ISSN: 0514-7336

THE MOUSTERIAN COMPLEX IN PORTUGAL

O Complexo Mustierense em Portugal

João Luís CARDOSO*
** Full Professor of Pre-History and Archaeology at the Open University (Lisbon). Coordinator of the Centre for Archaeological Studies in the Municipality of Oeiras. Correo-e: arqueolo@univ-ab.pt*

Fecha de aceptación de la versión definitiva: 26-10-06

BIBLID [0514-7336(2006)59;21-50]

ABSTRACT: Considering the available data, the Mousterian period is the only techno-complex from the Middle Paleolithic identified and characterized in Portugal. However, some of the sites referred in this work should be simply attributed to the Middle Paleolithic due to the lack of detailed elements. The site of Vale do Forno 8 probably represents the transition between the final Upper Paleolithic and the early Middle Paleolithic.

The open-air sites such as the ones in the outskirts of Lisbon and on the left margin of the Tagus estuary, where vestiges are extremely abundant and the permanence for long periods correspond to sites of residential character.

None of these sites were subject to extensive excavations in order to confirm this type of settlement and further knowledge of the social organization of the inhabited spaces. Other open-air sites located in fluvial terraces present smaller areas of occupation and were probably related to game activities, maybe seasonal in nature. This was the case of Santo Antão do Tojal, were elephants and horses were eventually captured, of Foz do Enxarrique were red deer was almost exclusive and of Vilas Ruivas, were faunal remains were not preserved but remains of wind-breaks or hunting blind structures were found associated with fireplaces and post-holes. Fireplaces were also found in Gruta da Buraca Escura and on the open-air site of Santa Cita.

Caves such as Gruta da Oliveira and the Gruta Nova da Columbeira show long stratigraphic sequences and prolonged settlements, of residential type, though a few other caves also show temporary settlements related to game activities or the exploitation of geological resources. In most cases, there is an alternance of the cave occupation by humans and large carnivores. Food subsistence of humans was non-specialized, capturing large, mid and also small preys such as the rabbit, an abundant endemic species. The terrestrial turtle was also captured, especially in Gruta Nova da Columbeira. Aquatic resources were a significative part of the food supply in caves close to the coast such as Ibn Amar over the Arade estuary and Gruta da Figueira Brava, over the sea, where a lot of different species of mollucs, crustaceans and sea mammals such as seal and dolphin were present.

In the caves some few kilometers from the coast, like Gruta Nova da Columbeira, recollection or fishing activities were not present. It means that the resource exploitation areas around the settlements were small. The same reasoning is applicable to the geological resources, in which the raw materials such as quartz, quartzite and flint were used in quantities according to their availability in the surrounding cave area, never more than in a 10 km around the settlements. In some cases e.g. Gruta da Figueira Brava and Gruta do Escoural, filonean quartz was extensively used in spite of its bad quality because of its abundance in the cave surroundings. In Lisbon region, where the distance between sites did not surpasse 30 km, there is also a strong relationship between the types of materials used and their availability, indicating the opportunistic and local origin of the production, even if mobility was high within each the exploited area.

From both technical and typological points of view, the Final Mousterian represented by the assemblages of Gruta da Oliveira, Gruta Nova da Columbeira and Gruta da Figueira Brava, showed no evidence of transition to the Upper Paleolithic but rather a "mousterianisation" of the lithic industry was observed.

The food supplies used and the species captured reflected the paleoclimatic conditions that took place. The eldest materials dated Mousterian were collected in Gruta da Furninha, from *ca.* 80 Ka calBP, and are related to the stripped hyaena *(Hyaena hyaena prisca*), a species of warm climate coexisting with the warmwater species *Patella safiana* and *Pectunculus bimaculatus* which existed in the 5-8 m a.s.l. marine conglomerate level observed in Forte da Baralha, in the littoral of the Arrábida Ridge. Presently these species do not occur at latitudes higher than the Mediterranean or the Atlantic Moroccan coast.

After the formation of the fossil deposits of Gruta da Furninha, the palaeoclimatic evolution is not known until *ca.* 45 Ka calBP, represented by the palaeontological sites of Vale de Janela in the Estremadura littoral and São Torpes in the Alentejo littoral. In both sites there were found species related to a cool and wet temperate climate, but *Myrica* also occurs, a termophilic genus. A climate cooler than the Mediterranean is in agreement with the presence of the mountain goat in the upper Mousterian levels of gruta da Oliveira dating before 43/42 Ka calBP. Afterwards, the climate became progressively warmer and Mediterranean-type: the mountain goat disappeared from Gruta da Oliveira and Mediterranean rodents are present in the Level 8 of that cave, dating from 38/37 Ka calBP, while *Cepaea nemoralis* appeared in Lapa dos Furos, dating from 40 Ka calBP.

