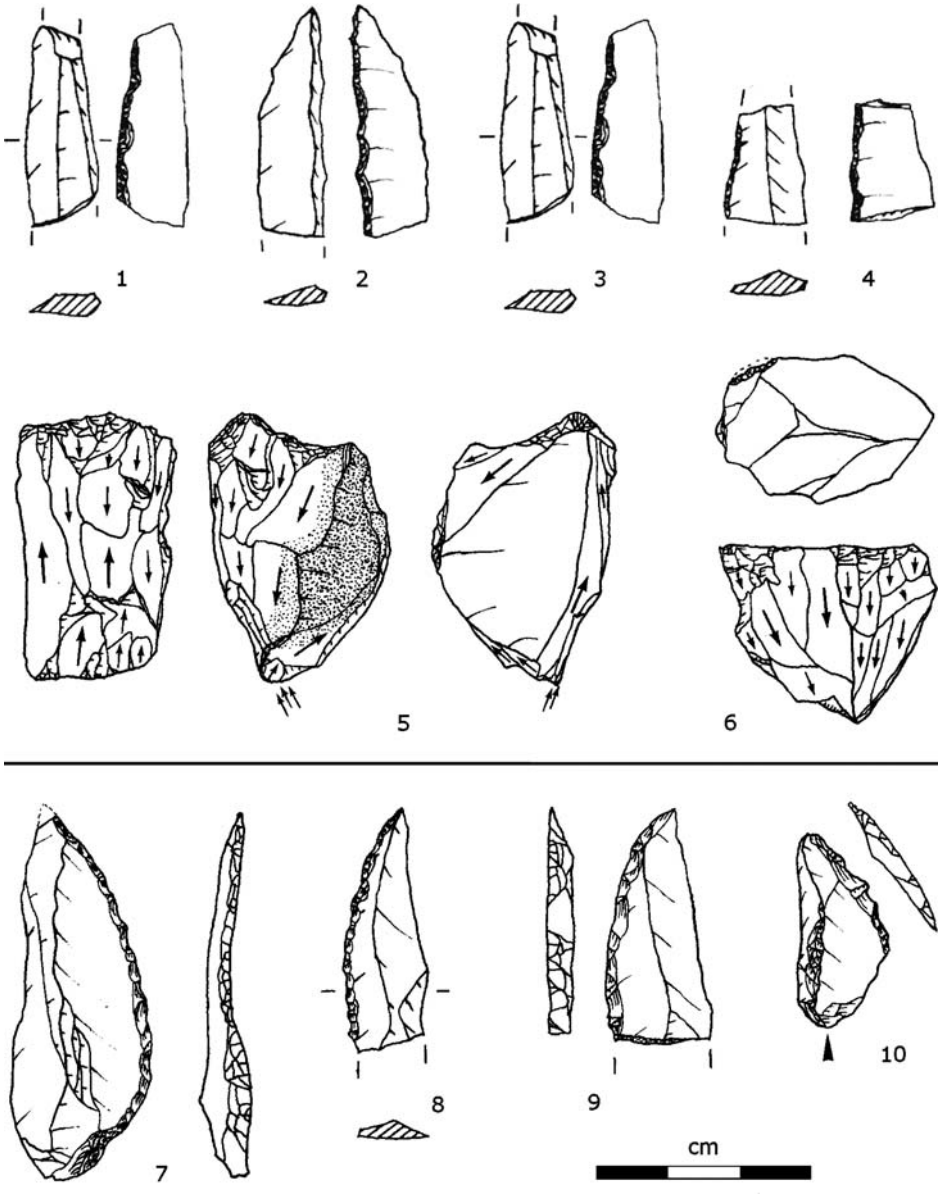

Fig. 5. Labeko Koba, diagnostic lithics (after Arrizabalaga and Altuna, 2000, modified). Above, level VII, Protoaurignacian: 1-4. Dufour bladelets; 5-6. Prismatic blade/bladelet cores. Below, level IX-base, Châtelperronian: 7-9. Châtelperron points; 10. Truncated piece.

point, another having been found in level V, the richest of the sequence, with almost 9000 lithic objects, 288 of which are retouched pieces. Among the latter, continuous retouched blades (including pieces with «Aurignacian retouch») are the better represented type and, by comparison with level VII, there is a marked decrease in the percentage of Dufour bladelets (only 26, i.e., 9%). The assemblage includes distally-twisted, medium-sized bladelet blanks, i.e., typical lateral removals from the «fronts» of carinated and thick-nosed «scrapers». Level IV is the last occupation of the cave, and yielded a lithic assemblage similar to that of level V in size and composition.

Eight AMS radiocarbon dates on bone samples from this sequence are all significantly rejuvenated, and in some instances the results are associated with explicit lab remarks as to the low quality of the collagen extracted (Arrizabalaga, 2000: 67). This rejuvenation must be an artifact of post-depositional degradation and diagenesis, due to the fact that, after collapse of the cave roof, most of the inhabited area became exposed to intensive weathering and leaching by rain and other natural elements (which also affected the lithic artifacts found outside the drip line extant at the time of digging). A good analogue for this process is provided by the Sesselfelsgrotte, in Germany, where bone dates for the sequence of Micoquian levels G1-G4a/5 range, from top to bottom, between ca. 31 and ca. 36 ka ^{14}C BP for samples collected in the porch, and between ca. 40 and ca. 48 ka ^{14}C BP for samples collected inside the cave (Richter, 2002). The Labeko Koba results, therefore, should be treated simply as minimum ages for the assemblages recovered in the dated levels; their use to assess the tempo of the Transition in the region is unwarranted.

2.5. Aragón

García *et al.* (2001) claim a delayed Mousterian at the cave of Fuentes de San Cristóbal (Huesca), where contemporaneity with the regional early Upper Paleolithic until ca. 30 ka ^{14}C BP (i.e., ca. 35 ka cal BP) would be demonstrated. The scant data provided in the preliminary report (Rosell *et al.*, 2000), however, do not support such a claim. Exposed and partly destroyed by road-cutting, the site preserved several sediment remnants which were rescue-excavated in 1998; a very small number of lithic artifacts was recovered in the upper part of the sequence (geological levels H1-H11), composed of deposits with a mixed origin (local, colluvial and possibly eolian). In sector P3 of the site, this upper deposit was ca. 7 m thick, and contained four archeological levels (M, N, O and P). Lowermost level P yielded a Mousterian point and a charcoal sample AMS dated to ca. 41 ka cal BP; overlying level O yielded an undiagnostic assemblage and two results on similar samples, one identical, and the other of ca. 32 ka cal BP. Thus, with due consideration of statistical error, all that can be said about Fuentes de San Cristóbal is that its latest Middle Paleolithic occupation took place within the ca. 44-37 ka cal BP interval, which is fully consistent with setting the regional Transition at ca. 42 ka cal BP, as elsewhere in northern Spain.

2.6. Catalonia

2.6.1. Cova dels Ermitons

This cave site is located in the southern flank of the Pyrenees, ca. 400 m above modern sea level. Initial excavation work, affecting an area of ca. 14 m^2, was conducted in 1970-71, and led to the identification of six archeological levels contained in the upper 1.5 m of the cave fill, which overlies basal sterile deposits recognized over a similar thickness. The time of the Transition corresponds to levels IV, V and VI (Maroto, 1994; Maroto *et al.*, 1996, 2001-2002; Ortega and Maroto, 2001), but analyses have been restricted to levels VI and IV because artifacts in level V are few and thought to derive from the erosion of the underlying deposits.

Level VI yielded a faunal assemblage dominated by ibex and containing remains of chamois and of a large bovid (*Bos*/*Bison*); carnivores are represented mostly by cave bear, but remains of wolf, panther and lynx have also been recovered. In contrast, the level IV assemblage is overwhelmingly dominated by cave bear, with occasional finds of skeletal material belonging to hyena, wolf, panther and fox; a few ibex finds represent the only conceivably anthropically-accumulated faunal material. Where the artifact assemblage is concerned, there are no differences between the two levels, except in that level IV is much poorer; it yielded 102 pieces, as opposed to 286 in level VI. This low number of artifacts (7/m^2 in level IV, 20/m^2 in level VI), coupled with the high proportion of retouched tools (>40% in both levels), suggests sporadic incursions and reduced, if not negligible, human involvement in the formation of the animal bone assemblages, in good agreement with the abundance of carnivore remains. Maroto (1994: 134-137) proposes exactly such an interpretation on the basis of his own analysis of patterns of fragmentation, body part representation and carnivore marks in the fauna from level IV.

Technologically, the lithic assemblages are fully Middle Paleolithic, based on the utilization of centripetal Levallois methods to extract flake blanks from the locally available raw-materials, often of mediocre quality; blade production, Levallois or prismatic, is not documented in the tool assemblage, nor among cores and debitage. Typologically, sidescrapers and denticulates dominate (together, they are 90% of the tool assemblage, the remainder corresponding to a few pieces of the Upper Paleolithic group, mostly truncations and flakes with abrupt retouch, as well as a few endscrapers and atypical burins). An atypical Châtelperron point made on a laminar flake of coarse-grained quartzite is reported from level VI, and another is illustrated by Rodríguez *et al.* (2003-2004) (fig. 6); these authors, however, assign both items to levels IV-V, not to level VI.

Only level IV of this sequence is dated. A bulk bone sample yielded a conventional result in the ca. 44-38 ka cal BP interval, and an AMS date with a much smaller error but right in the calibration plateau of ca. 33 ka ^{14}C BP falls in the 40.5-36.5 ka cal BP interval. Ortega and Maroto (2001) and Maroto *et al.* (2001-2002) argue that the AMS result is more reliable because of the method used and of the secure provenience of the sample,

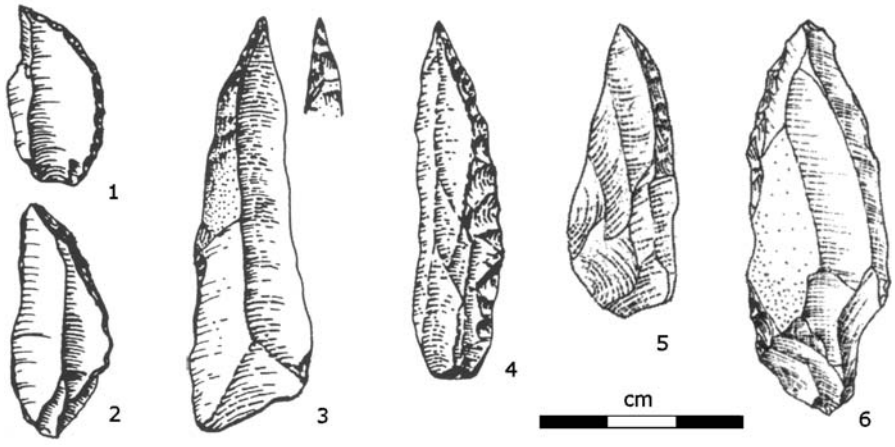

Fig. 6. Châtelperron points from northern Catalonian sites (after Maroto, 1994, and Rodríguez *et al.*, 2003-2004, modified). 1-4. L'Arbreda; 5-6. Ermitons.

collected in the exposed profile. Based on these arguments, they conclude that a perduration of the Middle Paleolithic into much later than ca. 42 ka cal BP is effectively demonstrated by the Ermitons evidence. However, there is no reason to believe that the conventional result represents an overestimation of the true age of level IV; given the exponential nature of radioactive decay, even a significant presence of material derived from the underlying deposits would have a negligible impact on that result. The AMS date, in turn, simply reflects the age of one particular bone, not necessarily representative of the totality of the level's contents; moreover, given the discrepancy with the conventional date and the widespread examples of undetected chemical contamination in bone samples from this time range (Zilhão and d'Errico, 1999; Jöris *et al.*, 2003), the younger AMS result may well be simply a minimum age.

In any case, because the faunal assemblage from level IV is carnivore-accumulated, the AMS result does not necessarily date the human occupation represented by the artifacts, which, in theory, could have been broadly contemporaneous, significantly earlier, or even significantly later. The lack of dates for the bracketing deposits prevents further speculation about the merit of these different alternatives. Two facts, however, suggest that the most parsimonious interpretation of Ermitons is that the bones in level IV represent carnivore activity at a time when humans were not using the cave any more: first, the fact that the artifact assemblage in level IV is identical to that in underlying level VI; second, the fact that the faunal contents of the sequence indicates a decrease in the human use of the site throughout the interval represented by this section of the deposits.

Provenience uncertainties also prevent assigning unambiguous meaning to these dates. Discrepancies exist between different publications regarding the stratigraphic position of

the pieces with Châtelperronian affinities, and initial reports (Maroto, 1994; Maroto *et al.*, 1996: 237) stated that the sorting of the excavated material into the different levels recognized in the profiles had been possible for the fauna (although only in a very approximate way), but not for the lithics; it is only in subsequent publications that the artifacts are presented as the two differentiated assemblages discussed above. It is clear, thus, that any chronostratigraphic inferences are to be taken with great caution; for instance, there is no reason to believe that the material represents only two periods of occupation instead of several. Given the overall framework of very occasional use of the site by humans, it would not be surprising, in particular, that, even if the debitage relates in its entirety to Middle Paleolithic reduction schemes, a very small, truly Upper Paleolithic component of diagnostic retouched tools exists in the lithics; besides the atypical Châtelperron points, the endscrapers with a wide front made on thin, elongated flake blanks that Maroto *et al.* (1996) illustrate, which are characteristic of the French Châtelperronian, could also belong to such a component.

In these circumstances, any conclusions regarding the putative links between the artifacts, the fauna, the profiles and the samples from Ermitons are open to question, and no interpretation of the dating results is secure. At best, the evidence from this site can be taken as suggestive of a brief Châtelperronian incursion leaving a few items that became mixed with those from preceding Mousterian ones; but it does not warrant the notion of a late survival of the Middle Paleolithic in the mountainous areas of northern Catalonia, and the far reaching implications such a notion would have for our understanding of the Transition in Europe.

2.6.2. Reclau Viver

Reclau Viver is a cave in the Serinyà valley; in 1944-1947, Corominas explored its >5 m thick sedimentary fill in 20 cm artificial spits (eventually emptying the site) but, despite the large volume excavated, stone tools were few (26 in the extant museum collection). An Aurignacian occupation with characteristic bone points was recognized at the base, but the different authors who subsequently revised the evidence agreed that a subdivision between a basal Aurignacian A and an upper Aurignacian B was warranted (cf. Canal and Carbonell, 1989: 335-336; Maroto, 1994).

Two series of radiocarbon results are available for these deposits. The conventional ones are clearly rejuvenated and will not be the object of further discussion; assessing the significance of the AMS ones, which are in correct stratigraphic order and whose chemical reliability has not been questioned, requires due consideration of the associated finds. The ca. 35.4 ka cal BP AMS result, on a sample collected 4.4-4.6 m below surface, is uncontroversial; it is conceivably related to the nosed «scraper» component recognizable in the lithics (fig. 7), both substantiating an occupation of the site in Evolved Aurignacian times. The ca. 44 ka cal BP AMS result, obtained on a sample collected 80 cm further down, is

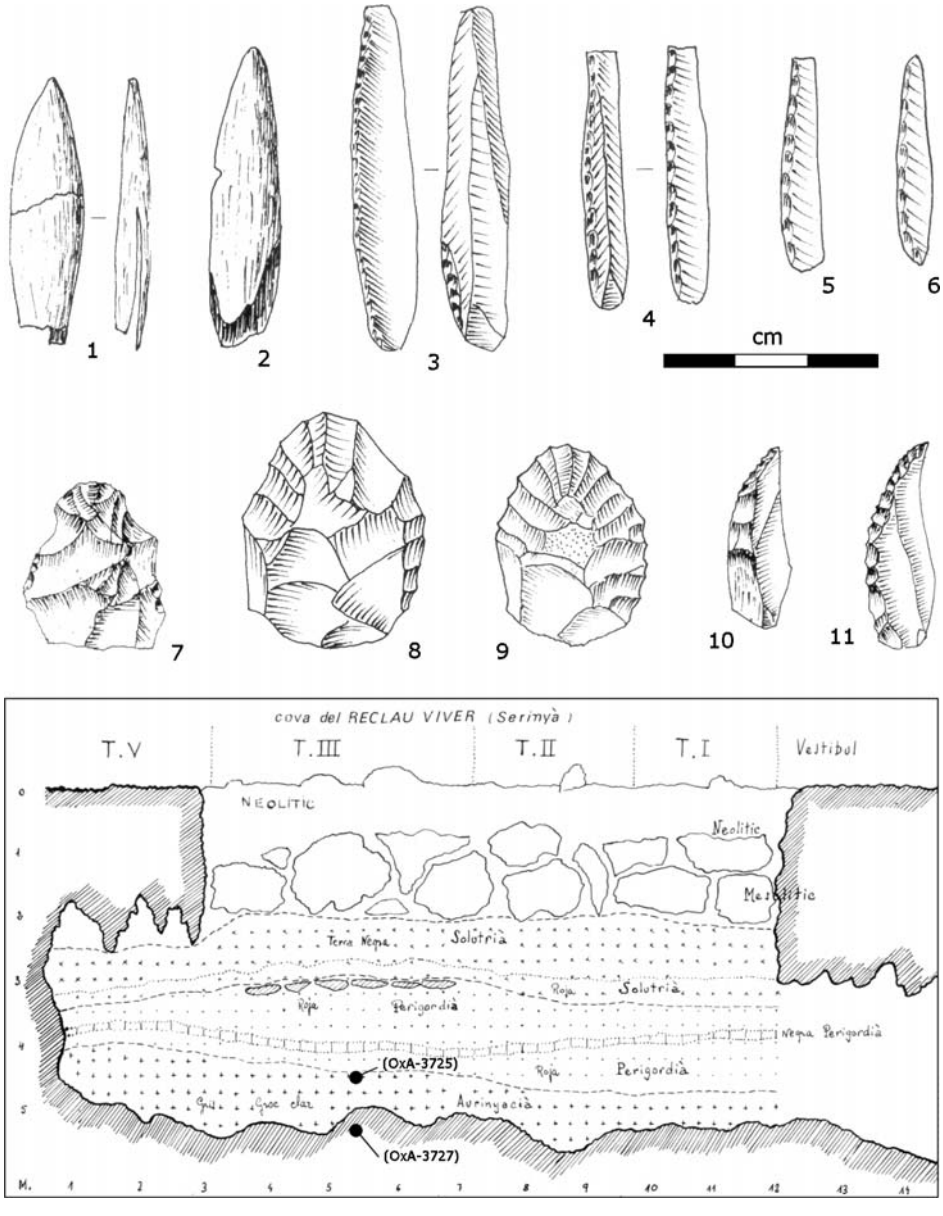

Fig. 7. Reclau Viver (after Canal and Carbonell, 1989, modified). Above, lithics from Corominas' «Aurignacian» level: 1-2. split-based bone points; 3-6. Dufour bladelets; 7. Thick-nosed «scraper»; 8-9. Carinated «scrapers»; 10-11. Small Châtelperron points. Below, Corominas' stratigraphy and approximate position of the two AMS dated bone samples (OxA-3725, 30,190 ± 500 ^{14}C BP; OxA-3727, 40,000 ± 1400 ^{14}C BP).

taken by Maroto (1994) as 1) confirmation of the archaic nature of the site's Aurignacian A and 2) corroboration of the great antiquity of the Catalonian Aurignacian as a whole. The scant lithics, however, are clearly mixed; this may be due to the fact that the levels were a homogeneous palimpsest, or to Corominas' failure in recognizing the detailed stratigraphic differences that might have allowed a correct individualization of the separate occupations contained in his basal «Aurignacian». In any case, the facts are that the assemblage found in the latter includes both Châtelperron points and Dufour bladelets of the Dufour subtype, indicating use of the site during the Châtelperronian and the Protoaurignacian, as well as an ensemble of Early Aurignacian split-based bone points.

Thus, Reclau Viver seems to have contained a fairly complete record of the EUP, with all stages represented by the corresponding index fossils. The AMS dates are consistent with this notion; given the provenience of the sample (at the bottom of the fill), however, the ca. 44 ka cal BP result is more likely related to the Châtelperronian, and may well simply represent a *terminus post quem* for the site's stratigraphic succession.

2.6.3. L'Arbreda

L'Arbreda, near Reclau Viver, is a wide-open cave, more like a rockshelter in fact, where a deep stratigraphic sequence, extending into the early Upper Pleistocene, has been recognized in the framework of two generations of digging (fig. 8). Modern work (Soler and Maroto, 1987; Bischoff *et al.*, 1989; Maroto, 1994; Maroto *et al.*, 1996) differentiated three major units: «*terra rossa*», «Upper Sequence» and «Lower Sequence». The levels of relevance for the Transition are in the «Upper Sequence», where a late Middle Paleolithic level I (ca. 0.25 m thick) underlies a series of Upper Paleolithic levels, of which H and G (ca. 1.5 m thick) are attributed to the Aurignacian. Level H yielded a lithic, mostly flint assemblage with strong affinities to the Protoaurignacian: prismatic cores were often abandoned at small sizes, with only bladelet scars visible, documenting the continuous reduction of blade and bladelet blanks, the latter used for the manufacture of the Font-Yves points and the Dufour bladelets of the Dufour subtype that make up the majority of the formal tools (57%, if all fragments are counted; 40%, if only the MNI of 92 Dufours is considered).

The upper part of ca. 1 m thick level H contained split-based points, and four Châtelperron points (cf. fig. 6) were found at the interface with underlying Mousterian level I. As discussed by Ortega and Maroto (2001), two of these points are made on laminar flint blanks documenting systems of raw-material exploitation and blade production unknown in the later Mousterian of the region. Therefore (contra Maroto *et al.*, 2001-2002), these items can hardly be disregarded as simply representing an instance of variation in the types of backed implements that are standard in Catalonian Middle Paleolithic assemblages. Thus, on the basis of the index fossils, L'Arbreda clearly replicates the chronostratigraphic succession of the Cantabrian strip, where, as best exemplified by Labeko Koba, the earliest Upper Paleolithic is a truly blade/bladelet-based Châtelperronian.

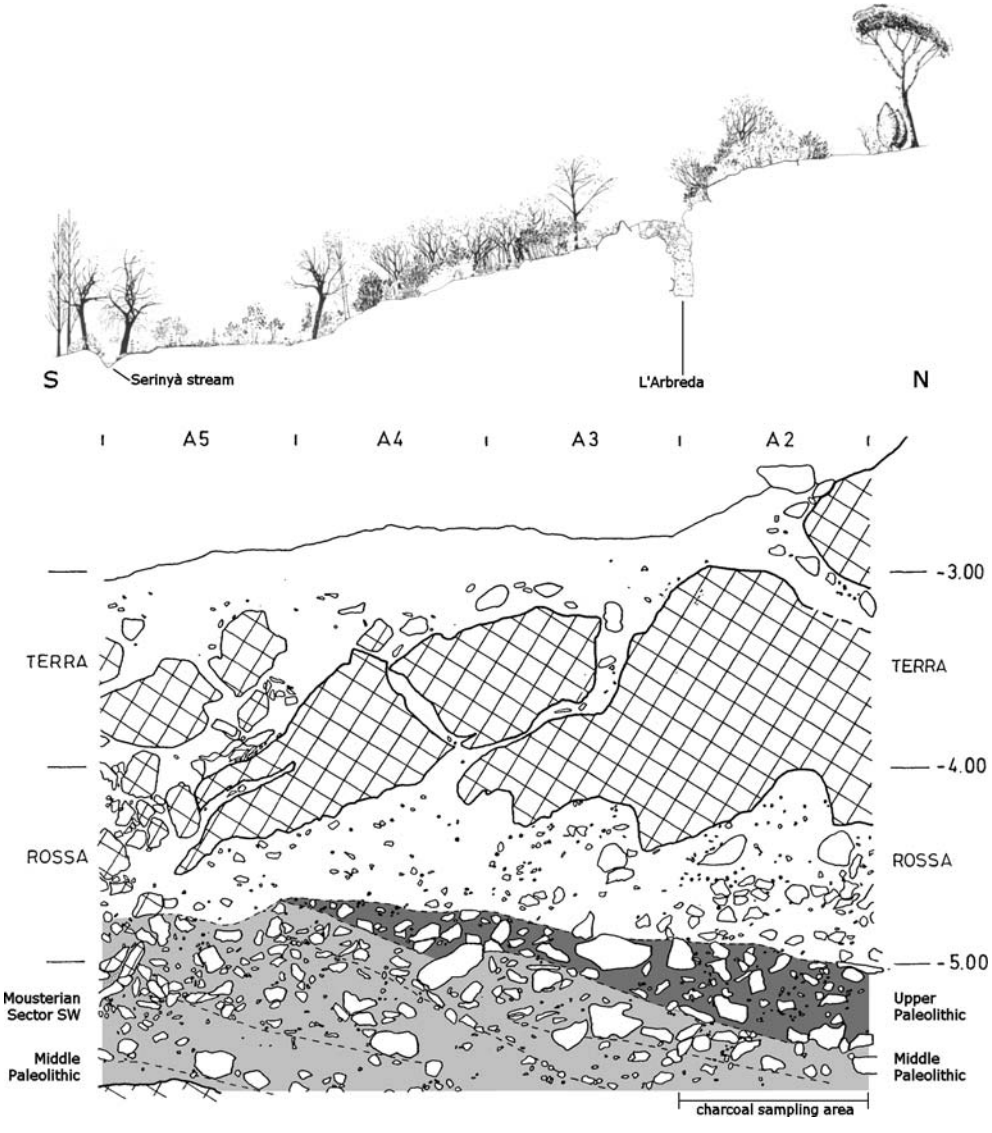

Fig. 8. L'Arbreda. Above: location in an N-S sagital profile of the Serinyà valley. Below: stratigraphy in the west profile. Note the open nature of the shelter and the slope of the deposits towards the interior area of the site whence came, in the opposite profile (3m away, at the interface between grid units D2 and E2), the AMS dated charcoal samples (after Canal and Carbonell, 1989, and Maroto, 1994, modified).

The fact that, at L'Arbreda, this succession does not form a sequence of well-separated sediment packages is due to disturbance of the deposits corresponding to the ca. 44-42 ka cal BP interval, aggravated by two facts (Bischoff *et al.*, 1989; Maroto, 1994: 185; Zilhão and d'Errico, 1999, 2003b). First, that, geologically, the Mousterian-to-Solutrean deposits of the «Upper Sequence» formed a single unit, the homogeneous clay matrix of which allowed no internal differentiation of layers or levels; second, that cave bears represent >50% of the total bone assemblage in level I, and are also present in level H, in both cases mostly by immature individuals, suggesting use of the site has a maternity den and, therefore, significant syn-depositional bioturbation.

Given this situation, and despite the marked slope of the stratigraphy, L'Arbreda had to be dug in horizontal spits, implying that at least some of the 5 cm thick excavation units inevitably cut across real stratigraphic boundaries; thus, prior to analysis, and in order to re-create the inferred stratigraphy, finds had to be sorted and grouped into perceived components (cf. Maroto, 1994). This task was facilitated by the marked contrast in raw-material procurement patterns apparent when the sets of technologically and typologically Upper Paleolithic artifacts (primarily made of flint from distant sources) were compared with Middle Paleolithic ones (primarily made of local, non-flint raw-materials). The animal bones and other ecofacts recovered from mixed excavation spits, however, are not susceptible to sorting according to such criteria; this caveat applies in particular to the charcoal, because all occurrences are of small, scattered flecks, not of material collected in hearth features (none were identified at the site). Consequently, at L'Arbreda, «level I», «level H» and «level G» can actually mean two very different things: when archeological material is dealt with, those labels stand for *post-facto* constructed sets of artifacts, judged to form coherent units of behavior on the basis of technological and raw-material attributes; where the site's geology is concerned, they stand for arbitrarily-bounded sediment slices recognized as separate «stratigraphic units» on the basis of the *post-facto* study of the extant profiles.

Apart from a broad correspondence derived from elevation criteria, there is therefore no necessary correlation between, say, «level H» as a lithic assemblage and «level H» as a band of deposits in a given profile. Moreover, as the excavators explicitly acknowledged (cf. Maroto, 1994: 185-186 and 206), the sorting approach used to define the artifact collection is inherently circular and prone to a certain degree of error. In particular, there is no reason to exclude the possibility that «level H» as a lithic assemblage is heterogeneous; besides the diagnostic Protoaurignacian material, it may conceivably include as well non-diagnostic artifacts belonging to the other EUP entity represented at the site by index fossils and which also used non-local flint, i.e., the Châtelperronian. These different meanings of the L'Arbreda «levels» also carry the implication that profile charcoal samples collected at elevations corresponding to the intersection between the vertical distributions of the sets of «level H» and «level I» artifacts are equally likely to relate to any one of the three technocomplexes represented in those sets (i.e., Mousterian, Châtelperronian and Protoaurignacian).

One must also bear in mind that all samples come from the back of the shelter, where, given the slope of the stratigraphy, sediments accumulated by progradation mechanisms,

at least in part. In the sampled profile, at the interface between the D and E rows of the grid, this slope cannot be appreciated, because, at the relevant elevation, the section is only 2 m wide. However, the opposite west profile (cf. fig. 8) clearly shows that, at the front of the shelter, the Mousterian is at a higher elevation than even the surface of the Aurignacian at the back. This topographic configuration implies that the Aurignacian levels must contain an inherited Mousterian component, particularly where small-sized flecks of charcoal are concerned. In these circumstances, one can expect three things: first, that significant age discrepancies are likely to arise from the multiplication of dating assays on charcoal samples from the back of the shelter even when the samples involved come from the same profile and were collected at the same elevation; second, that significant age discrepancies may exist between profile charcoal samples and bone samples excavated at the same elevation in adjacent squares; third, that the age of excavated samples does not necessarily vary in the same direction as the elevation at which they were collected.

The actual results obtained meet all three expectations (fig. 9): despite the difference in 25 cm between the respective collection points, the upper and lower chronological limits of the intervals of deposition of the charcoal contained in «profile level I» and in «profile level H» are broadly identical; the youngest charcoal sample actually comes from «profile level I», not from overlying «profile level H»; and the bone date from the top of «excavation level H» is older than the bone date from its base. Given that no independent chemical evidence supports the notion that the discrepancies represent contamination, all results must be accepted as valid, because, given the site's geological context, equifinality issues dictate that «external consistency» criteria cannot be used to disregard putative anomalies (except where obviously aberrant results are concerned).

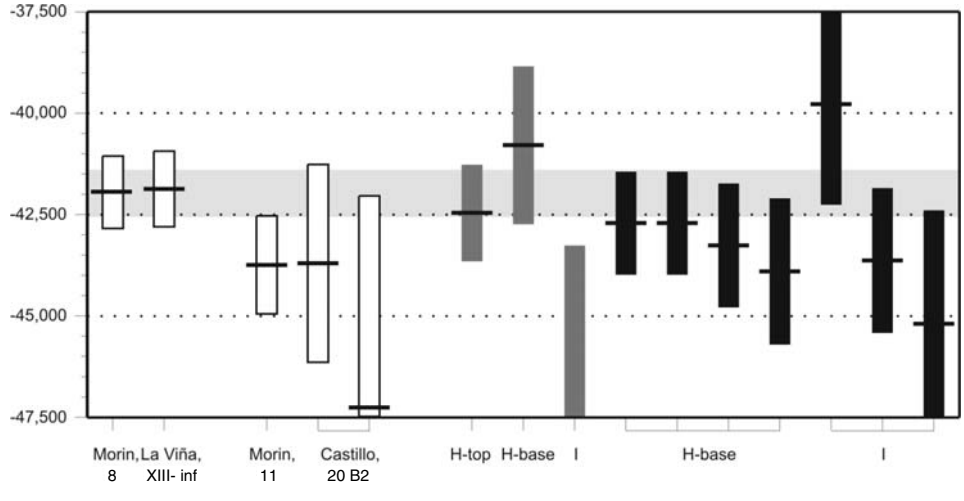

Fig. 9. L'Arbreda. Calibrated radiocarbon dates on bone (dark gray bars) and charcoal (black bars), compared with reliable results (white bars) for the latest Mousterian and the earliest Upper Paleolithic of the Cantabrian strip.

Therefore, of the 12 finite results so far obtained for L'Arbreda, only the two conventional dates of ca. 22.6 and ca. 25.8 ka ^{14}C BP can be legitimately rejected; all the others must be assumed to represent correct assessments of the samples' age. In these circumstances, all that can be said about L'Arbreda is that the H-I package of sediments located between ca. 6.25 and ca. 5 m below surface was deposited between ca. 45 and ca. 40 ka cal BP, in agreement with the magnetic susceptibility results of Harrold *et al.* (2003). This is the time interval during which unfolds, elsewhere in southwestern Europe, the Châtelperronian-to-Protoaurignacian-to-Early Aurignacian sequence, and the site's archeology and dating are consistent with the notion that northern Catalonia is a synchronous part of that process. Contra Bischoff *et al.*'s (1989) claims, based on averaging to ca. 38,500 ± 1000 ^{14}C BP (ca. 43 ka cal BP) the four charcoal results obtained for «level H», and on an unwarranted equivalence between «level H» as a profile sampling location and «level H» as the «pure», homogeneous artifact assemblage recovered in a closed context that it is not, L'Arbreda does not support an earlier emergence of the Protoaurignacian in the western Mediterranean. This conclusion is all the more warranted because, even if one were to reject the bone dates and the younger determination for level I, the calibrated results for the base of H, given their large statistical errors, significantly overlap the corresponding range obtained for La Viña and Morín.

2.6.4. Abric Romaní

With its 17 m of deposits, the Abric Romaní is arguably the major Middle Paleolithic site of Mediterranean Iberia (Vallverdú *et al.*, 2005). U-series dating of travertines sandwiching the archeological sequence of levels M to B, formed in the ca. 70-45 ka cal BP interval (Bischoff *et al.*, 1988, 1994), provides a secure *terminus post quem* for the ca. 50 cm thick EUP level A (or 2) that once capped the sequence but early twentieth-century excavations completely removed. According to Laplace and Soler, cited by Canal and Carbonell (1989: 367), the small assemblage of 44 retouched tools from this level contains six Gravette points and nine backed bladelets, as well as carinated endscrapers and retouched blades and bladelets (including the Dufour subtype of Dufour bladelets). This composition has led to suggestions that the level was a multicomponent unit containing remains from at least two Upper Paleolithic periods, Gravettian and Aurignacian.

Bischoff *et al.* (1994) collected charcoal samples from residue deposits adhering to the back wall of the shelter, at an elevation which they correlated with the original EUP deposit. The AMS results obtained are consistent with the nature of the extant artifact collection: one sample yielded a result of ca. 28 ka cal BP, in the time range of the Gravettian; one yielded a result of ca. 33 ka cal BP, in the time range of the Late Aurignacian; the other five dated to ca. 42.8-40.7 ka cal BP, in the time range of the Protoaurignacian and in good agreement with two conventional radiocarbon dates of travertine carbonates of ca. 41.1-40.6 ka cal BP, and a range of similar U-series results for the same travertine samples. These results

indicate that the model of the Transition inferred above for l'Arbreda also pertains in this more southerly location, half-way between the Pyrenees and the delta of the Ebro.

2.7. Valencia

2.7.1. Cova Negra

Cova Negra (Valencia) is a cave site with a long Middle Paleolithic sequence, beginning with basal last interglacial levels and capped by surficial reworked deposits with a rather poor, seemingly Upper Paleolithic but essentially undiagnostic assemblage. It has been suggested (Villaverde and Fumanal, 1990; Villaverde *et al.*, 1998; Villaverde, 2001), on the basis of chronostratigraphic arguments (climatic inferences derived from sediment analyses and from the composition of the micromammal bone assemblages), that the human occupations in levels IV and III-I date to the latter part of OIS-3. Dominated by sidescrapers and with low numbers of types from the Upper Paleolithic group, the corresponding lithic assemblages, however, differ little from those in the underlying levels, and present no technological indicators suggestive of a local trend towards characteristically Upper Paleolithic blade reduction strategies (Villaverde, 1984).