From 36 Ka calBP on, there was a climatic cooling and the mountain goat reappears in low altitude mountain ranges (Gruta Nova da Columbeira and Gruta da Figueira Brava). In fact, the weather conditions were probably cooler than in the present and comparable to those in the cantabrian region, as suggested by the findings in Gruta da Figueira Brava. But the presence of the land turtle, which was abundant in Gruta Nova da Columbeira (up to 34-31 Ka calBP) demands summer temperatures *ca.* 20-30 ºC for egg hatching. On the other hand, the microfauna from Level K in Gruta do Caldeirão, including *Allocricetus bursae*, shows how steppic conditions migrated to the western part of the Iberian Peninsula and prevailed when the first industries of the Upper Paleolithic occurred, an evolved phase of the Aurignacian, about probably 35-34 Ka calBP.

Within this particular paleoclimatic framework of the western and southwestern parts of the Peninsula, it is possible to accept the survival of population remains of some species including the ancient elephant which is present in Foz do Enxarrique about 33.6 Ka calBP, and also the last Neanderthals and their Late Mousterian industry.

Key words: Climate. Chronology. Lithic assemblages. Mousterian. Portugal.

RESUMO: O Mustierense é o único tecno-complexo do Paleolítico Médio reconhecido e caracterizado em Portugal. Alguns dos conjuntos industriais referidos neste trabalho foram, contudo, incluídos na designação mais genérica de Paleolítico Médio, por falta de elementos de pormenor.

As estações de ar livre referenciadas parecem corporizar, nuns casos, face à enorme quantidade de vestígios, estacionamentos intensivos e prolongados, de tipo residencial, favorecidos pela abundância de matérias-primais disponíveis. É o caso das estações dos arredores de Lisboa e das existentes na margem esquerda do estuário do Tejo. Nenhuma foi objecto de escavações em extensão, impossibilitando a confirmação desta situação, por um lado e, por outro, o conhecimento da organização interna do espaço habitado. Outras estações de ar livre, implantadas em terraços fluviais, ocupam áreas menores e configuram actividades cinegéticas especializadas, talvez de carácter sazonal: é o caso de Santo Antão do Tojal, onde provavelmente se capturou o elefante, da Foz do Enxarrique, especializada na caça ao veado e de Vilas Ruivas, onde os restos faunísticos não se conservaram. Naquela última estação, foram identificadas estruturas habitacionais, atribuídas a pára-ventos (wind-breaks), ou a tapumes de caça (hunting-blinds), associadas a lareiras e a possíveis buracos de poste; estes testemunhos juntam-se às lareiras identificadas na Gruta da Buraca Escura e no sítio de ar livre de Santa Cita.

As grutas revelam por vezes estratigrafias extensas, denunciando permanências prolongadas e recorrentes, o que configura a situação de corresponderem a sítios de tipo residencial, sem prejuízo de também se conhecerem grutas com ocupações episódicas, relacionadas com actividades cinegéticas ou de exploração de recursos geológicos. A Gruta da Oliveira e a Gruta Nova da Columbeira estão no primeiro caso. Evidencia-se a alternância da sua ocupação por carnívoros e pelo homem. A variedade dos recursos cinegéticos identificados mostra uma economia de subsistência não especializada, capturando-se presas de grande, médio e pequeno porte. Entre as últimas encontra-se o coelho, espécie endémica, então muito abundante, cuja caça era acompanhada pela da tartaruga terrestre, a qual atinge expressão significativa na Gruta Nova da Columbeira. Os recursos aquáticos constituíam parte significativa da dieta em grutas próximo do litoral, como a Gruta de Ibn Amar, sobre o estuário actual do rio Arade e a Gruta da Figueira Brava. Nesta última, a importância desse contributo alimentar é evidenciada pela diversidade e abundância das espécies de moluscos identificados, acompanhados de crustáceos e até de mamíferos marinhos, como a foca e o golfinho.

O facto de a componente de pesca e recolecção não se ter reconhecido em grutas fora da linha de costa actual evidencia a área relativamente limitada de captação de recursos inerente a cada gruta, sem prejuízo de os seus habitantes, dentro dos respectivos territórios, conhecerem um alto grau de mobilidade, o qual é sublinhado pela diversidade de recursos explorados. Esta situação também se aplica à utilização dos recursos geológicos. Com efeito, nota-se que as matérias-primas mais utilizadas, são o quartzo, o quartzito e o sílex, em percentagens variáveis consoante a sua própria disponibilidade na envolvência imediata das grutas, não ultrapassando um raio superior a 10 km. Noutros casos, como na Gruta da Figueira Brava e na Gruta do Escoural, observou-se uma incidência muito forte na utilização do quartzo filoneano, apesar da sua má qualidade, em virtude de ser a rocha disponível no território adjacente.