The late chronology suggested for these Middle Paleolithic developments is supported by a conventional radiocarbon date of ca. 33.3 ka cal BP for flowstone carbonates from the top of level V. Two other dates for similar samples only yielded minimum ages (>33 ka cal BP), which nonetheless allows restriction of the very large standard deviation associated with the finite result to the plus side of the error interval. Other attempts at dating the sequence with alternative methods (U-Th, ^{14}C on bone) were unsuccessful, but TL on sediments yielded results of ca. 50 and ca. 53 ka cal BP for level IV (Villaverde *et al.*, 1998). These results overlap in the ca. 45-33 ka cal BP interval, suggesting that is when levels V and IV accumulated, in agreement with the chronostratigraphic interpretation; however, they do not suffice to prove an age of <42 ka cal BP for the site's latest Mousterian, which remains conceivable, but unproven.

2.7.2. Cova de Mallaetes

In 1970, Fortea and Jordá (1976) excavated an area of 4 m^2 (the East Trench) in this other Valencian cave site where, underlying a well-defined Gravettian sequence (levels X-VIII), they recognized basal deposits lacking any backed items (levels XIV-XI). These deposits were in lateral stratigraphic continuity with the levels that, in 1946-1949, yielded to Pericot a few Aurignacian pieces, namely a large, flat, 22 cm long lozenge-shaped bone point typical of the Evolved Aurignacian. A charcoal sample from Fortea and Jordá's level XII, conventionally

dated to ca. 34.8 ka cal BP, is fully consistent with this diagnosis and confirms human occupation of the cave in the time range suggested by the typology of the bone tools.

2.7.3. Cova Beneito

This shallow cave located in the northern part of the province of Alicante yielded a >4 m thick Upper Pleistocene sequence excavated between 1980 and 1990 by G. Iturbe. At the bottom, archeological levels D4-D1 yielded a clearly Middle Paleolithic stone tool assemblage in a deposit accumulated under a mild and humid climate. Initial analysis (Iturbe *et al.*, 1993) suggested that, technologically, uppermost level D1 was of a transitional nature, given its richness in notches and denticulates, the relative abundance of Upper Paleolithic tool-types (endscrapers, burins, and typical perforators), the laminarity of the blanks (a blade index of 19% was reported), and the presence of a pierced lynx canine.

This assemblage had come from a test pit conducted against the back wall of the cave. In 1994, Domènech (2004, 2005) excavated the D1 unit over a much wider area, and recovered additional material. Her subsequent reanalysis of the combined assemblage rectified most aspects of the earlier diagnosis: in fact, many of the items initially classified as denticulates corresponded to Kombewa cores and to different kinds of core-trimming byproducts, and the apparent laminarity had not been assessed on the basis of technical criteria; technologically, the assemblage is actually characterized by the preferential use of Levallois reduction methods for the production of flake blanks (the metric elongation of some underlying the illusion of laminarity) and, typologically, by the predominance of different varieties of sidescrapers.

The 1994 excavation also showed that the surface of D1 was erosive, and that this level was separated from the overlying C4 level by a sterile *éboulis* with a sandy matrix. This fact seemingly precluded explanations of the Upper Paleolithic stone tool types and tooth pendant in level D1 of the test pit as post-depositional vertical movement from an *in situ* Aurignacian occupation immediately above. However, in 1999, further profile work carried out in the area of the test pit showed that, in this part of the site, the entire sequence of C5-C1 levels found on top of the basal Mousterian was in derived position; Middle Paleolithic artifacts were recovered at the interface between C1 and the overlying B9-B1 package of deposits (Domènech, 2005), whereas Upper Paleolithic, cf. Aurignacian material had been reported by Iturbe *et al.* (1993) from C4, >70 cm deeper. In retrospect, therefore, Villaverde *et al.*'s (1998) cautionary questioning of the putative transitional nature of D1, based on the stratigraphic observations that «the deposits slope toward the cavity's interior, where the deep sondage that reached the Middle Paleolithic levels is located», and that «exterior slope deposits could have been redeposited in the back of the cave by colluvial processes or mass wasting», seems to have been entirely justified.

Thus, it is quite likely that, in the confined space of the 1980-1990 sondage, and as a result of the occurrence of the processes discussed above, the excavators could not carry

out an accurate separation between the C and D packages and, accordingly, may have ended up assigning to D1 material that actually belonged in the overlying, disturbed deposits (such as the pierced lynx canine); by the same token, one must also hypothesize that the separation between B and C must have been equally fuzzy. Moreover, significant percolation and post-depositional vertical migration of small-sized particles was facilitated, where the test pit is concerned, by the fact that, in this sector of the cave, against the wall, the deposits corresponded to an accumulation of blocks with little fine sediment and numerous voids. Such a lack of clear boundaries between the C package and the geological units under- and overlying it provides in any case a reasonable explanation for the complete stratigraphic incoherence of the dates obtained for all samples collected between D1 and B8 (fig. 10).

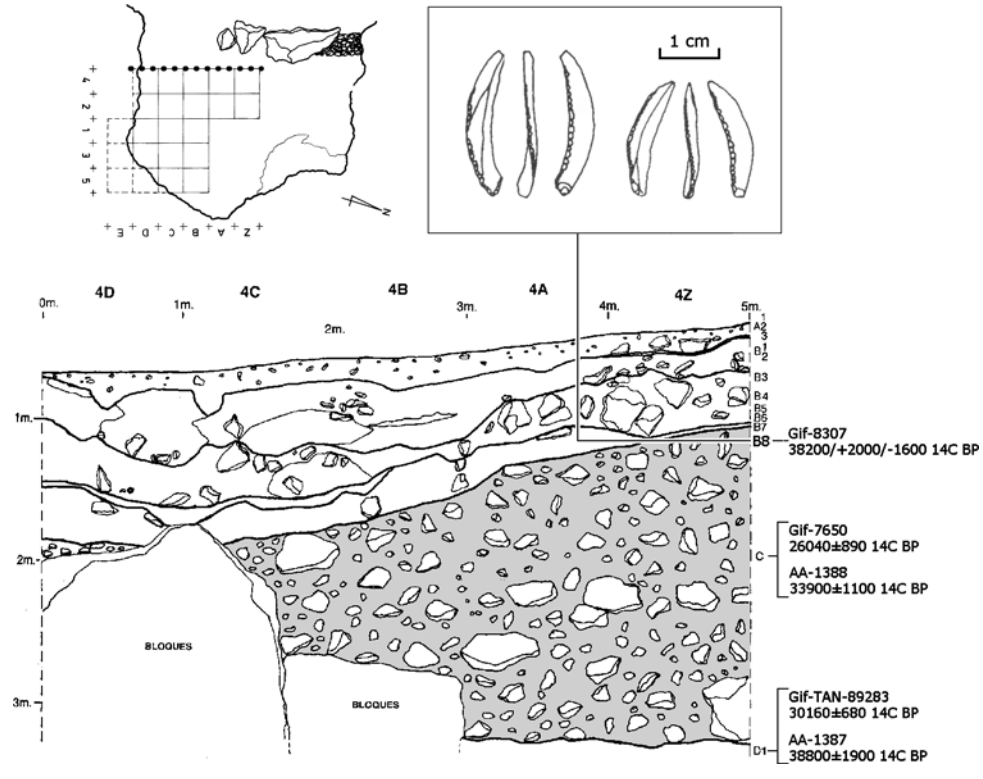

Fig. 10. Beneito (after Iturbe *et al*., 1993, modified): stratigraphic profile and radiometric ages for the B8-D1 deposits. Note the slope of the deposits towards the interior, as well as the coarse and open-textured nature of unit C, which contained charcoal and artifacts of very different ages. The abundant Roc-de-Combe bladelets from B8-B9, at the base of a Gravettian sequence, indicate an Evolved Aurignacian use of the site, separated from the Late Mousterian in unit D by a long hiatus during which significant post-depositional disturbance occurred.

In fact, even if the anomalous AMS result of ca. 25 ka ^{14}C BP for a charcoal sample from D3 is conceivably related to undetected contamination of a small, very old sample, possibly at the limit of applicability of the method, and even if the conventional result of ca. 26 ka ^{14}C BP for C4 could well be an artifact of the inadequate nature of the sample (a mix of charcoal and sediments), the near 8000 years that separate the two AMS charcoal results for D1 seem difficult to explain in the same vein. The conclusion seems inescapable, therefore, that D1 did indeed contain charcoal of very different ages, in agreement with the fact that, archeologically, it yielded a few Upper Paleolithic stone tool types among an otherwise clearly Middle Paleolithic assemblage. At the opposite boundary of the C package, a similar discrepancy exists, with the conventional charcoal result obtained for the base of B8, from a sample collected at an elevation of -2.62 m, being 4000 years older than the AMS charcoal result obtained for C4, from a sample collected at -3.33 m.

The implication of the above is that none of these results is of any use in assessing the age of the different industrial components represented in the D, C and B9-B8 levels of Beneito, which, therefore, should be considered simply as not dated. However, the fact that a Gravettian level (B7) separated a rather complete Solutrean sequence (B6-B1) from the assemblage found in the B9-B8 levels lends credence to the diagnosis of the assemblage contained in the latter as Aurignacian (more specifically, Evolved Aurignacian, given the presence of characteristic Roc-de-Combe bladelets made on small, twisted blanks).

2.7.4. Cova Foradada

Casabó (2001) reports Aurignacian deposits in this coastal cave site of Alicante. The lithic assemblage remains undescribed at the time of writing, but its association with several AMS charcoal dates in the ca. 35-31 ka cal BP range warrants the diagnosis. These levels also yielded human remains (Arsuaga *et al.*, 2001), but the material comes in its entirety from Sector II of the site, where the Aurignacian deposit (level II) underlies later prehistoric levels. Given the small size of the skeletal elements recovered, and the fact that human remains are far more abundant in immediately overlying level I (eighteen, against four in level II), the possibility that these putative Aurignacian fossils are intrusive cannot be excluded at present.

2.8. Murcia

The Sima de las Palomas is a vertical shaft located in the Cabezo Gordo, a small but prominent hill rising in the coast plain of Murcia and overlooking the large Mar Menor lagoon. It contains a variably brecciated sediment fill, largely removed by nineteenth-century miners looking for water; this work exposed an 18 m deep stratigraphic column preserved

against the rear wall of the shaft, and left a significant volume of rubble at its bottom. Neandertal fossils (now totaling over a hundred) were first recovered at the site in 1991, when a local amateur extracted from the upper part of the column a cemented block containing one mandible and one maxilla. More material would subsequently be found in the mine rubble and in the systematic excavations carried out at the site since 1993 (Walker, 2001; Walker *et al.*, 2004a, 2004b).

The archeological work affected the upper 2 m of the sediment column; the lithic assemblage contained therein, which so far has been the object of preliminary publication only, is entirely Middle Paleolithic in nature. At the bottom of the excavated area, additional, *in situ* Neandertal material has been recovered. One piece in particular —the left side of an adolescent Neandertal mandible— was found cemented to a burnt animal bone fragment, whence a sample extracted for radiocarbon dating yielded an age of ca. 38.6 ka cal BP. Previously, a U-Th result indicating a maximum age of 56 ka cal BP had been obtained on calcite sampled from deposits exposed 0.5 m deeper in the sediment column (Sánchez-Cabeza *et al.*, 1999). In spite of its large standard deviation (+13,000/-10,000), this U-Th result provides a *terminus post quem* for the mandible that is fully consistent with the associated ^{14}C date. Both concur, therefore, to support the notion that the 2 m of Middle Paleolithic deposits overlying the dated levels document the survival of the Middle Paleolithic in this part of Iberia until well beyond the thirty-ninth millennium cal BP.

2.9. Andalucía

2.9.1. Carihuela

At about the same time a similar notion was being proposed for Cova Negra, Vega *et al.* (1988) and Vega (1990, 1993) argued that the 6 m deep stratigraphic sequence that J.-Ch. Spahni excavated in 1954-1955 at the Cueva de la Carihuela (Granada) documented a late survival of the Middle Paleolithic in southern Iberia. More than one hundred individual levels were recognized in this sequence, grouped into 12 major stratigraphic units, correlated with the marine record on the basis of paleoclimatic proxies (sediments, pollen, micromammals) (Carrión *et al.*, 1998). The keystone of this scheme is the link established between Unit VI and the middle part of OIS-3, which then allows the placement in OIS-2 of the upper levels of Unit V and of the whole of Unit IV, both containing Mousterian industries throughout: in Bordesian terms, a Typical Mousterian in most of Unit V, which is capped by a Denticulate Mousterian, followed, in Unit IV, by generalized Middle Paleolithic assemblages that cannot be securely reduced to any of Bordes's variants.

These suggestions are consistent with a radiocarbon date of ca. 48 ka cal BP obtained for the lowermost part of Unit VI (Carrión *et al.*, 1998). A number of TL dates on burnt flints also exist, but these are experimental results obtained early in the history of the method,

and the exact stratigraphic provenience of the samples is often uncertain; hence, they will not be considered here. Given the lack of reliable chronometric determinations for the critical stretch of the sequence, the upper limit of the time interval during which took place the human uses of the cave recorded in Unit IV is at present impossible to assess. Because of the millennial scale variability of OIS-3 climate and the several erosive scars observed throughout the sequence, inferences derived from paleoclimate cannot be of help here. For instance, Carrión *et al.* suggest that pollen zones N-M, in Unit V, correspond to the maximum of the Upper Pleniglacial, on the basis of the nature of the sediments (a thermoclastic scree), indicative of relatively cold and arid conditions, corroborated by the microfaunal (presence of *Microtus arvalis*) and pollen (*Artemisia* steppe) records. Given the chronology of the base of Unit VI, it seems rather more likely, however, that the episode of development of carbonate concretions recorded in the middle part of Unit V relates to GIS-12, a period of marked climatic amelioration observed in the Greenland ice cores ca. 45.5 ka cal BP. In this scenario, Unit V could then relate to any of the numerous cold spells recorded in those cores until GIS-8, which peaks ca. 38.5 ka cal BP. In sum, depending on how the accordion of levels is stretched, the end of the Carihuela Mousterian in Unit IV can be placed as late as post-LGM times, or as early as GIS-11 (ca. 43-42 ka cal BP).

Thus, as in Cova Negra, a perduration of the Carihuela Mousterian beyond 42 ka cal BP is conceivable, but remains undemonstrated. A separate issue is that of the putative association of modern human remains with the site's Late Mousterian lithic assemblages. Such suggestions were critically re-evaluated by Vega (1993), who showed that the levels where Spahni recovered those remains corresponded to the upper part of Unit IV, above a stalagmitic crust clearly separating it from the underlying Mousterian sequence, and that their artifact component, very poor in both number and preservation, suggested that the deposits had been displaced from an area closer to the original entrance. The only *in situ* and diagnostic human remains recovered at Carihuela are the tibia and the cranial fragments of Neandertal affinities recovered in Units VI and V.

2.9.2. Cueva de Zafarraya

Throughout the 1990s, the strongest basis for the association of a delayed southern Iberian Mousterian with a survival of Neandertals in the region until much later than elsewhere in Europe was the evidence provided by the cave of Zafarraya, a mountain site located at the boundary between the Málaga and Granada provinces. Hublin *et al.* (1995) published conventional bone dates for Mousterian levels I3-I7 and I8 placing their deposition between ca. 35 and ca. 37 ka cal BP; these dates were independently supported by a couple of similar U-Th results on ibex teeth with large errors. A complete Neandertal mandible was recovered in immediately underlying level D, for which a single, stratigraphically consistent U-Th determination (also on ibex tooth material) indicated an interval of deposition comprised between ca. 37.4 and ca. 29.4 ka cal BP.

An extensive project to date the site's sequence with a battery of different methods is reported by Michel *et al.* (2003); their results shed doubts on the reliability of U-Th at the site because of low uranium content, leading to many instances of lack of correlation between calculated age and stratigraphic depth. ESR dating of tooth enamel yielded more encouraging results for samples between 133 and 171 cm below datum, placing them between ca. 40 ka and ca. 33 cal BP; the standard deviations, however, are very large, and, hence, the results are of little use in setting a *terminus ante quem* for the mandible, recovered in two halves at 193 and 198 cm below datum. AMS dating of charcoal samples was also attempted in the framework of the same project, but the results are equally problematic because most samples were collected in a disturbed section of the profile; those samples are not included in table 1 and need not be the object of further discussion. Of the two charcoal samples that come from the area of the cave where the mandible was found, one yielded a result of 36.2 ka cal BP (OxA-7120), but the other (at ca. 15 ka ^{14}C BP) was clearly intrusive. Finally, two horse tooth samples from that same area but collected ca. 20 cm above the human mandible yielded AMS radiocarbon ages of ca. 31 and ca. 35 ka cal BP. Thus, in spite of the stratigraphic problems, the weight of the evidence is clearly in favor of an age somewhere between 35 and 40 ka cal BP for the uppermost Mousterian of Zafarraya, similar to that obtained for Cabezo Gordo. Whether the Neandertal mandible was *in situ* or derived from lower, older levels, however, cannot be appreciated at present; given the problematic nature of the site, it is apparent that establishing the age of the specimen will require direct dating.

Still, the late chronology of the uppermost Mousterian levels does provide a *terminus post quem* for the small collection of Dufour bladelets of the Dufour subtype found intrusive therein. Barroso *et al.* (2003) suggest that these items are related to an occupation of the cave dating to the Protoaurignacian *sensu strictu*, but, given the chronostratigraphic data reviewed above, this can hardly be the case. As documented in France by level 6 of the Pataud rockshelter, and corroborated by the Portuguese evidence (see below), that subtype reappears in the Late Aurignacian; thus, together with a few other items that clearly are both Upper Paleolithic and intrusive, the Zafarraya Dufours document an use of the cave at the end of the Aurignacian sequence, not during the Protoaurignacian, at which time the site was still being used by Mousterian people.