Do ponto de vista tecnológico e tipológico, os três conjuntos reconhecidamente datados do Mustierense Final do território português mais importantes: Gruta da Oliveira; Gruta Nova da Columbeira e Gruta da Figueira Brava, não evidenciam qualquer indício de evolução para indústrias do Paleolítico Superior notando-se, ao contrário, um reforço das suas características mustierenses.

Os mais antigos materiais mustierenses estratigrafados provêm da Gruta da Furninha, datados de *ca.* 80 Ka calBP, encontrando-se associados a hiena raiada *(Hyaena hyaena prisca)*. Trata-se de espécie de clima quente, já então uma relíquia a nível europeu, compatível com a ocorrência, no cordão conglomerático formado ao longo do litoral da serra da Arrábida a 5-8 m de altitude, contemporâneo daquele depósito, de *Patella safiana*, espécie de águas quentes, que actualmente não ultrapassa a latitude do litoral atlântico marroquino, acompanhada de *Pectunculus bimaculatus*, de distribuição mediterrânea.

Desconhece-se a evolução paleoclimática entre a época de formação do depósito fossilífero da Furninha e cerca de 45 Ka calBP. Tal é a cronologia obtida pelo radiocarbono para as jazidas de interesse paleontológico de Vale de Janela, no litoral da Estremadura e de São Torpes, no litoral alentejano. Apesar de existirem em ambas as jazidas espécies de clima temperado mais fresco e húmido que o mediterrânico, é de salientar a manutenção do género *Myrica*, de características termófilas. Com efeito, a tendência para um clima temperado fresco é compatível, para a referida época, com a presença de cabra montês nos níveis mustierenses inferiores da Gruta da Oliveira, anteriores a 43/42 Ka calBP. A partir desta época o clima parece tormar-se progressivamente mais quente, assumindo características mediterrâneas: tal é indicado pelo desaparecimento da cabra montês na Gruta da Oliveira, acompanhada (Nível 8) de associação de roedores de características mediterrâneas datada de *ca*. 38/37 Ka calBP, compatível com a presença de *Cepaea nemoralis* na Lapa dos Furos, *ca*. de 40 Ka calBP.

A partir de 36 Ka calBP as condições climáticas parecem modificar-se progressivamente no sentido do arrefecimento: a cabra montês reaparece nas cadeias montanhosas atlânticas de baixa altitude (Gruta Nova da Columbeira e Gruta da Figueira Brava); o arrefecimento climático, corresponde a condições um pouco mais frias que as existentes actualmente na zona, mas comparáveis às do litoral cantábrico, é comprovado pelo conjunto de indicadores disponíveis na Gruta da Figueira Brava, o mais completo até ao presente reunido. Mas a presença, até *ca*. 34-31 Ka calBP, na Gruta Nova da Columbeira, da tartaruga terrestre, espécie ali abundante, que requeria temperaturas da ordem dos 20 a 30 graus centígrados ao longo do Verão, para a incubação dos ovos, indica que o arrefecimento clumático não poderia ter sido muito acentuado. Por outro lado, a microfauna do Nível K da gruta do Caldeirão, com *Allocricetus bursae*, demonstra a progressão até ao ocidente peninsular das condições estépicas cerca de 35 Ka calBP. Tais condições prevaleciam aquando do surgimento na região, talvez *ca*. 35-34 Ka calBP, das primeiras indústrias do Paleolítico Superior, pertencentes já a um estádio evoluído do Aurignacense.

É neste quadro paleoclimático particular ao ocidente e sudoeste peninsular que se devem entender sobrevivências tardias de certas espécies, como o elefante antigo, presente na Foz do Enxarrique cerca de 33,6 Ka calBP o qual, oferecendo condições geográficas favoráveis, favoreceu também a tardia presença dos últimos Neandertais e, com eles, do Mustierense Final no território português.

Palavras chaves: Clima. Cronologia. Indústrias. Mustierense. Portugal.

1. Introduction

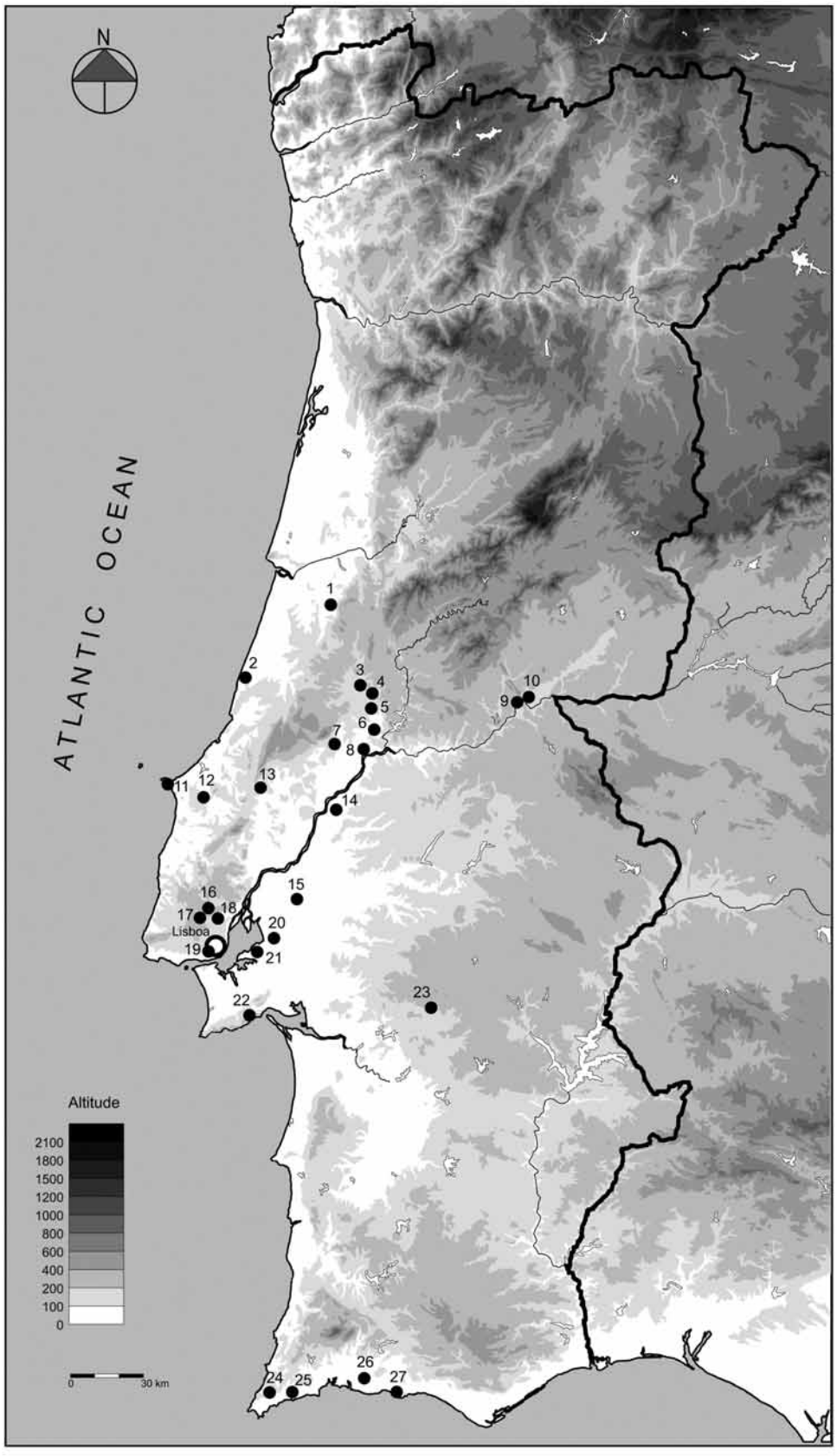
In order to understand the human presence in present-day Portuguese territory corresponding to the Mousterian complex –the only cultural complex from the Middle Paleolithic so far recognised and characterised in the Portuguese territory (Bicho, 2004)– whose *terminus* has been verified at roughly 35/34 Ka calBP years, a limit generally accepted nowadays (Table 1), it is important to begin with a brief description of the most important sites that have been identified up to now (Fig. 1). This will form the basis for a discussion of the main issues leading,

in the final part of this article, to a concluding summary of models of land use and occupation, closely linked to the evolution of the paleoclimatic and paleogeographic characteristics of the environments in which human activity took place.

Although some of the caves occupied during the Mousterian period had been excavated in the 19th. century, as was the case with the Furninha cave, and the materials carefully recorded according to the levels on which they were found (Delgado, 1884), interest in excavating caves declined during the 20th. century in favour of the study of open-air sites, usually lacking any stratigraphic indicators. Two main reasons lay behind this: on the one hand, the impossibility of carrying out lengthy and systematic explorations of caves due to the lack of available and suitably qualified archaeologists and, on the other hand, the lack of funding meant that researchers could not be trained who could then, in collaboration with specialists from other countries, establish an area of research, as had been the case in Spain. From the beginning of the 20th. century until the start of the 1960s, the study of Middle Paleolithic materials in Portugal was therefore restricted to the results of surface collections, involving low investment and a methodology that any amateur could learn in a few hours. This happened with the rich Paleolithic sites on the outskirts of Lisbon, discussed later, which were the object of intensive collecting following the discovery of the famous site at Casal do Monte just outside Lisbon, in 1909, by Joaquim Fontes. This approach to studying Paleolithic materials was boosted in the mid-1940s by the presence of H. Breuil in Portugal (between June 1941 and November 1942), legitimising this form of collecting with the adoption of a method –the so-called "series method"– that resolved the limitations arising out of a lack of stratigraphic information, based as much on the typology as on the physical state of the industry. Thus the greater the surface wear on the examples, including the identification of the superimposition of successive forms of erosion (e.g. water, wind), the older the item was, based on the principle that all items were affected by the same conditions since they had been abandoned on the surface. Without wishing to enter into a discussion on the relative merits and limitations of these criteria, which continued to be used in Portugal for the following sixty years due to the work of G. Zbyszewski, a disciple of Breuil, it may be affirmed that he presided almost exclusively over the classification of Lower and Middle Paleolithic industry in Portugal until the start of