2.9.3. La Araña (Complejo del Humo)

The small town of La Araña, in the outskirts of Málaga, features an important cluster of major prehistoric sites, among which three localities in the Complejo del Humo are potentially of great importance for the study of the Middle-to-Upper Paleolithic transition because they contain long stratigraphic sequences spanning the relevant time interval: the Cueva del Humo, the Abrigo 3 and Abrigo 4 (the latter two corresponding in fact to the bottom ends of karstic chambers exposed by erosion and road cutting) (Ramos and Durán, 1998;

Ferré *et al.*, 2004; Ramos *et al.*, 2005). At the Abrigo 3, the stratigraphic patterns, coupled with preliminary TL dates on the thick stalagmitic crusts that divide the fill into well differentiated packages, indicate a survival of the Middle Paleolithic beyond ca. 35 ka cal BP (Ramos, n.d.). The deposits in question are rather rich in characteristic lithic assemblages, and document a systematic exploitation of marine resources (simple visual inspection of the profiles suffices to diagnose many of the levels as true shell-middens, the dominant taxon being *Mytilus* sp., often represented by quite large specimens); among the mammals, rabbits predominate in a assemblage that also comprises ibex, red deer and aurochs, as well as rare remains of lynx and wild cat that, with the humans, could have been the accumulators of the abundant lagomorph remains.

2.9.4. Cueva Bajondillo

Bajondillo cave is a rockshelter located at the western end of the Bay of Málaga, within eyesight of the Complejo del Humo. It also features a Middle-to-Upper Paleolithic sequence (Cortés and Simón, 1997, 1998, 2001; Cortés, 2003, 2005; Cortés *et al.*, 2005), but its urban setting in the town of Torremolinos has limited access for research purposes. Two rescue operations, in 1989 and 2000, enabled the recuperation of artifact assemblages, a stratigraphic description of the deposits containing them, and sampling of the levels for chronometric dating.

The maximum thickness of the sequence is 5.4 m, but the levels of concern here correspond to a ca. 50 cm package in the lower half of the sequence (fig. 11). Level 14 is a 20 cm thick yellowish horizon which yielded a Middle Paleolithic assemblage characterized by Levallois and discoidal reduction schemes; typologically, it is dominated by notches and denticulates, which comprise nearly 40% of the formal tool assemblage. Level 11 is a darker horizon which yielded a lithic assemblage featuring thick-nosed «scrapers» and Dufour bladelets of the Roc-de-Combe subtype, i.e., of Evolved Aurignacian affinities. In the southern part of the excavated area, the two levels are in direct contact, but in the central area they are separated by discontinuous lenses of reddish deposits (levels 12 and 13), very poor in artifacts (some 400 pieces only) and featuring a mix of Mousterian and Upper Paleolithic items. Cortés *et al.* (2005) emphasize that the lithics in these localized, stratigraphically intermediate levels are a combination of different components, not a homogeneous, «mosaic», «transitional» assemblage upon which to sustain notions of a local development of the Aurignacian in level 11 out of a putative directly ancestral technology locally represented by level 14.

At Beneito, it could eventually be recognized that a similar mix related to the occurrence of post-depositional processes, and a similar explanation must pertain at Bajondillo, where the main profile quite clearly shows that 1) the contact between levels 14 and 11 in the southern part of the site is erosive, and displays a significant slope from the southern to the central and northern parts of the excavated area, and 2) the sequence of levels

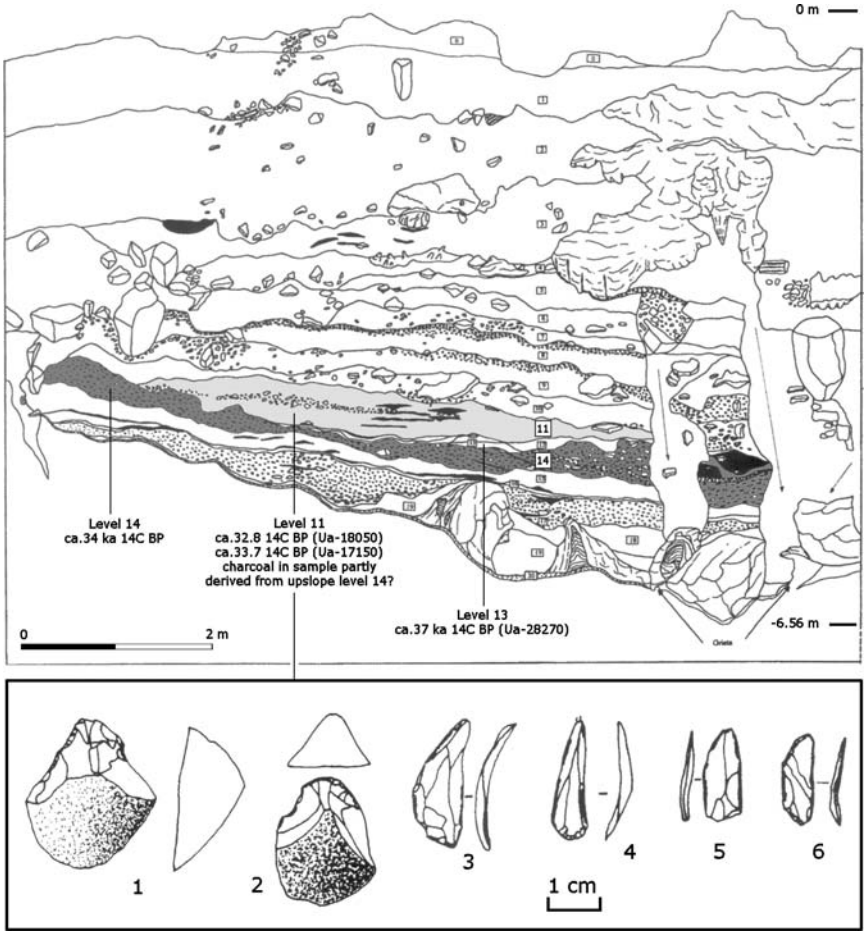

Fig. 11. Bajondillo (after Cortés and Simón, 1997, and Cortés *et al.*, 2005). Above: stratigraphy of the west profile as recorded in 2000, with indication of the critical levels for the Transition; note the topography of the deposits and that, except where intervening mixed units (levels 12-13) have been recognized, level 11 (light gray) directly overlies level 14 (dark gray); in this context, it is quite possible that the radiocarbon dates for level 11 reflect the presence in the samples of inherited Mousterian charcoal. Below: level 11 lithics (1-2. Thick-nosed «scrapers»; 3-6. Roc-de-Combe bladelets).

13 to 11 corresponds to the fill of the erosive depression formed in the previously accumulated Mousterian deposits (as shown by the thinning out of Aurignacian level 11 towards the southern end of the profile, where Mousterian level 14 is directly overlain by Gravettian level 10). In this context, progradation mechanisms must have been involved in the build-up of levels 13-11 and, hence, it is to be expected that such levels contain material derived from the underlying Middle Paleolithic.

That this inference applies not only to the artifact but also to the charcoal component of the deposits is indicated by the AMS results reported by Cortés (2005: table 2) and Cortés *et al.* (2005: fig. 5) for levels 13 and 14: 37,005 ± 1790 ^{14}C BP (i.e., ca. 41.6 ka cal BP), and ca. 34 ka ^{14}C BP (i.e., ca. 39.5 ka cal BP), respectively. No further details are given, but this information suffices to make two facts clear: that the results for levels 13 and 14 are stratigraphically reversed, and that, in spite of the marked stratigraphic discontinuity separating them, the result for level 14 is identical to those in the ca. 39-38 ka cal BP range obtained for level 11. Thus, although, at face value, the dates for level 11 argue for a penetration of the Aurignacian into southwestern Iberia well before the chronological horizon postulated by the Ebro frontier model, the broader stratigraphic context shadows considerable doubt on their reliability.

In any case, at the upper end of their two sigma interval, the dates for Bajondillo level 11 overlap those for the earliest Upper Paleolithic of Valencia, Alicante and Gibraltar (fig. 12); the greater antiquity apparent when only the mid-points of the age ranges are used may thus be a simple artifact of the large statistical errors, compounded by the ca. 33 ka ^{14}C BP calibration plateau. It must be further stressed that, besides methodologically unsound, the use of the mid-points also generates a contradiction between radiocarbon and TL at the site; ignoring the standard deviations, the mid-points obtained with the latter method would in fact place the accumulation of the level some ten millennia after the

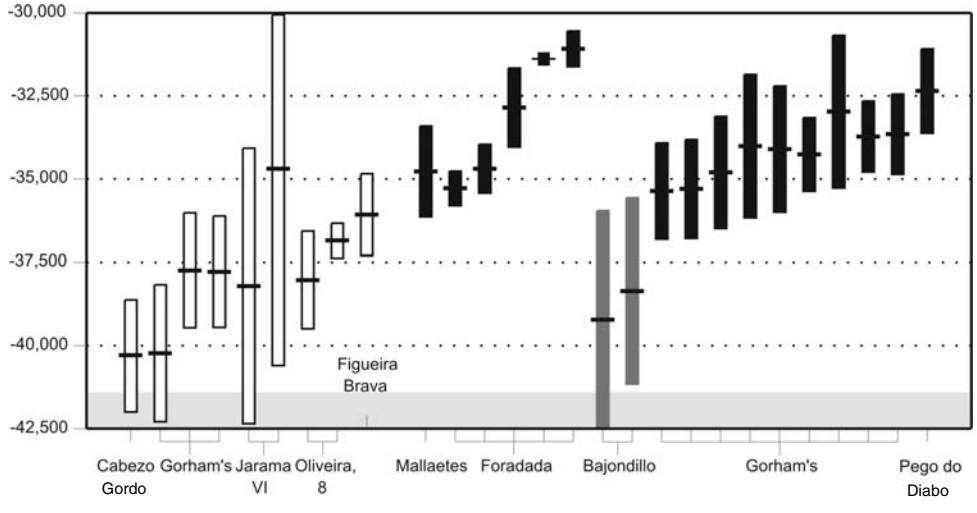

Fig. 12. Bajondillo. Two sigma ranges of calibrated radiocarbon dates (dark gray bars), compared with the dates for the earliest Upper Paleolithic (black bars) and the latest Mousterian (white bars) south of the Ebro basin. The persistence of the Mousterian after ca. 42 ka cal BP is clear, and its replacement by the Evolved Aurignacian seemingly takes place some seven millennia later; note that, in the upper range of their large error interval, the Bajondillo results overlap the replacement horizon, and that their mid-points are significantly earlier than any known occurrences of the Evolved Aurignacian elsewhere in Europe.

range indicated by the mid-points yielded by radiocarbon. Finally, the lithic assemblage is very characteristic and, elsewhere in Spain and France, no occurrences of the «thick-nosed "scraper" *cum* Roc-de-Combe bladelets» assemblage-type are known before ca. 37 ka cal BP; thus, it is rather unlikely that such kinds of assemblages were already in existence in the Torremolinos area some two millennia earlier.

The anomalous radiocarbon results obtained for level 11 must therefore relate to major contamination by older material. The samples are reported to come from combustion features described as darkened *cuvettes* laying on whitish deposits and reddened cobbles, and to have been obtained from areas no more than a few millimeters thick and of only ca. 5 cm in diameter (Cortés *et al.*, 2005). This provenience decreases the probability of a spurious stratigraphical association, but the features appear to have been identified in the profiles, not during surface excavation; thus, there is reason to question whether they really are *in situ* fire areas, and whether the charcoal contained therein relates indeed to a single firing event. In light of the fact that progradation processes were involved in the formation of level 11, it is in fact striking that, under the laws of radiocarbon decay, a result of ca. 33 ka ^{14}C BP can be obtained for a sample that should date in the ca. 30 ka ^{14}C BP range (as one would expect for an Evolved Aurignacian context), if 80% of that sample is made up of material with an age of 34,000 radiocarbon years; put another way, the results for level 11 may simply indicate that the charcoal in the samples was for the most part derived from level 14. A variant of the contamination argument involves a contribution from bedrock. This problem tends to be of significance only in the direct dating of rock art pigments (cf. Fortea, 2000-2001) but, because of the nature of the level 11 samples («sediments and charcoal»), must be of concern at Bajondillo, where the fill is made up of detritical material eroded from the late Middle Pleistocene travertines into which the shelter is excavated; in fact, 30% of carbon with an age of 200,000 years mixed in a bulk sample otherwise made up of material with an age of ca. 30,000 years suffices to bring the measured result down to ca. 33 ka ^{14}C BP.

Given the above, it is only fair to conclude that the age of the Bajondillo Aurignacian remains uncertain. The site suggests that, as shown for the Alicante coast by Beneito, the earliest Upper Paleolithic occupation of southern Andalucía was by people with an Evolved Aurignacian technology. But, at both sites, the Middle/Upper Paleolithic interface is fuzzy and post-depositionally disturbed, and great caution must be in order when interpreting the archeological association and significance of their radiocarbon dates. With current evidence, use of these sites to counter well-established patterns derived from more secure contexts is unwarranted.

2.10. Gibraltar

Waechter's 1951-54 excavations at Gorham's cave, a site located at Governor's Beach, on the eastern side of the Rock of Gibraltar, exposed a stratigraphic sequence spanning some 100,000 years and largely composed of eolian deposits accumulated over a last interglacial marine terrace. Ongoing research (Vega, 1993; Barton *et al.*, 1999; Pettitt and Bailey, 2000; Pettitt *et al.*, 2002) has provided further insights and refined the chronological evidence produced in the framework of Waechter's excavations (fig. 13).

The upper deposits from the time of the Transition were identified as layer D by Waechter, who described them as featuring a combustion area at the base, and as containing abundant flint flakes, bones and shells; although lacking in diagnostic stone tools, the artifacts were Aurignacian-like, as independently corroborated by conventional radiocarbon dates in the ca. 34-32 ka cal BP interval. This layer corresponds to Context 9 of the recent excavations, whence several AMS radiocarbon determinations produced a series of statistically identical results. Thus, it is clear that the earliest Upper Paleolithic occupations of Gorham's took place in the transition from the 36th to the 35th millennium cal BP (cf. fig. 12). At the other end of the Transition interval, Waechter's Mousterian layer G was also very rich in flints, bone and shell, and yielded conventional radiocarbon dates in the 53-51 ka cal BP range; stratigraphically, it correlates well with Context 22 of the new excavations, whence two AMS results on charcoal samples replicate the conventional ones.

According to Waechter, a sterile deposit, layer E, was found under D, and a poor, *sensu lato* Upper Paleolithic existed in layer F. These units probably correspond, respectively, to Contexts 11 and 13a of the new excavations; the former was equally found to be sterile, whereas the latter yielded an AMS radiocarbon date on burnt bone identical to those for Context 9. In the main area of the new excavations, securely Middle Paleolithic human activity was found between Waechter's layers F and G, in Contexts 19 and 18, AMS dated to between ca. 50 and ca. 46 ka cal BP. A hearth remnant at the contact between Context 18 and 16 designated as Context 24 yielded a result of ca. 37.7 ka cal BP, but the only conceivably associated piece of archeology is a quartzite denticulate found more than one meter away in otherwise sterile sands. Still, this find is consistent with interpretations of that result as dating the latest Middle Paleolithic activity at the site, an inference that is further corroborated by two results in the same time range obtained from test trenches further inside the cave, where, according to Pettitt *et al.* (2002), the dated charcoal samples (OxA-10295 and OxA-10230; cf. table 1 and fig. 12) were clearly associated with Mousterian artifacts.

Two main conclusions can be drawn from the above review: first, that the chronometric indications of a perduration of the Middle Paleolithic in southern Iberia well beyond ca. 42 ka cal BP derived from sites in Andalucía and Murcia are confirmed by the evidence from Gibraltar; second, that, at Gorham's, a major hiatus (erosional or depositional) seems to exist in the period between ca. 48 and ca. 38 ka cal BP, at least in the excavated areas. The processes of soft sediment loading distortion affecting the sandy deposits of Contexts

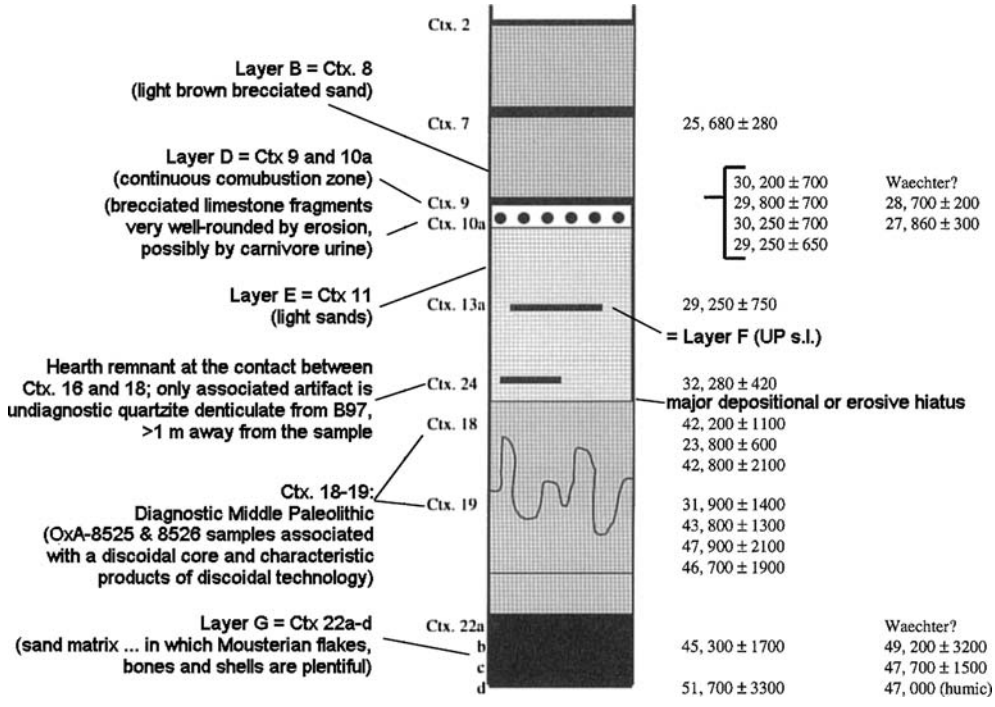

Fig. 13. Gorham's. Correlation between Waechter's layers and the stratigraphy in the main area of the new excavations (after Pettitt and Bailey, 2000, modified).