Site	Level	Sample	Method	Lab Reference	Age BP	Comment
Almonda, EVS	EVS Cone	*Equus* (tooth enamel)	U-Th	SMU-231E1	35,000±2.000	Low 230Th/232Th ratio
Almonda, Gruta da Oliveira	8	Burnt bone	AMS^{14}C	GrA-10200	31,900±200	Alkaline fraction dated
	8	Burnt boné	AMS^{14}C	OxA-8671	32,740±420	
	9	Burnt bone	AMS^{14}C	Beta-111967	40,420±1.220	
	9	Burnt bone	AMS^{14}C	GrA-9760	38,390±480	Alkaline fraction dated
	11	Burnt boné	AMS^{14}C	OxA-8672	42,900±1.20	
	Mousterian Cone	*Equus* (tooth enamel)	U-Th	SMU-308-247E2	53,000+5.600-5.300	Average of the two determinations, ca 62,000
				SMU-247E1	70,250±9,000	
Gruta do Caldeirão	K top (J6)	*Cervus*	AMS^{14}C	OxA-5541	18,060±140	Low colagen content (0,32%N; 3,66%C; 0,53%H)
	K base (K5)	*Capra*	AMS^{14}C	OxA-5521	23,040±340	Low Colagen content (0,32%N; 2,39%C)
	K top	*Cervus*	AMS^{14}C	OxA-1941	27,600±600	
Conceição	C	Sediments	OSL	QTLS-CNC11	27,200±2,500	Layer C overlies the archaeological level; result is minimum age
	E	Sediments	OSL	QTLS-CNC12	74,500+11,600-10,400	Layer E underlies the archaeological level; result is maximum age
Gruta do Escoural	Test 3a, 90-100	*Bos* (tooth enamel)	U-Th	SMU-248	26,400+11,000-10,000	Low uranium content
	Test 3a, 80-90	*Cervus* (tooth enamel)	U-Th	SMU-249	39,800+10,000-9,000	Low uranium content (3,4%)
	Test3a, 60-70	*Equus* (tooth enamel)	U-Th	SMU-250	48,900+5,800-5,500	
Gruta da Figueira Brava	2	*Patella* sp. Shells	^{14}C	ICEN-387	30,930±700	
	2	*Cervus* (tooth enamel)	U-Th	SMU-232E1	30,561+11,759-10,725	
	2	*Cervus* (tooth enamel)	U-Th	SMU-233E2	44,806+15,889-13,958	
Foz do Enxarrique	C	*Equus* (tooth enamel)	U-Th	SMU-225	32,938±1,055	Average of the three results, 33,600±500
	C	*Equus* (tooth enamel)	U-Th	SMU-226	34,088±800	
	C	*Equus* (tooth enamel)	U-Th	SMU-224	34,093±920	
Guta Nova da Columbeira	16 (=7)	Carbonaceous earth	^{14}C	Gif-2703	26,400±700	
	7	Tooth enamel	U-Th	SMU-235E1	35,876+27,299-35,583	
	7	Tooth enamel	U-Th	SMU-238E1	54,365+22,240-27,525	
	20(=8)	Carbonaceous earth	^{14}C	Gif-2704	28,900±950	
	8	Tooth enamel	U-Th	SMU-236E1	60,927+27,405-35,522	
					101,487+38,406-55,919	
Lapa dos Furos	4	*Helix nemoralis* shells	^{14}C	ICEN-473	34,580+1,160-1,010	Layer 4 underlies the archaeological level; result is maximum age
Gruta do Pego do Diabo	3	Bone colagen	^{14}C	ICEN-491	18,630±640	Impure colagen
Pedreira de Salemas	1	Bone colagen	^{14}C	ICEN-366	29,890+1,130-980	
Gruta de Salemas	T.V.b	Bone colagen	^{14}C	ICEN-379	24,820±550	Dated level contains a mix of Middle and Upper Paleolithic artifacts
Santo Antão do Tojal	2	*Elephas* (bone)	U-Th	SMU-305	81,900+4.000-3,800	
Vilas Ruivas	B	Sediments	TL	BM-VRU1	51,000+13,000-12,000	Average of the two results
					54,000/+12,000/-11,000	
	B	Sediments	TL	BM-VRU2	68,000+35,000-26,000	

TABLE 1. *Radiometric results for the Musterian of Portugal (after Zilhão, 2001, modified).*