19 and 18 probably relate to that hiatus and explain well, as discussed by Pettitt *et al.* (2000), the intrusion of later charcoal responsible for the couple of anomalous results obtained for these contexts on samples of small, isolated lumps of charcoal. In the Greenland ice core sequence, this interval is one of marked instability, and it is thus difficult to correlate the geological events responsible for this long hiatus with any of the different stadial and interstadial episodes recorded therein.

Although no detailed analyses of the archeological finds have yet been published, Pettitt and Bailey (2000) indicate that discoidal methods were the most common throughout the different units of Context 22, where chert dominates and retouched tools are rare; in the new excavations, a Levallois product was recovered at the base of this Context, and Waechter had recovered a «tortoise» core from his layer G, which also featured a number of Levallois, often laminar blanks. These data, however, do not suffice to reduce the assemblages to any of the Bordesian variants of the Mousterian. Of particular significance is the regular exploitation of marine resources recorded in the Gibraltar caves throughout the Middle Paleolithic (as best exemplified in the adjacent Vanguard Cave by the «mussel hearth» context, situated beneath Units 53-55, AMS radiocarbon dated to >50 ka cal BP

—Barton *et al.*, 1999). At Gorham's itself, besides the abundant shellfish remains mentioned above, the Mousterian levels also contained bones of seal (*Monachus monachus* and *Halichoerus grypus*) and great auk (*Alca impennis*) (Serangeli, 2001).

2.11. The Mesetas

In interior Iberia, the Aurignacian is still unknown. Of particular significance is the fact that systematic survey and excavation work carried out over the last decade in the Côa valley to establish the archeological context of its open air Paleolithic rock art detected Mousterian and early Gravettian occurrences, but has so far failed to find any Aurignacian sites (Zilhão *et al.*, 1997; Aubry 2001, 2002; Aubry *et al.*, 2002; Mercier *et al.*, 2001; Valladas *et al.*, 2001).

A rather late AMS bone date of ca. 31 ka ^{14}C BP (i.e., ca. 36 ka cal BP) is reported for Mousterian level 5a of the cave site of La Ermita (Burgos), but the dating lab explicitly considered this result to be a minimum age only, because of poor collagen preservation (Moure, 1997). Thus, the only truly Late Mousterian context in these regions seems at present to be that in level 2 of the Jarama VI cave (Guadalajara) (García, 1997; Jordá, 2001). This level, 20 to 160 cm thick, featured a sparse faunal and lithic component organized around a small hearth and, in its uppermost part, consisted of fluviatile silts accumulated during a period of wet climate in the framework of low-energy flooding of the cave by the Jarama river. The underlying level 3 is a sandy deposit, 5 to 60 cm thick and predominantly formed through the degradation of the limestone walls of the cave under cold and humid conditions. The sequence is capped by level 1, 20 to 50 cm thick, for the most part accumulated through gelifraction of the cave walls, and containing blade and bladelet blanks suggestive of an early Upper Paleolithic age. In Middle Paleolithic levels 2 and 3, complete reduction sequences are represented, and quartz is the preferred raw-material; formal tool-types include points, sidescrapers, notches and denticulates, but most blanks remained unretouched. Where level 2 is concerned, the fauna is composed of rabbit, chamois and red deer, and an anthropic role in its accumulation is documented by cut-marked bones, but carnivore-inflicted damage also exists, corroborating suggestions derived from the reduced number of artifacts (by comparison with levels 1 and 3) that, at this time, the site was only sporadically used by humans.

Radiocarbon dating of the Jarama VI sequence yielded three AMS charcoal results in stratigraphic order, and placing the occupation at the top of level 2 in the ca. 38-35 ka cal BP range. In the Greenland record, this interval corresponds to a long stretch of ameliorated climatic conditions consistent with the environmental inferences derived from the geological features of the deposit.

2.12. Portugal

2.12.1. Foz do Enxarrique

Discovered in 1982 and located at Vila Velha de Ródão, across the border from Spain, Foz do Enxarrique is an open air site contained in fluviatile deposits accumulated by the Tagus river that has been excavated over an area of ca. 150 m^2 (Raposo *et al.*, 1985). As suggested by the available U-Th date of 33,600 ± 500 cal BP (average of three horse tooth enamel samples; Brugal and Raposo, 1999), these lateral inundations probably reflect the same kinds of climatic conditions responsible for the formation of level 2 of Jarama VI. The faunal assemblage is heavily herbivore-dominated, and includes horse, red deer, aurochs, rhino and elephant; although the bones of the larger species (elephant and rhino) and of the few carnivores may represent natural transport and accumulation, the remaining material (>90% of the total) features cut-marking and burning, especially of red deer bones. These observations suggest that humans were at least in part involved in the accumulation, but even if the fauna were entirely of non-anthropic origin, its geological association with the lithic assemblage is unquestionable and, therefore (contra Jöris *et al.*, 2003), the U-Th date provides indeed a stratigraphically reliable assessment of the chronology of the human behavior represented by the >10,000 artifacts recovered. Regrettably, this abundant and characteristic Middle Paleolithic assemblage has not yet been published in detail; preliminary reports (Raposo, 1995) refer the use of both discoidal and Levallois reduction schemes to exploit locally available quartzite cobbles, as well as the scarcity of retouched pieces.

2.12.2. Lapa dos Furos

Lapa dos Furos is a small, two-entrance cave site located in a steep valley opening into the left side of the canyon cut by the Nabão river ca. 7 km north of the city of Tomar. In 1987-1988, testing at one of these entrances, which had been completely sealed by the accumulation of sediments, revealed a 2.7 m deep stratigraphic sequence containing Pleistocene faunal material underneath disturbed levels with pottery and other artifacts of Holocene age (Zilhão, 1997). The uppermost unit with no such intrusions was level 3, which yielded a very poor lithic assemblage featuring a single diagnostic item, a notch made on a blank produced in the framework of a Levallois reduction scheme; underlying level 4 was sterile, but yielded remains of red deer and abundant *Cepaea nemoralis* shells. A sample of the latter, carefully selected on the basis of their pristine condition, was dated to ca. 40 ka cal BP, providing a *terminus post quem* for the few Middle Paleolithic artifacts in overlying level 3, which also contained significant amounts of such shells. Given the nature of the sample, a reservoir effect must be considered; thus, the result for level 4 is consistent with a GIS-8 age and, hence, with the ecology of this species, well adapted to insolated, moderately forested areas (Callapez, 1999).

2.12.3. Gruta do Caldeirão

A few kilometers downstream from Lapa dos Furos, on a valley opening to the opposite side of the canyon of the Nabão, the Gruta do Caldeirão, excavated between 1979 and 1988, yielded a >6 m deep stratigraphic sequence spanning the interval between the Middle Paleolithic and the recent Holocene (Zilhão, 1992, 1997; Ellwood *et al.*, 1998, 2001; Callapez, 2002, 2003; Chauvière, 2002; Davis, 2002). Capping the >1m of excavated basal Mousterian deposits, level K (with an average thickness of 45 cm) yielded a poor but industrially unambiguous lithic assemblage (98 items, of which 39 were chippage, over an area of ca. 3 m^2), where quartzite and quartz are the predominant raw-materials; the formal tools include sidescrapers, notches and denticulates. Immediately overlying level Jb, excavated over ca. 4.7 m^2, was on average ca. 22 cm thick and yielded an equally poor lithic assemblage (63 objects, of which 19 are debris) containing clearly Upper Paleolithic items, namely a few blades and bladelets; two marine shell ornaments (an *Aporrhais pespelecani* and a *Semicassis saburon*) were found at the base of the level, in direct contact with the surface of level K, and a third (a *Littorina obtusata*) was found slightly above (fig. 14).

Of four bone samples from level K submitted to AMS dating, only one yielded a finite result, of ca. 32.4 ka cal BP; because of low collagen content or low carbon yield, the other are minimum ages only. That level K result is consistent with those for the overlying sequence of EUP and Solutrean deposits in levels Jb to Fa, which are themselves in correct stratigraphic order and, hence, there is no apparent reason to disregard it. However, the fact that all other attempts at dating level K failed needs to be considered against the fact that all samples from Upper Paleolithic levels were successful, which suggests that quite different collagen preservation patterns pertain in the sequence when the interface between level Jb and level K is crossed. Given that there is no chemical reason to suspect rejuvenation via residual contamination, and considering the widespread situations of disturbance that seem to characterize the Middle/Upper Paleolithic interface in most cave sites of southern and western Iberia, one must entertain the hypothesis that the K sample dated to ca. 32.4 ka cal BP, collected only a few centimeters below the stratigraphic interface, is in fact intrusive from overlying level Jb, dated to ca. 30.8 ka cal BP on a sample collected half-way through its thickness.

In any case, whether rejuvenated or intrusive, it would seem, contra previous interpretations (Zilhão, 1997, 2000; Zilhão and Trinkaus, 2002), that the level K date should no longer be retained as a reliable indicator of the upper boundary of the Portuguese Middle Paleolithic, and that the age of Caldeirão's latest Middle Paleolithic occupation must be considered an open issue. The magnetic susceptibility study of the sequence, however, matches quite well the oscillations indicated in the deep-sea record off the Portuguese coast during OIS-2 (fig. 15). This fact suggests that the rather warm climate inferred for levels N to L, at the base of the Middle Paleolithic sequence, does reflect local conditions during the later part of OIS-3 and, in particular, may well be a manifestation of the impact of the extended period of amelioration comprised between the beginning of GIS-8 and the

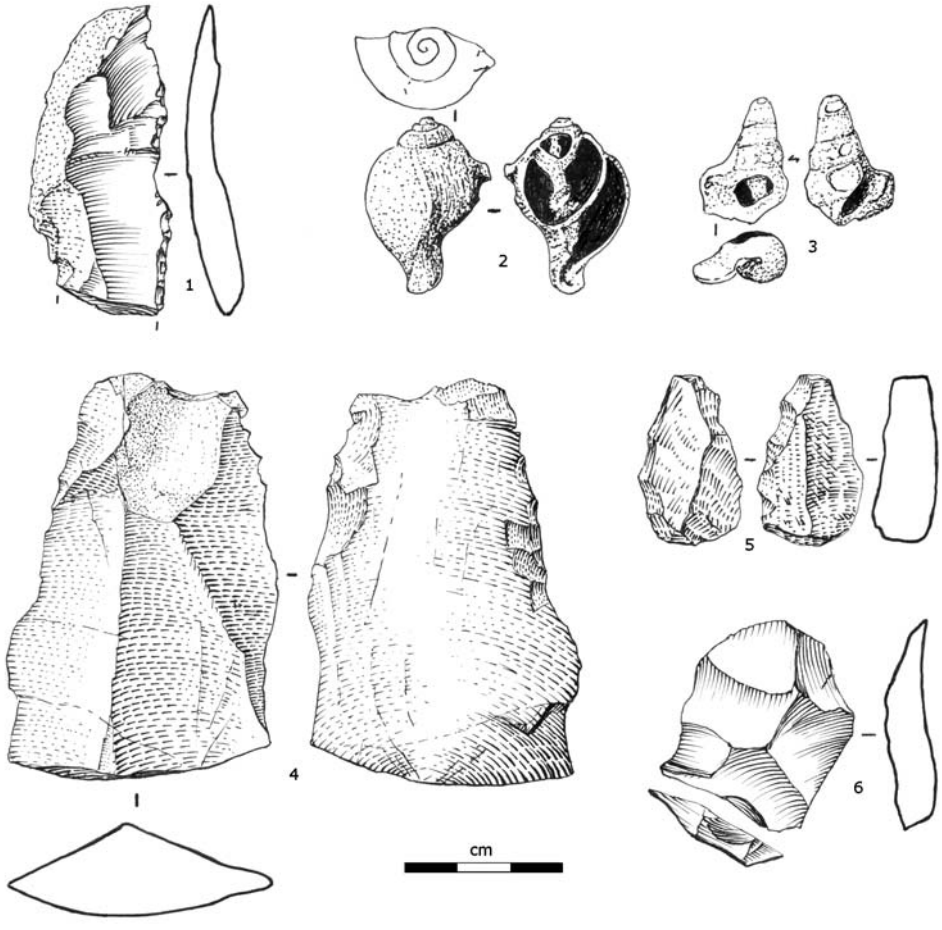

Fig. 14. Caldeirão. Above: artifacts from Upper Paleolithic level Jb. Below: artifacts from the underlying Middle Paleolithic levels K (nos. 4-5) and O (no. 6). 1. Blade with continuous retouch; 2. *Semicassis saburon* shell; 3. *Aporrhais pespelecani* shell; 4-5. Sidescrapers (quartz); 6. Levallois flake (after Zilhão, 1997).

end of GIS-7. Under this assumption, the upper part of layer K cannot be much older than ca. 35 ka cal BP, and should be contemporary with level 3 of the nearby site of Lapa dos Furos.

Finally, if we bear in mind that *Aporrhais pespelecani* is a common occurrence in Aurignacian bead assemblages of southern Europe (Taborin, 1993; Vanhaeren, 2002), and that the three shell ornaments, as well as a continuously retouched blade, come from sediments bracketed by the two radiocarbon determinations discussed above, a very sporadic occupation of the site in Late Aurignacian times becomes conceivable, although unproven.

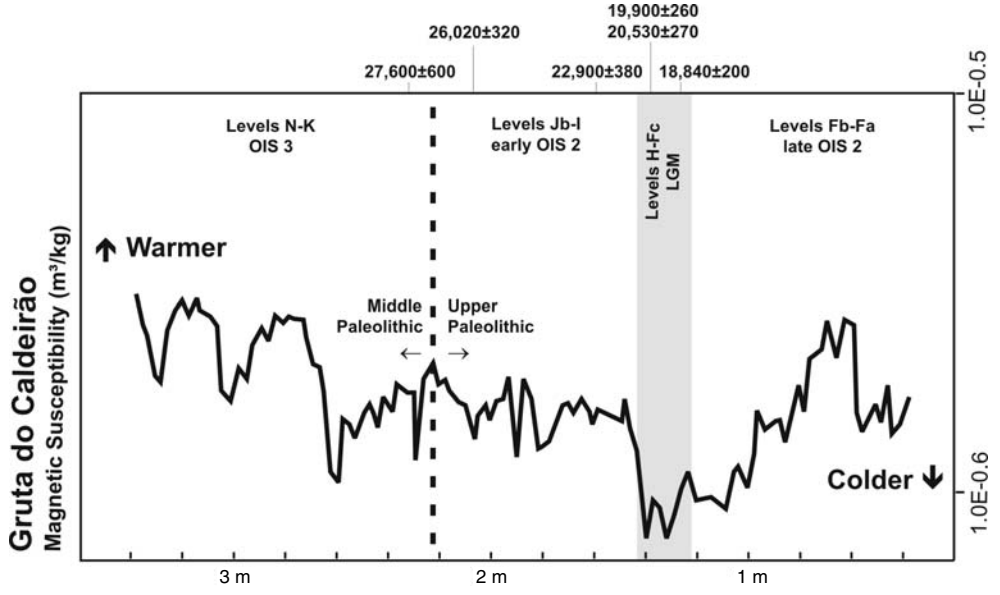

Fig. 15. Caldeirão. Magnetic susceptibility curve and associated uncalibrated radiocarbon results BP (after Ellwood *et al.*, 1998 and Zilhão, 2000, modified).

Given the characteristics of the faunal assemblage, it is any case clear that, at this time as in the preceding Middle Paleolithic, the cave continued to function mostly as a carnivore den (Davis, 2002).

2.12.4. Gruta da Oliveira

Located in the Almonda karstic system (Torres Novas), the Gruta da Oliveira is the key site supporting the notion of a late survival of the Mousterian in Portugal (Zilhão *et al.*, 1991, 1993; Zilhão, 2000, 2001; Marks *et al.*, 2001). More than 6 m of a long Middle Paleolithic sequence, sealed by a thick stalagmitic floor, itself buried under 4 m of brecciated *éboulis* accumulated by the collapse of the cave entrance, have already been excavated, but only the uppermost archeological levels 8 and 9 are of relevance for the Transition; in both cases, the radiocarbon chronology is based on pairs of statistically identical results obtained from samples of burnt bone analyzed in different laboratories.

Level 8 is dated to ca. 38-37 ka cal BP. The lithic assemblage (fig. 16), although small (95 tools and debitage exceeding 2.5 cm, mostly quartzite, followed by flint, and with small amounts of quartz), is technologically characteristic, including typical Levallois flake production, especially when fine-grained quartzites are used; trapezoidal, rectangular and ovoid shapes are represented in broadly similar percentages, and dorsal scar patterns are

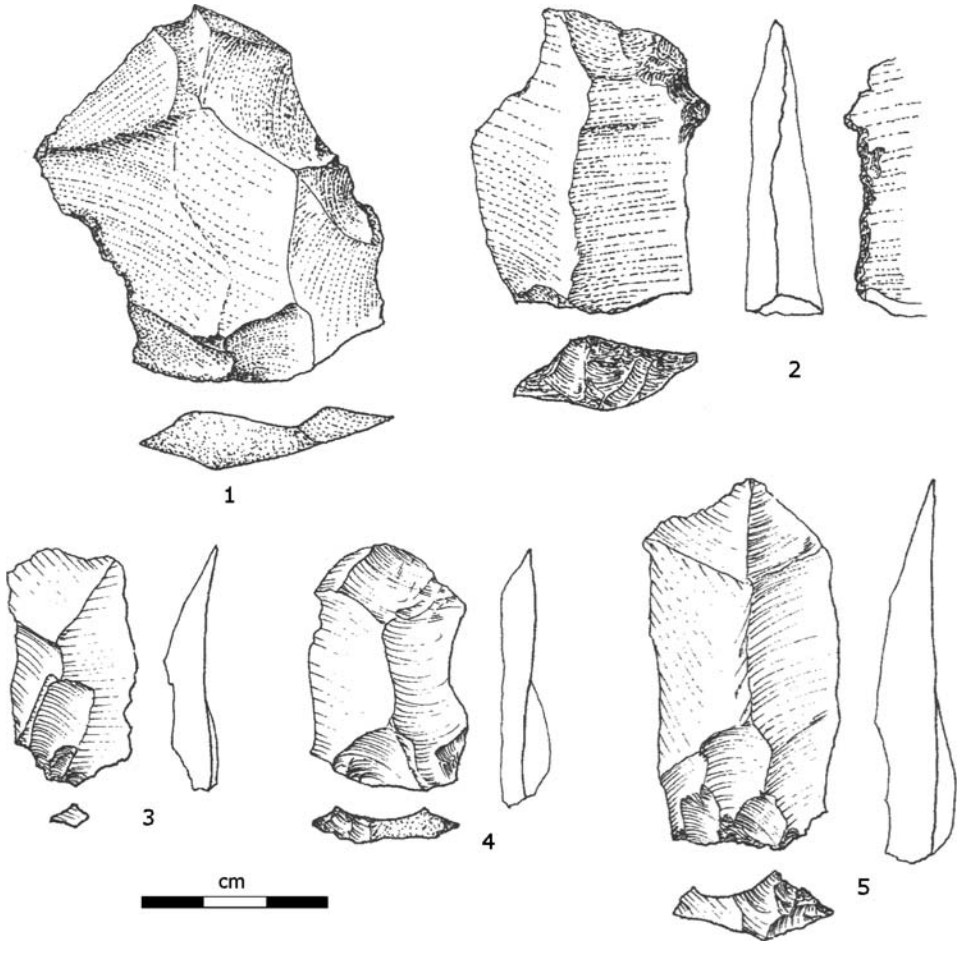

Fig. 16. Oliveira. Level 8 lithics: 1. Levallois flake (quartzite); 2. Flake with inverse retouch (quartz); 3-5. Levallois flakes (flint) (after Marks *et al.*, 2001, modified).

mostly radial or unidirectional. Level 9 is dated to ca. 44-43 ka cal BP. The lithic assemblage is only slightly larger (112 tools and debitage exceeding 2.5 cm, with a similar raw-material composition as in level 8) and somewhat technologically distinct: ovoid shapes and radial scar patterns are now clearly dominant, representing 46% and 54%, respectively, of the total number of analyzed pieces. The number of tools is small in both levels, and they are mostly notches, denticulates and irregularly retouched blanks.

The assemblages from the underlying stratigraphic units are much richer, and still under study. Worthy of note is the fact that, in levels 10 to 14 (fig. 17), a truncated bladelet (in all likelihood, a fragment of a geometric microlith), as well as prismatic and pyrami-

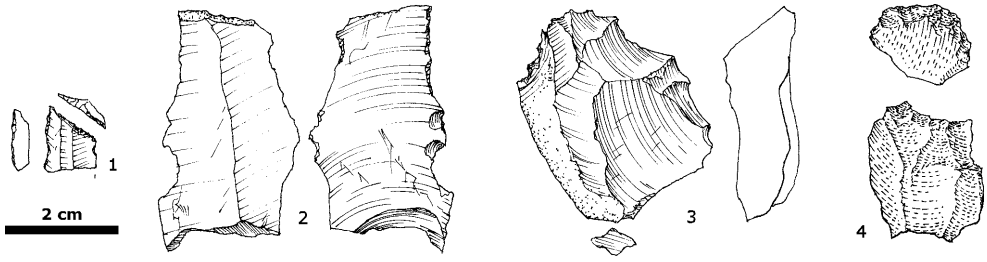

Fig. 17. Oliveira. Level 14 lithics: 1. truncated bladelet (broken trapeze?); 2. blade with continuous inverse retouch; 3. carinated «scraper»; 4. bladelet core (quartz).

dal blade and bladelet cores, are present among otherwise traditional Middle Paleolithic assemblages based on the production of flakes by way of discoidal and Levallois reduction schemes. These levels probably record an industrial phenomenon akin to that reported by Maíllo *et al.* (2004) for Mousterian levels 20-21 of El Castillo and 11-12 of Morín, dated to the same time range. Human remains from Oliveira include a hand phalanx in level 9, a proximal ulna in level 10, and a distal humerus in level 18; none are anatomically diagnostic, but their chronology suggests they are of Neandertals.

The evidence indicates that, until the end of level 9, sediment accumulation was a rather continuous process, punctuated by short arrests signaled by the formation of thin carbonated crusts. However, a major discontinuity exists at the interface with level 8, and, in extant profiles, thicker stalagmite can indeed be observed at that point in the sequence (fig. 18); in the squares closer to the cave entrance, a microfauna breccia existed at the corresponding depth, suggesting a long period of abandonment of the cave by humans. The dates for level 8 indicate occupation during GIS-8, which is consistent with the level's faunal and microfaunal contents. Open landscape species typical of colder periods (ibex, horse, and rhino), well represented in level 10 and below, are in fact absent from level 8, where *Apodemus sylvaticus* and *Eliomys quercinus* represent 96% of the rodent assemblage, suggesting that, at this time, the surrounding territory was Mediterranean woodland.

2.12.5. Gato Preto

Gato Preto (Rio Maior) is a small, single level open air site that yielded a lithic assemblage forming a thin lens (3-5 cm) within a low-energy overbanking fluviatile deposit. The spatially restricted distribution of the lithics, their association with a hearth, and the fact that they have been systematically refitted (Almeida, 2000) prove the stratigraphic integrity of the assemblage, dominated by thick-nosed «scrapers» (fig. 19): 27% of the 96 formal tools, 32.5% if 16 irregularly retouched flakes are excluded from the counts. This industrial struc-

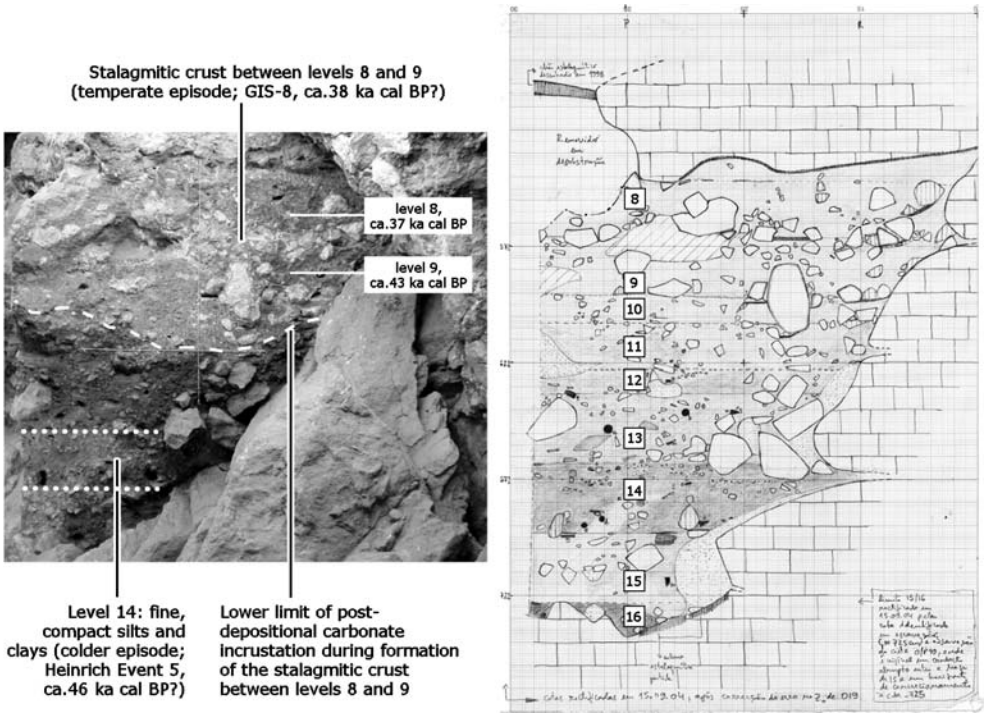

Fig. 18. Oliveira. Stratigraphic profile P/R17-19 (the scale is given by the field drawing to the right, where the smaller grid units represent 1 cm).

ture suggests a specialized occupation, geared towards bladelet production, although none of the small, twisted blanks found bore the characteristic Roc-de-Combe retouch.

In the absence of typical bladelet tools, the technology indicated either an Evolved Aurignacian or a Terminal Gravettian/Protosolutrean. Initially, the first possibility was favored (Marks *et al.*, 1991; Zilhão, 1993), but the second was eventually retained (Zilhão, 1997; Almeida, 2000), despite a TL date of 38,100 ± 3900 cal BP, thought to be too old, even if no technical problems could be detected (Debenham, 1991). Subsequent developments in the calibration of radiocarbon dates now make it clear, however, that the Gato Preto result is fully consistent with the Evolved Aurignacian chronology suggested by the lithics; the original diagnosis was therefore probably correct. This conclusion is further strengthened by the fact that detailed comparisons (Zilhão, n.d.) indicate close similarity between Gato Preto and the assemblages in levels 8 and 7-lower of the long Aurignacian sequence of the Abri Pataud (Chiotti, 1999), as well as major structural differences with the assemblages of the Terminal Gravettian/Protosolutrean of Portugal; in the latter, prismatic cores are overwhelmingly preferred for the production of bladelets over thick «scrap-

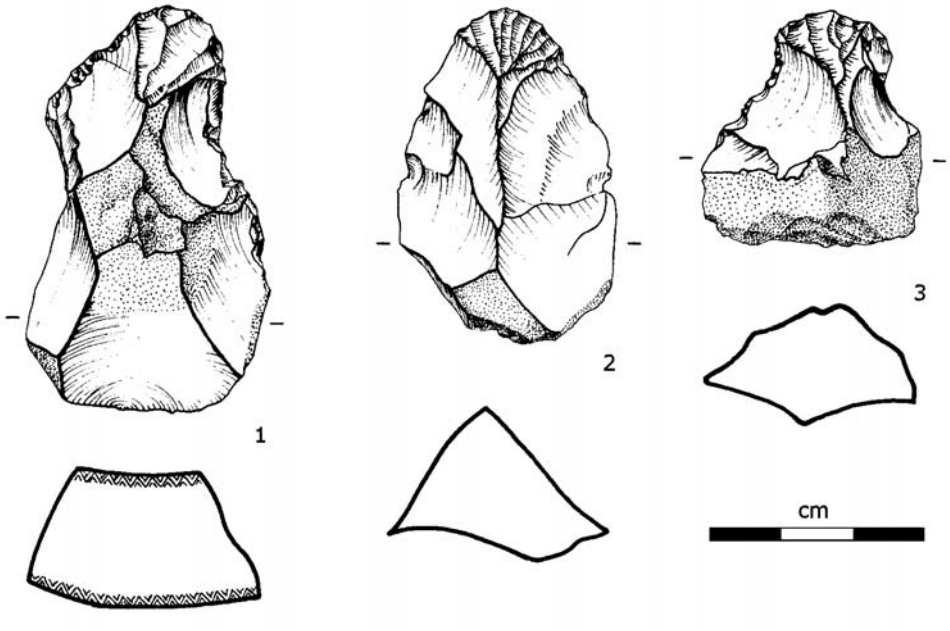

Fig. 19. Gato Preto. Thick-nosed «scrapers» (all flint) (after Zilhão, 1997, modified).

ers/burins», among which most are carinated, nosed forms being rather rare, exactly the opposite of what happens at Gato Preto.

The similarity with the Pataud levels suggests that the large time interval indicated by TL, due to the method's inherently large standard deviations, can be constrained to ca. 37.5-34 ka cal BP. In any case, it is now clear that Gato Preto demonstrates a true Aurignacian occupation of the Portuguese territory (contra Bicho, 2000, Marks, 2000, and Straus *et al.*, 2000). This conclusion, in turn, lends further credence to the Late Aurignacian diagnosis proposed for other (open air, as yet undated) workshop sites in the Rio Maior area: Vascas, Vale de Porcos and Chainça (Zilhão, 1997, n.d.; Thacker, 2001).

2.12.6. Gruta Nova da Columbeira

In 1962, excavations carried out by the Geological Survey exposed a ca. 8 m deep stratigraphic sequence at this cave site located in the vicinity of the town of Bombarral (Ferreira, 1984). Subsequently, the profile was studied and sampled by J. Roche (Santos, 1985), who also produced preliminary faunal reports (Roche, 1972); a more complete study was carried out by Cardoso (1993). In the excavators' system of level designation, the uppermost archeological remains were those in level 4; from here to the base of the sequence, in

level 9, the deposits contained Middle Paleolithic assemblages only, described as a «Denticulate Mousterian of Levallois facies, rich in sidescrapers» (Raposo and Cardoso, 1998a; Cardoso *et al.*, 2002). The site has featured prominently in discussions concerning the late survival of the Mousterian in Iberia because of two conventional radiocarbon dates in the 34-31 ka cal BP range obtained by J. Roche on samples of «carbonaceous earth» from levels 20 and 16 of his profile drawing (8 and 7 of the excavators) (Delibrias *et al.*, 1986). Raposo and Cardoso (1998a) report other attempts at dating the site, all failed: U-Th yielded results with such large standard deviations that they are useless for any meaningful chronological argument, and ^{14}C AMS dating of bone was unsuccessful, presumably due to the lack of collagen in the submitted samples.

The dating lab explicitly warned against the bad quality of the samples whence the conventional radiocarbon results came and, hence, against their reliability. Moreover, although those results are for the base of the sequence, they fall within the age range of the Aurignacian and the Gravettian of the region; under reasonable assumptions of sedimentation rate, their acceptance would thus imply, as previously pointed out (Zilhão, 2000), a prolongation into Solutrean times of the overlying Mousterian levels. To explain away this objection, Raposo (in Cardoso *et al.*, 2002: 78) speculated that the ca. 1.5 m of sediments corresponding to levels 4-6 of the excavators could derive from an unknown primary location; representing the last occupation of the cave, level 7 could thus date indeed to ca. 31 ka cal BP, the absence of Upper Paleolithic material in the overlying, putatively derived deposits resulting, in this hypothesis, from a very rapid, if not almost instantaneous accumulation process. These speculations are in contradiction with the description of the site's stratigraphy provided in the same publication (p. 51), according to which the different levels were separated by thin stalagmitic crusts, implying sedimentation hiatuses; simple inspection of the extant profile in any case makes it clear that the hypothesis is a geological impossibility, as also results from the detailed stratigraphic study associated with the limited re-excavation of that profile carried out in the early 1980s (Roche *et al.*, 1983).

Given the regional context, it remains possible that levels 3-6 of the Gruta Nova da Columbeira are a Late Mousterian contemporary with level 3 of Furos, level K of Caldeirão, and level 8 of Oliveira. However, the dating problems reviewed above make it clear that, for the time being, this sequence must be considered undated and, therefore, of no further relevance for discussions of the Transition in Iberia.

2.12.7. Gruta de Salemas

The cave site of Salemas (Loures) is located in a low elevation limestone massif extending to the north of the city of Lisbon, and was completely excavated in 1959-1960 by the Geological Survey (Zbyszewski *et al.* 1961; Roche *et al.* 1962; Roche and Ferreira 1970). A Mousterian level was recognized at the base of the sequence, in level T.V.b (*Terras vermelhas de base*), whence a bulk sample of bone fragments yielded a result of ca. 25 ka ^{14}C BP

(Antunes *et al.*, 1989). As extensively discussed elsewhere (Zilhão, 1997), this result is devoid of any chronological or archeological significance, because the «T.V.b» deposits contained a mix of Early Upper and Middle Paleolithic lithics, and this mix must have been reflected in the composition of the sample too. A heavily worn left lower deciduous molar from the basal deposits of Salemas is considered to be of Neandertal affinities by Antunes *et al.* (2000) but, given the above, its exact chronology cannot be known.

For somewhat different reasons, the date of ca. 34.6 ka cal BP obtained on another bulk bone sample from level 2 of the adjacent site of Pedreira de Salemas cannot be retained either. Although this deposit reportedly contained Mousterian artifacts, the faunal assemblage is essentially a natural accumulation at the bottom of a shaft; thus, the animal remains are unlikely to be related to the human behavior represented by the geologically associated artifacts. Moreover, those remains may well represent a rather long stretch of time, for which, given the nature of the sample and the exponential decay of radioactive carbon, the chronometric result obtained is simply a biased average.

Between the Mousterian and an important, extensive Upper Solutrean, the cave of Salemas featured a «Perigordian» deposit. Among the clearly Gravettian lithics recovered therein, three Dufour bladelets of the Dufour subtype (fig. 20) suggest a Late Aurignacian use of the site.

2.12.8. Gruta do Pego do Diabo

Pego do Diabo is a small cave located on the opposite side of the valley dominated by the Salemas limestone outcrop. Excavation work carried out in 1988-1989 revealed that, on top of a poor, almost exclusively paleontological Middle Paleolithic deposit (levels 3 and 4), an Upper Paleolithic level 2 also existed. Over most of the cave's area, this level corresponded to the ground surface, but further inside it was covered by a disturbed level 1 and an Iron Age level A (Zilhão, 1997, n.d.). Level 2 yielded an ensemble of Dufour bladelets of the Dufour subtype (cf. fig. 20), and contained a large mammal association (lynx, lion, wolf, fox, badger, hyena, wild boar, horse, red deer, chamois and ibex) that, in Portugal, is characteristic of the EUP (Cardoso, 1993; Valente, 2004); accordingly, and following the same parallels with the Abri Pataud sequence mentioned above for Zafarraya, the lithic assemblage was attributed to a Late Aurignacian occupation.