1 - Gruta da Buraca Escura; 2 - Mira Nascente; 3 - Lapa dos Furos; 4 - Estrada do Prado; 5 - Gruta do Caldeirão; 6 - Santa Cita; 7 - Gruta da Oliveira; 8 - Ponte da Pedra; 9 - Vilas Ruivas; 10 - Foz do Enxarrique; 11 - Gruta da Furninha; 12 - Gruta Nova da Columbeira; 13 - Rio Maior region; 14 - Vale do Forno; 15 - Arneiro Cortiço; 16 - Gruta e Pedreira de Salemas; 17 - Gruta do Correio-Mor; 18 - Terraço de Santo Antão do Tojal; 19 - Midle Paleolithic of the vulcanic complex of Lisbon; 20 - Cascalheira; 21 - Conceição; 22 - Gruta da Figueira Brava; 23 - Gruta do Escoural; 24 - Lagoa Funda e Lagoa do Bordoal; 25 - Vale de Boi; 26 - Gruta de Ibn-Amar; 27 - Praia da Galé.

FIG. 1. *Location of the studied sites.*

the 1980s, when a small group of researchers emerged who, despite their different academic backgrounds, finally managed in various ways to harness the necessary funding for extensive research into cave and open-air site deposits.

In spite of the scarcity of human resources, it is during this period, spanning the last 25 years, that the most significant advances have been made towards understanding the Middle Paleolithic in Portugal, although this has been inseparable from parallel research into the Upper Paleolithic, bearing in mind that the sites were either the same or were located in the same geographical area, particularly the Estremadura Limestone Massif and adjacent areas, where there is an abundance of karst caves, thus justifying combined research work.

The direct predecessor of the studies currently being undertaken into the Middle Paleolithic period in Portugal was the excavation of the Gruta das Salemas (Loures), followed by that of the Gruta Nova da Columbeira (Bombarral), both carried out by the staff of the *Serviços Geológicos de Portugal* at the beginning of the 1960s. It was the only official organisation that had the necessary resources and technical means to carry out such research, albeit in a circumstantial and limited manner since it was subordinated to geological work. Nevertheless, it was the excavation of these caves, due, in particular to the work of O. da Veiga Ferreira, which inaugurated the era of modern research into the Middle and Upper Paleolithic in Portugal. The delay in following-up the research explains the long period before the appearance of the first summary on the Early and Middle Portuguese Paleolithic (Zby 74). A later and more detailed summary appeared twenty years later (illustrating the rapid evolution of knowledge that had taken place in the interim; Raposo, 1993). Recently, the subject has interested several researchers (Bicho, 2004; Zilhsa, 1992, 2004, 2006; Cardoso, 2002).

2. The archaeological record

2.1. *Sites on the outskirts of Lisbon*

The earliest recovery of Paleolithic materials on the outskirts of Lisbon dates from the end of the 19th century, initially in the Monsanto hills, where the abundance

of flint, occurring in the form of nodules in the hard Cretaceous limestone, enabled thousands of items to be chipped in workshops which operated throughout most of the Paleolithic period and extended into post-Paleolithic times. However, successive quarrying of the Cretaceous limestone in this region, especially after the great earthquake of 1755, did away with most of the existing remains. The most substantial collections were found in the vast basalt complex of Lisbon which extends almost continuously from the Cascais to the Loures region, forming a long arc around the capital, with a greater concentration of occurrences in the Amadora and Benfica regions. The extensive Paleolithic area discovered in the region was therefore named the Lisbon Paleolithic Volcanic Complex.

In 1932, A. do Paço (Paço, 1932) mapped out 94 Paleolithic sites surrounding the capital and the inventory was subsequently updated but not significantly altered (Paço, 1940; Jalhay & Paço, 1941). Many of these sites (Fig. 2) had been previously identified by Vergílio Correia and Joaquim Fontes who, in the same year but as the result of independent work, presented the first summaries of these sites (Fontes, 1912; Correia, 1912), thus demonstrating the Paleolithic richness of the region. Joaquim Fontes was also responsible for identifying the first and certainly the most important site in the region, Casal do Monte, in 1909 (Fontes, 1910). He was also apparently the first person to use the term "Mousterian" in Portugal (referring to the "Moustier epoch" and "Moustier type") in 1912 whilst studying examples collected from sites on the outskirts of Lisbon, stating that he was using the nomenclature of G. and A. de Mortillet. Encouraged by the interest his discoveries aroused abroad, since little was known at the time about the Portuguese Lower and Middle Paleolithic, in the same year Joaquim Fontes presented the first summary on the Mousterian period in Portugal (Fontes, 1913) at the 8th session of the French Pre-Historic Conference held in Angoulême in 1912. In this study he classified the main types of Mousterian tools on the basis of collections he had gathered from sites on the outskirts of Lisbon, describing the Gruta da Furninha as the only known site of stratigraphic interest based on of the excavations carried out there by Nery Delgado in 1879.