In the area of the cave where it was best preserved from Holocene intrusions by the presence of overlying deposits, level 2 was divided in two sublevels, 2a and 2b, each ca. 20 cm thick; Dufour bladelets were found in both. Conventional radiocarbon dating of two bulk samples of bone fragments from each of these sublevels yielded results of ca. 28 ka cal BP for 2a, and of ca. 33 ka cal BP for 2b. Because a few obviously intrusive recent Holocene items were still present in 2a (namely, a few sheep teeth and three very small sherds of wheeled pottery), the most parsimonious interpretation of the discrepancy in the dating results is that, in spite of careful selection, the submitted bulk sample contained

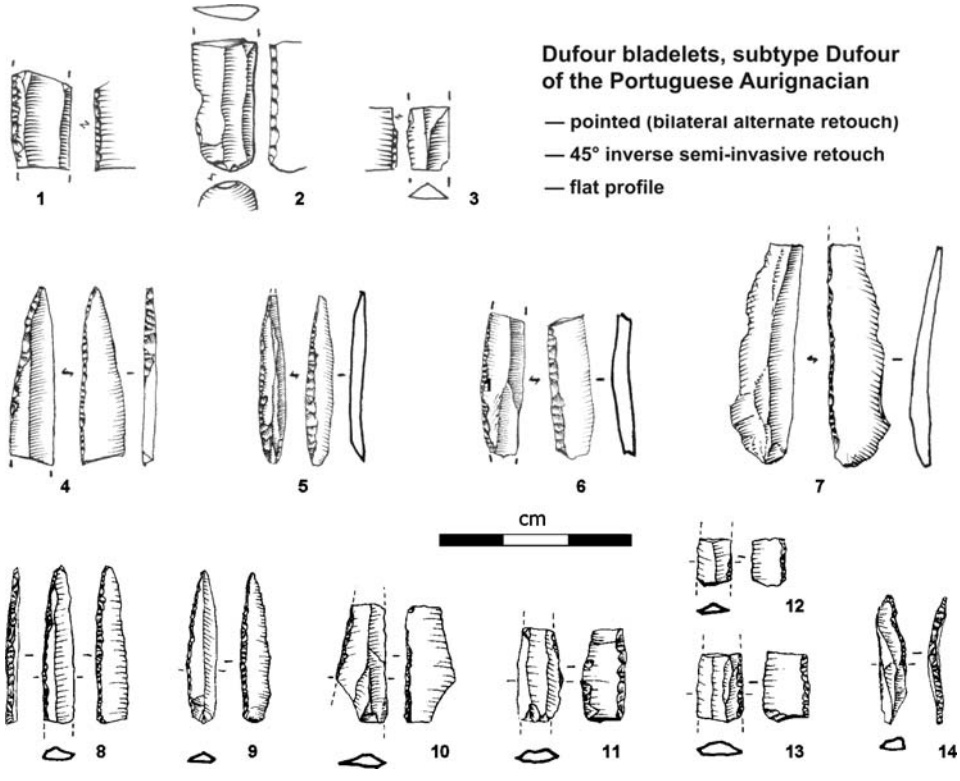

Fig. 20. Bladelet tools of the Portuguese Aurignacian: 1-3. Salemas; 4-7. Escoural; 8-14. Pego do Diabo (after Zilhão, 1997, modified).

a small amount of contaminating modern bone material (in fact, 3% of a 1500 year old component would suffice to produce a 23,000 result for a sample where 97% of the material dated to 28,000). The result obtained for 2b, in turn, fits the expectations derived from the comparison with the Pataud sequence and there is no reason to question its reliability. Conventional dating of level 3 with a bulk sample of bone fragments was also attempted, but failed; due to the poor quality of the collagen extracted, the dating lab reported the result as a minimum age only.

2.12.9. Conceição

Conceição (Alcochete) is an open air site located in a terrace of the Tagus, on the south side of the estuary, rescue-excavated over an extensive area in 1996, in the framework of the construction of the new Lisbon bridge. Raposo and Cardoso (1998b) describe the site and

the numerous Middle Paleolithic assemblage recovered in the excavated area and in the adjacent land surfaces, and treat the associated OSL results as evidence that the occupation represented by those artifacts is of a rather late age. This interpretation, however, is unwarranted, because those results simply provide maximum and minimum ages for the archeological level bracketed by the sterile deposits whence the samples came. Below the level, the dating of fluviatile sands to the ca. 98-64 ka cal BP interval indicates that the Middle Paleolithic occupation of the site took place after a major early Upper Pleistocene regressive episode that may well relate to OIS-4; above the level, the dating of eolian sands to the ca. 32-22 ka cal BP interval indicates, in turn, that the occupation took place before the last glacial maximum. Thus, the OSL results are consistent with an OIS-3 age for the Middle Paleolithic of Conceição, but cannot be used to constrain its chronology any further.

2.12.10. Gruta da Figueira Brava

The site of Figueira Brava (Sesimbra) is a limestone cave open to the sea at an elevation of ca. 5 m above modern sea level, in a setting rather reminiscent of Gibraltar's Vanguard and Gorham's caves. Ten to twelve cubic meters of the deposits filling up the innermost part of a gallery leading out from a large interior chamber of the cave into another chamber now full of sediments were excavated between 1986 and 1990 (Antunes 1990-1991, 2000); the lithic assemblage is described by Raposo and Cardoso (2000a, 2000b). A 1 m thick stratigraphic succession was recognized under a thick stalagmitic crust cementing domestic bones and fragments of Roman amphorae (level 1). Underlying level 2 was somewhat disturbed in its upper reaches by the penetration of materials from such historic uses of the site and, at the bottom, featured a 25 cm thick darker band with fire-cracked rocks; this deposit was differentiated as level 3 but contained similar artifacts, although faunal remains were scarce. Thirty centimeters —a nearly sterile lens of reddish sands (level 4) and the Tyrrhenian cobble conglomerate (level 5) under it— separated the archeological levels from bedrock.

Excluding chippage, the lithic assemblage recovered in levels 2-3 is made up of ca. 2500 objects, 358 of which were classified as retouched tools. Locally available low quality quartz is the predominant raw-material and discoidal techniques were used to reduce it, but Levallois blanks are also present; typologically, the assemblage fits the definition of a Denticulate Mousterian. Although hyena remains comprise 6% of the identified specimens (which total ca. 400), Antunes (2000) states that the herbivore taxa represented in the large mammal assemblage are anthropically-accumulated; aurochs, red deer and ibex, in similar proportions, make up >80% of that total, but rhino and elephant are also represented, as well as such marine species as dolphin (*Delphinus delphis*) and seal (*Pusa hispida*). Among the other animals, the presence of the great auk (*Alca impennis*) must be noted, as well as the abundant remains of marine invertebrates, of which >900 specimens were recovered, mostly mussels and limpets, but including also crabs (*Cancer*, *Maja*); these

shellfish remains can only represent human food consumption, and the occurrence of *Tapes* and *Ostrea* indicates that the procurement of these kinds of resources extended into nearby estuarine areas.

Attempts at dating the deposits by radiocarbon with bone samples failed due to the lack of collagen, and two U-Th results on teeth have such large standard deviations that their use to assess the chronology of the human occupation is completely uninformative. It was possible, however, to obtain a conventional radiocarbon date on a sample of *Patella* shells recovered in non-disturbed areas of level 2 and presenting a uniform patina and degree of fossilization (Antunes, 2000: 60); this sample yielded a reliable result of ca. 36 ka cal BP (Antunes *et al.*, 1989). Geological deposits at the same elevation and containing natural accumulations of mollusk shells have been identified in the nearby raised beach of Forte da Baralha; a sample of rolled shell fragments dated to 31,540/+1540/-1290 ^{14}C BP (ICEN-1128), i.e., ca. 37 ka cal BP, and a sample of well preserved, complete *Mytilus* shells dated to 33,730/+3990/-2660 ^{14}C BP (ICEN-1131), i.e., ca. 38 ka cal BP (Pereira and Angelucci, 2004).

In spite of the large standard deviations, the ages obtained for these beach deposits suggest that the coast line was rather close to the cave during the later part of OIS-3 and, where its archeological fill is concerned, they are consistent with the radiocarbon result. Because a bulk sample was used, however, a problem of interpretation similar to that noted above for the site of Pedreira de Salemas exists for level 2 of Figueira Brava. In both cases, the excavation of the fill was paleontologically oriented, and no information exists on the vertical distribution patterns of the different components of the excavated deposits. The use of bulk samples assumes their chronological homogeneity, but the assumption is not necessarily warranted, and the possibility that the Figueira Brava sample mixed shells accumulated over an extended period of time cannot be excluded. However, because they are marine shells recovered in a continental deposit, those finds (unlike the animal bones from Pedreira de Salemas) are in and of themselves indicative of human behavior. Moreover, bearing in mind the exponential nature of radioactive decay, for a result of ca. 36 ka cal BP to be obtained, the bulk sample would have to include shells of that or even more recent age, even if it also included a significantly earlier component. In these circumstances, and given, 1) the total absence of Upper Paleolithic items in the deposit, 2) the marked difference in surface appearance between the few intrusive recent Holocene shells and the *in situ* Pleistocene ones, and 3) the careful selection of the sample in order to exclude any potential contaminants of Roman age, it is legitimate to conclude that Middle Paleolithic activity was still ongoing at the site ca. 36 ka cal BP, even if level 2 in fact spanned a much more extended period of time.

In sum, the limitations of the data allow no further probing into the specific characteristics of the latest Mousterian occupations of the site, and the systematic dating of individual shells is required to investigate how long did the accumulation of levels 2-3 of Figueira Brava effectively last. Until then, the finds recovered can only be considered as providing an averaged-out image of OIS-3 times at the mouth of the paleoestuary of the

Sado and, although reasonable, assignment of any individual item to the time period indicated by the single radiocarbon date available is not necessarily warranted. That is the case, in particular, with the taurodont upper left second premolar of Neandertal affinities recovered at the site (Antunes *et al.*, 2000); the other bones attributed to *Homo* in Antunes (1990-91), a phalanx and a metacarpal, however, are clearly those of a carnivore.

2.12.11. Gruta do Escoural

The Paleolithic cave art site of Escoural, in the Alentejo (Santos, 1964, 1967; Glory *et al.*, 1965; Gomes *et al.*, 1990; Santos *et al.*, 1981; García *et al.*, 2000), revealed a stratigraphic sequence comprising, under stalagmite-incrusted Neolithic burials, Pleistocene clay deposits featuring a rich faunal assemblage, probably accumulated by denning hyenas (Cardoso, 1993). Elsewhere in the cave, this fauna was found in association with an abundant Middle Paleolithic quartz industry contained in modernly excavated deposits; a U-Th date of ca. 49 ka cal BP is available for these contexts (Otte and Silva, 1996). In the areas of the Paleolithic «sanctuary» excavated in the 1960s, however, artifacts were rather scarce. Besides a sagaie bone point of unknown but clearly Upper Paleolithic cultural affinities, such items included a Solutrean laurel-leaf, as well as a set of four Dufour bladelets identical to those from Salemas and Pego do Diabo (cf. fig. 20). Accordingly, this set has been interpreted as documenting a Late Aurignacian use of the site (Zilhão, 1997).

3. Conclusion

A number of conclusions can be drawn from the above review. They are summarized below, and graphically represented in the form of a correlation chart (fig. 21).

1. In the Greenland ice cores, the time interval before and after Heinrich Event 4, ca. 40 ka cal BP, is characterized by significant climatic instability. Most Iberian cave and rockshelter sequences show significant disturbance during this period, often resulting in the formation of palimpsests mixing Middle and Upper Paleolithic components (El Castillo, Morín, L'Arbreda, Beneito, Zafarraya, Bajondillo), or in the presence of erosive or depositional hiatuses (Gorham's, Oliveira). Where the Transition is concerned, the implication is that issues of sample association and assemblage definition tend to be ubiquitous, and that careful scrutiny of the evidence using appropriate taphonomic filters is an absolute prerequisite to any behavioral or historical reconstructions of the process.
2. Despite the dating problems, Labeko Koba is at present the primary site for the Transition in northern Iberia, because it is the only modernly excavated instance where

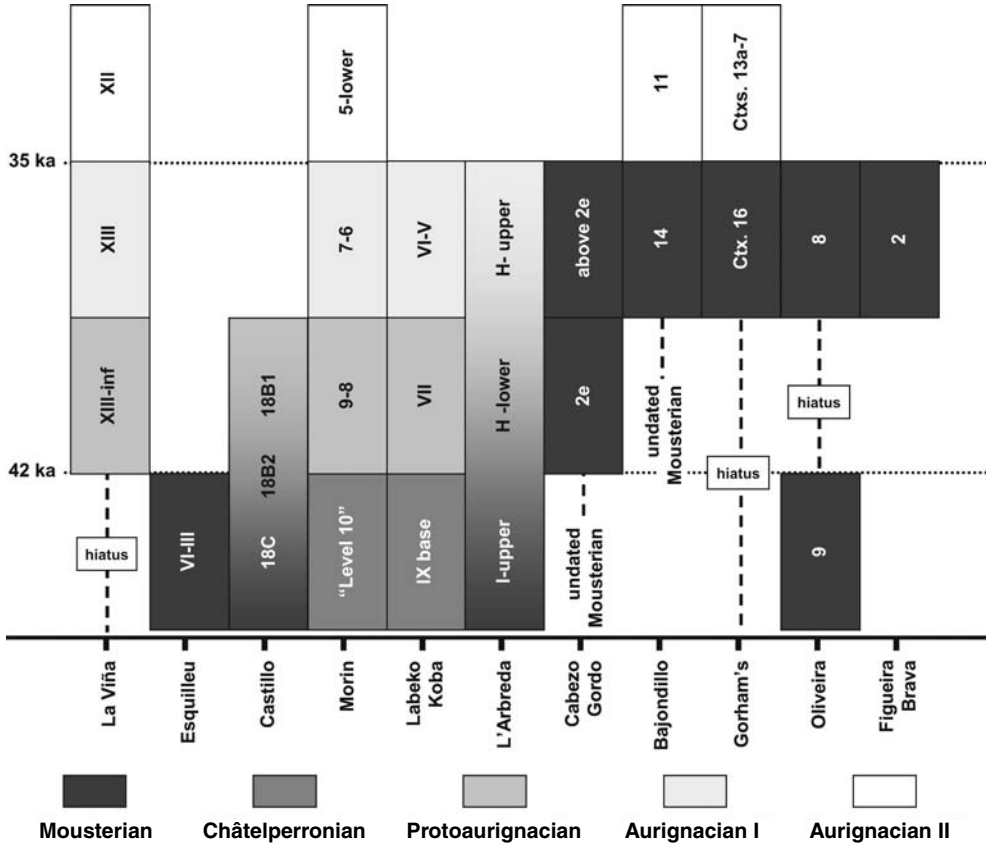

Fig. 21. Stratigraphic correlation scheme for the Transition in Iberia.

the assemblage-types of southwestern Europe's earliest Upper Paleolithic co-occur in stratigraphic order and contained in neat, well-separated sediment packages unaffected by post-depositional disturbance or excavation error. Given Labeko Koba and the diagnostic Châtelperron points recovered in Morín at the Mousterian/Aurignacian interface, it is clear that, in the territories of central and eastern Cantabria and in Euskadi, the Transition is a three-step process featuring, from earlier to later, the Mousterian, the Châtelperronian, and the Protoaurignacian. These sites provide the standard against which the illusory nature of the putatively «intermediate» assemblage-type proposed by Cabrera *et al.* (2001) on the basis of the contents of level 18 of El Castillo, located within walking distance from Morín, becomes easily apparent.

3. The available evidence does not support the assignment of A Valiña to the Châtelperronian and, at La Viña, the Châtelperronian is absent. In the latter site, a major hiatus separates the basal Aurignacian from the underlying Mousterian; thus,

it is unclear whether the absence is geological or a true reflection of population history. Given the survival of the Mousterian into the time range of the Châtelperronian suggested by Esquilleu, the Besaya drainage, slightly to the west of the city of Santander, may represent the westernmost limit of the distribution of the Châtelperronian in Iberia; however, because doubts remain concerning the dating of Esquilleu's relevant levels, this inference is still open to confirmation by future research.

4. To the east, the range of the Châtelperronian extends to the Mediterranean Pyrenees, where the diagnostic points from Ermitons, L'Arbreda and Reclau Viver, made on blanks that feature a prismatic blade technology unknown in the regional Mousterian, cannot be reduced to a mere typological component of the latter. They are more likely to represent sporadic, logistic incursions into cave sites that, at the time, were only marginally used by humans.
5. North of the Ebro divide, from Asturias in the west to Catalonia in the east, a well-defined, industrially characteristic Protoaurignacian appears in the archeological record above the Mousterian or the Châtelperronian; when reliably dated, these occurrences are contemporary, and their age (ca. 42 ka cal BP) is the same as elsewhere in Europe (notably at Isturitz, immediately across the border, in the French Basque Country). As is also suggested by the stratigraphic evidence, this chronological horizon represents a sound *terminus ante quem* for the end of Neandertal-associated technocomplexes in these regions.
6. South of the Ebro divide, the Châtelperronian, the Protoaurignacian and the Early Aurignacian remain unknown; although perturbation of key sequences at the Middle/Upper Paleolithic interface conceivably explains the lack of coherent assemblages, this «absence of evidence» is strengthened by the fact that index fossils such as the split-based bone point have never been found, not even in the form of isolated occurrences, or of diagnostic finds made in mixed contexts. The earliest Upper Paleolithic of these regions is an Evolved Aurignacian with thick-nosed «scrapers»/cores and Roc-de-Combe bladelets, well defined in Beneito levels B9-B8 and Bajondillo level 11. Everywhere else in Europe, including northern Iberia (cf. La Viña's level XII), this assemblage-type post-dates 37 ka cal BP and, given the problems with the dating results for those two sites, an earlier age for it in southwestern Iberia cannot be supported.
7. The evidence from Gato Preto indicates synchronicity between littoral Portugal and Andalucía, but the Foz do Enxarrique U-Th date suggests a regional survival of the Mousterian into the time period of the Late Aurignacian. Because the Aurignacian remains unknown in the Mesetas, such a survival is conceivable, and the hypothesis that the earliest Upper Paleolithic occupation of interior Iberia is of Gravettian age cannot be rejected at present; but neither can the hypothesis that this pattern is a simple artifact of the uranium uptake assumptions used at Foz do Enxarrique, and that the latter could well be somewhat earlier.
8. As in France, Late Aurignacian occurrences are rare; those known come from stratigraphic contexts of poor integrity or undated but, given the supra-regional culture

history, there is no reason to question the industrial diagnoses that have been proposed for them.