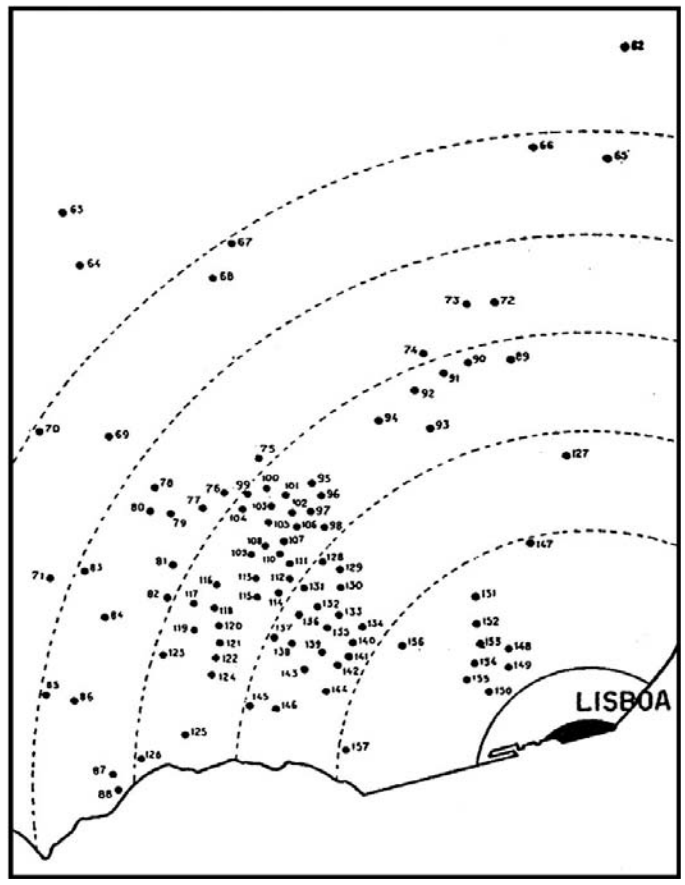


FIG. 2. *General distribution of the Paleolithic sites located in Lisbon outskirts (after Paço, 1940).*

The thousands of tools that had been previously been recovered, considerably enlarged by their own collections (Fig. 3), were studied exhaustively by H. Breuil and G. Zbyszewski as part of their systematic review of the Paleolithic in the Lisbon region, thus identifying a long succession of industry from the Lower Acheulean to post-Paleolithic times. This considerable industry is explained not only by the broad diachronics of the succession, but also by its geographical isolation, since it is associated with a near peninsula bordered by the ocean in the west, the Tejo estuary in the south and the Tejo valley in the east, and particularly by the availability of raw material, essentially consisting of Cretaceous flint (Fig. 4) and, to a lesser extent, quartz and quartzite pebbles from the Plio-Pleistocene deposits that have almost completely disappeared today.

FIG. 3. *Collection of Paleolithic artefacts at Linda-a-Pastora (Oeiras), in Lisbon outskirts by H. Breuil and collaborators in 1941/1942 (after Cardoso, Zbyszewski & André, 1992).*

Bearing in mind the technical and typological characteristics of the tools, the human presence must have reached its peak during the Mousterian age. At this time, the region was, probably densely covered with shrubs and intermittently surrounded by forest areas, would have been a good hunting ground, also due to the mild climate resulting from the low latitude and proximity to the coast. In fact, the predominance of open-air camps