9. In Murcia (Cabezo Gordo), Gibraltar (Gorham's) and Portugal (Oliveira), Mousterian occurrences are reliably dated to the time interval of ca. 42-37 ka cal BP. Thus, the fact that the Châtelperronian, the Protoaurignacian and the Early Aurignacian have never been found south of the Ebro divide must indeed be taken as «evidence of absence». Diagnostic fossil remains of Neandertals are associated with the Late Mousterian at Cabezo Gordo, and the Zafarraya mandible may well be of the same age. In coastal areas, these Late Mousterian occurrences are seemingly characterized by a systematic exploitation of marine resources, namely shellfish, as shown by sites in Málaga (Complejo del Humo), Gibraltar (Gorham's) and Portugal (Figueira Brava).
10. The dispersal of Aurignacian moderns into southern and western Iberia, and the ensuing disappearance of aboriginal Neandertal groups (by whatever mechanism, most likely absorption —Zilhão and Trinkaus, 2002), can at present be dated to the cold phase following the GIS-7 temperate episode, i.e., to after 35,200 cal BP. With that phase, the rather extended period of predominantly mild conditions that followed Heinrich Event 4 came to an end (fig. 22). The simultaneous timing of such significant events in the spheres of cultural process and climate history probably reflects an underlying causal link, not simple coincidence.

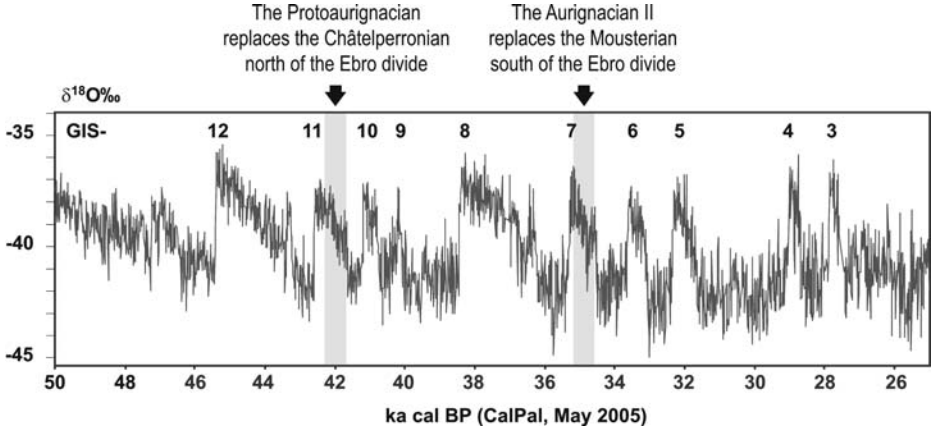

Fig. 22. The timing of the establishment and disappearance of the Ebro frontier in relation to the climatic oscillations (Greenland Insterstadials) identified in the GISP2 ice core. The termination of the delayed Mousterian of southern Iberia coincides with the end of a long period of globally milder conditions that may have generated the expansion of temperate, almost interglacial environments in the littoral areas of Portugal, Andalucía, Murcia and Valencia. Contrasting cultural adaptations may thus explain the stabilization throughout the duration of those conditions of a Mousterian/Aurignacian (and Neandertal/modern human) frontier situated along the Ebro divide.

Thus, although many issues remain unresolved at a certain level of detail, a «big picture» clearly emerges from the evidence, and that is the picture of the «Ebro frontier» as initially suggested 15 years ago. Although healthy skepticism is always in order, future research should more profitably focus on elucidating the reasons underlying the pattern (ecological, cultural, or a combination of both) than in sterile discussions revolving around its reality as a fact of the archeological record.

Texto breve

Cronoestratigrafía de la transición entre el Paleolítico Medio y el Paleolítico Superior en la Península Ibérica

Los últimos avances en la calibración de dataciones radiocarbónicas y en el tratamiento de muestras de hueso han reducido el margen de incertidumbre que siempre existe en la interpretación de los patrones cronológicos del período de transición entre el Paleolítico Medio y el Paleolítico Superior en Europa, que está muy cerca de los límites de aplicabilidad del método. Sin embargo, dichos avances no permitirán alcanzar los resultados a los que se podría aspirar si no van acompañados de un significativo progreso en la comprensión de los procesos de formación de los yacimientos. En efecto, es de esperar que, debido a la compleja historia ambiental de este período, las cuevas y abrigos hayan estado afectados, en mayor o menor grado, por alteraciones sin y posdeposicionales que requieren un examen profundo de la naturaleza de la relación entre las muestras y los contextos o hechos que supuestamente datan. Entre los problemas de asociación, dos son de gran importancia cuando se trata de la interpretación de dataciones radiocarbónicas: la formación de palimpsestos (la compresión de diferentes niveles de ocupación en un solo «nivel», como resultado de la deposición de artefactos en superficies que permanecieron expuestas durante largos períodos por hiatos de sedimentación, o que fueron reexpuestas por procesos de erosión) y la redeposición de depósitos más antiguos tanto por agentes geológicos (por ejemplo, la progradación) como biológicos (por ejemplo, la excavación de madrigueras). Este artículo intenta llevar a cabo una valoración tafonómica detallada de la evidencia estratigráfica y cronométrica proporcionada por los yacimientos relevantes para el estudio de la transición en la Península Ibérica, medida con una escala de tiempo que utiliza fechas calibradas.

En las regiones localizadas al norte de la divisoria del Ebro, los datos sugieren conformidad con el modelo general europeo. En el norte de Cataluña, País Vasco y este de Cantabria, la primera etapa de la transición es el paso del Musteriense al Chatelperroniense. La evidencia es escasa y solamente en Labeko Koba se ha podido documentar un Chatelperroniense auténtico; el conjunto lítico, aunque pequeño, es tecnológica y tipológicamente característico, y se encuentra separado de los niveles superiores aurignacienses por depósitos estériles que garantizan

su integridad. En otros yacimientos (como, por ejemplo, las largas secuencias de El Castillo, Morín o L'Arbreda), las ocupaciones relacionadas con este tecnocomplejo se reconocen en base a fósiles directores recuperados en contextos estratigráficamente inciertos, pero ubicados entre niveles musterienses anteriores y auriñacienses posteriores. Aunque se ha sugerido que tales puntas y cuchillos de Châtelperron deberían considerarse simplemente como parte del «grupo Paleolítico Superior», que normalmente existe en tipologías del Musteriense tardío, su laminaridad no es conforme con tales sugerencias. La producción de este tipo de soportes no está documentada en el Paleolítico Medio de estas regiones, por lo que aquellos tipos de útiles sólo pueden ser interpretados como representando un sistema de producción lítico diferenciado.

Debido a la contaminación química de las muestras de hueso de Labeko Koba, no ha sido posible, hasta el momento, establecer una cronología absoluta para el Chatelperroniense español. Otro problema por solucionar es el del límite occidental de su distribución. Hasta la fecha no han sido identificados yacimientos chatelperronienses ni en Cantabria occidental ni en Asturias, y la atribución al tecnocomplejo del nivel III (o IV-Norte) de A Valiña, en Galicia, no es respaldada por el escaso conjunto lítico. Basándose en las fechas obtenidas en la Cueva de Esquilleu, también se ha sugerido que, en estas regiones, la correspondiente cronoestratigrafía podría estar ocupada por un Musteriense profundamente adentrado en el intervalo ocupado por el Auriñaciense regional. Cuando consideramos los intervalos de probabilidad de las fechas en cuestión, se observa, efectivamente, un solapamiento, aunque es más probable que éste refleje las incertidumbres del método de datación y los potenciales problemas estratigráficos creados por una bioturbación importante de los niveles, que una real coexistencia plurimilenaria del Musteriense y el Auriñaciense en las montañas del este de Cantabria. Esta conclusión viene además corroborada por el hecho de que, más al oeste, en La Viña, el primer Auriñaciense tiene exactamente la misma cronología que en Morín. En el norte de Cataluña también se ha barajado la hipótesis de un Musteriense prolongado, en base a yacimientos como Ermitons y Fuentes de San Cristóbal, aunque tampoco aquí esta evidencia se mantiene frente a un estudio más detallado. Los resultados de Ermitons, obtenidos con muestras de hueso, son probablemente sólo fechas mínimas y, en todo caso, las muestras procedían del nivel IV, que corresponde a una guarida de osos. Incluso aceptando que su verdadera edad está reflejada en los resultados obtenidos, la interpretación mas parsimoniosa seguiría siendo la de que estas fechas documentan la ocupación de la cueva por los osos y que los escasos restos de ocupación humana contenidos en ese nivel no tienen por qué ser contemporáneos (y con toda probabilidad no lo fueron).

En Morín y La Viña, los niveles auriñacienses más antiguos se corresponden con el Protoauriñaciense tal como ha sido definido en Francia, Italia, Austria y Rumania, siendo los resultados radiocarbónicos idénticos a los obtenidos para esta cultura, por ejemplo, en Isturitz y Mochi: ≈36.5 ka ^{14}C BP, es decir, ≈42 ka cal BP. Se ha defendido que el material protoauriñaciense recuperado en L'Arbreda sería significativamente más antiguo, basándose en la datación de carbones aislados procedentes de perfiles; sin embargo, las muestras no estaban en asociación directa con el material lítico, y provienen de depósitos acumulados por progradación que inevitablemente contienen un importante componente heredado. La atribución de una edad igual de antigua para el supuesto Auriñaciense arcaico del nivel 18 de El Castillo se basa en dos errores de interpretación: primero, la noción de que el «Auriñaciense Delta» excavado por Obermaier es un nivel arqueológico homogéneo, lo cual es contradictorio con su importante y obvio componente Musteriense y con las fechas directas de >50 ka cal BP, obtenidas sobre muestras de fauna de ese

nivel; segundo, la noción de que el nivel 18 del área exterior, excavado en los años ochenta, es también, por correlación con el nivel interior de Obermaier, enteramente Auriñaciense, a pesar de no contener elementos diagnósticos. Las dataciones radiocarbónicas obtenidas para esta área indican claramente que, tal como en el área interior excavada por Obermaier, los depósitos son un palimpsesto, y que la mezcla de características tecnológicas observada en el conjunto lítico se explica por su naturaleza culturalmente heterogénea, no por el hecho de que ese conjunto corresponda a una hipotética industria «de transición». En los yacimientos de La Viña, Morín, Labeko Koba y L'Arbreda, estratigráficamente superpuesto al Protoauriñaciense, hay un Auriñaciense Antiguo (Auriñaciense I), caracterizado por la presencia de puntas de hueso de base hendida y, en Morín y La Viña, hay un Auriñaciense Evolucionado (Auriñaciense II) a techo de la secuencia y con fechas de datación radiocarbónica que son consistentes con el modelo estratigráfico.

Los restos humanos procedentes del nivel 18 de El Castillo han sido tradicionalmente considerados como representación de los autores de las industrias auriñacienses del norte de España. Sin embargo, las afinidades morfológicas neandertales de esos restos no significan necesariamente, dada la composición heterogénea del nivel, que el Auriñaciense de la región haya sido fabricado por neandertales. La datación directa, con resultados correspondientes al Protoauriñaciense, de los restos humanos modernos de Oase (Rumania), y el hecho de que restos de humanos modernos estén asociados al Auriñaciense Antiguo y Evolucionado de Francia sugieren que en España se daría una situación similar. Por otro lado, el importante conjunto de restos neandertales tardíos de El Sidrón ha sido directamente datado en el intervalo de tiempo ocupado por el Chatelperroniense en Francia. Por lo tanto, parece poder concluirse que, en el norte de España, la primera etapa en la transición del Paleolítico Medio al Superior (el paso del Musteriense al Chatelperroniense) refleja innovaciones producidas dentro de las poblaciones neandertales de la región, mientras que la segunda etapa (el paso del Chatelperroniense al Protoauriñaciense) consistiría en un proceso de sustitución tanto cultural como biológico.

Al sur de la divisoria del Ebro, sin embargo, dicho proceso de sustitución no parece haber tenido lugar hasta ≈37-35 ka cal BP, ya bien adentrado el período correspondiente al Auriñaciense II. De hecho, el Protoauriñaciense y el Auriñaciense Antiguo permanecen desconocidos tanto en las Mesetas como en las costas de Valencia, Murcia y Andalucía, así como en Portugal; en todas estas regiones, su posición cronoestratigráfica está ocupada por un Paleolítico Medio prolongado, como fue indicado, inicialmente, por el estudio litobioestratigráfico detallado de las secuencias de Cova Negra y Carihuela, y después respaldado por resultados cronométricos obtenidos en un considerable número de yacimientos portugueses. La asociación de este Musteriense con los neandertales, a su vez, estaría demostrada por el descubrimiento de la mandíbula de Zafarraya y la datación de ≈30-32 ka ^{14}C BP (≈35-37 ka cal BP) de muestras de fauna recogida en niveles adyacentes. En combinación con la evidencia paleoambiental (que sugiere que esta supervivencia tardía de poblaciones neandertales del Paleolítico Medio corresponde a un largo periodo de mejora en las condiciones climáticas, favoreciendo la expansión de paisajes boscosos, al menos en las zonas de costa), estos resultados permitieron formular un modelo —La Frontera del Ebro— que explica la penetración tardía de humanos modernos auriñacienses en el sudoeste de la Península Ibérica, por el hecho de que la cuenca del Ebro representaría el límite sur de las biomasas de estepa y de estepa-tundra en las cuales hasta entonces habían prosperado.

Se le ha objetado a este modelo que, en muchos de los yacimientos más relevantes, prin-

cipalmente en Cova Negra y Carihuela, faltan datos cronométricos y también que, cuando existen, normalmente proceden de muestras de huesos y, por lo tanto, son susceptibles de no representar más que edades mínimas. Por otro lado, los esfuerzos realizados en Zafarraya para conseguir una cronología más precisa mediante la utilización de una batería de métodos diferentes dieron lugar a un cuadro confuso, que sugiere importantes perturbaciones posdeposicionales; y la pequeña colección de laminitas Dufour intrusiva en los niveles superiores del Paleolítico Medio de este yacimiento ha sido utilizada para apoyar la existencia del Protoauriñaciense al sur del Ebro. Finalmente, los resultados radiocarbónicos de las cuevas de Beneito y Bajondillo parecían indicar, para los niveles auriñacienses ahí reconocidos, una edad significativamente más temprana que la propuesta por el modelo de la frontera.

Sin embargo, si examinamos detalladamente los datos, estas objeciones no se sostienen realmente. En las cuevas de Cabezo Gordo (Murcia), Gorham's (Gibraltar) y Oliveira (Portugal), se observa una prolongación del Musteriense hasta ≈37 ka cal BP, documentada por fechas radiocarbónicas sobre huesos y carbones obtenidas en los niveles superiores de largas secuencias del Paleolítico Medio y que son consistentes estratigráficamente con la cronología de los depósitos inferiores. Además, en Cabezo Gordo, los depósitos correspondientes han ofrecido numerosos, aunque fragmentados, restos humanos atribuidos a neandertales. Por otra parte, los trabajos más recientes en Beneito han demostrado de forma concluyente que las muestras «tempranas» procedían de niveles redepositados y que hubo significativos desplazamientos verticales en los «cailloutis» abiertos que forman los depósitos correspondientes a la transición (Unidad C), explicando la inversión estratigráfica de fechas. Por lo que respecta a Bajondillo, la pobre calidad del material datado (mezcla de sedimento y carbón), la existencia de niveles mezclados en el contacto entre el Musteriense y el Auriñaciense, las fechas idénticas obtenidas para los niveles musterienses inmediatamente inferiores al Auriñaciense, y la geometría de los depósitos apuntan a que los resultados disponibles reflejan alguna contaminación por material heredado. Esta inferencia encuentra apoyo suplementario en el hecho de que el conjunto lítico tiene afinidades tanto tecno como tipológicas con el Auriñaciense II, el cual no se encuentra en ningún lugar de Europa en unas fechas tan tempranas como las indicadas por los resultados de Bajondillo. Finalmente, las laminitas Dufour de Zafarraya son idénticas a las procedentes de los yacimientos portugueses de Pego do Diabo y Escoural y se relacionan, tal como se documenta en la secuencia modelo del abrigo Pataud, en Francia, con los estadios finales (III-IV) del complejo Auriñaciense, no con el Protoauriñaciense.

Por lo tanto, parece claro que en las áreas del litoral del sudoeste de la Península Ibérica, del delta del Ebro en el este, al Peñón de Gibraltar en el sur, y al estuario del Mondego en el oeste, existió una supervivencia del Musteriense (y de los neandertales) hasta, al menos, unos cinco milenios después de la sustitución del Chatelperroniense por el Protoauriñaciense en el norte de España y las regiones adyacentes de Francia. En el interior ibérico, sin embargo, el Auriñaciense permanece completamente desconocido, a pesar del intenso trabajo de prospección llevado a cabo en ciertas zonas, principalmente el Valle del Côa (noroeste de Portugal). No es imposible, por lo tanto, que las dataciones por series de uranio de ≈33-34 ka cal BP obtenidas para el Paleolítico Medio del yacimiento portugués de Foz do Enxarrique, cerca del Tajo internacional, señalen que estas áreas podrían haberse convertido en un refugio neandertal hasta el Gravetiense inicial.

Aunque el modelo de entidades discretas y sustituciones abruptas es evidente en el registro cultural, eso no significa que tenga que ser así también en el plan de la biología humana. Los

neandertales están claramente asociados al Musteriense y al Chatelperroniense y, por lógica biogeográfica, hay que inferir que las intrusiones del Protoauriñaciense en el norte de España ≈42 ka cal BP y del Auriñaciense II en el sudoeste de la península en fecha ≤37 ka cal BP tienen que estar, por lo menos en parte, relacionadas con la inmigración de humanos modernos. Sin embargo, esto no tiene por qué haber llevado a la repentina extinción de las poblaciones neandertales que vivían en esos territorios. De hecho, la evidencia indirecta proporcionada por el esqueleto del niño de Lagar Velho, algo posterior (≈30 ka cal BP), sugiere que la sustitución total que se observa en el dominio de la tecnología lítica puede haber estado asociada a una muy importante mezcla en el dominio de la biología de las poblaciones.

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