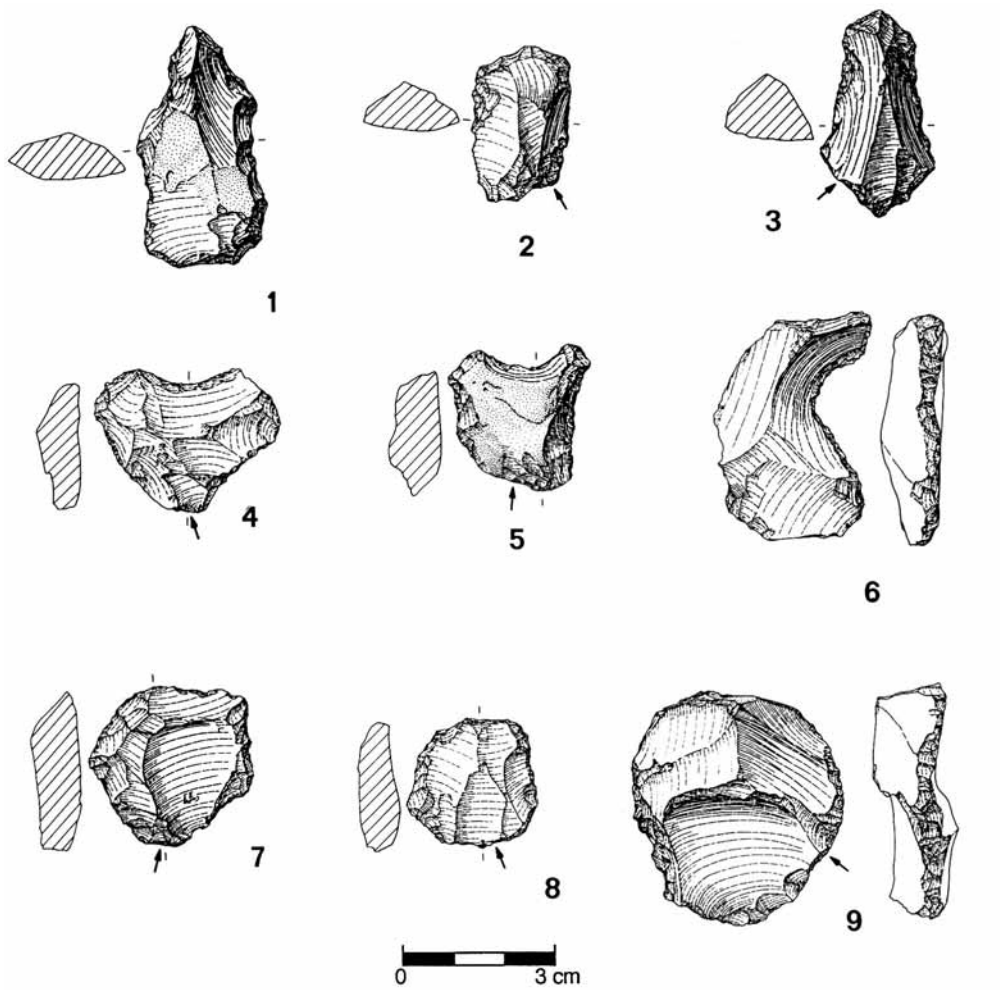


FIG. 4. *Artefacts from the Mousterian site of Venteira (Amadora), in Lisbon outskirts. 1 – borer; 2, 9 – endscrapers; 3 – double sidescraper; 4, 5 – transverse scrapers; 6 – notche; 7, 8 – sub-discoid scrapers; 10 – double convergent sidescraper; 11 – Mousterian core. All of flint (after Cardoso & Zbyszewski, 1995).*

over cave dwellings, which were almost always sporadically distributed, indicates the existence of a generally benign climate during most of the last glacial period.

The Paleolithic materials on the surface were so widely dispersed that the concentrations observed locally, all invariably lacking stratigraphic information, were denied the status of authentic archaeological sites by H. Breuil and G. Zbyszewski as, in fact, they are not, in the traditional sense of the term, signifying the demarcated distribution of artefacts with a well-defined stratigraphic position: "These are widely dispersed over all the surfaces that were investigated and, although denser in certain areas, were not really located in authentic sites" (Breuil & Zbyszewski, 1942: 32).

Due to gravity and post depositional mass movement, the items were dispersed over the slopes. In the upper parts of the landscape, erosion revealed basalt outcrops and, at the bottom of the valleys levelled by fine sediments, it covered the older levels containing Paleolithic materials. This does not, however, refute the existence of areas containing obvious concentrations of artefacts separated by areas where they do not occur, as Joaquim Fontes had already clearly emphasised (Fontes, 1912).

The most recent summary on the Lisbon Paleolithic Volcanic Complex (Cardoso, Zbyszewski & André, 1992) demonstrates the interdependence of the type of raw materials used and the regional geological sources that were potentially available. Thus, in the most westerly zones of this Paleolithic area, close to the flint nodules found in the hard Cretaceous limestone ridges, this is the raw material which predominates, whereas in the central sector, representing the largest concentration of materials, as witnessed in the Amadora and Benfica areas, there is a greater use of quartzite and quartz, which would have been available locally in the remains of the Plio-Quaternary detritic deposits. Finally, in the most easterly zone in the Loures area, quartz vein pebbles predominate, originating in Tertiary detritic deposits. This shows that, notwithstanding the remarkable mobility of these groups and the mere dozens of kilometres that separated the eastern from the western zone, the production of artefacts was carried out locally, according to need, and opportunistically, making use of rock that was available locally.

2.2. *The Tejo valley terraces and the terraces of the left bank tributaries*

2.2.1. Foz do Enxarrique (Vila Velha de Ródão)

Located upstream from the previous site and from Portas de Ródão and associated with a 5-10 m terrace of the River Tejo periodically affected by river flooding, a single archaeological level has been identified in an area of roughly 150 m^2, consisting of fine sediments (Fig. 5) which, due to the formation of a calcium carbonate precipitate, have allowed the presence of faunal remains (Raposo *et al.*, 1985). In fact, the association with the

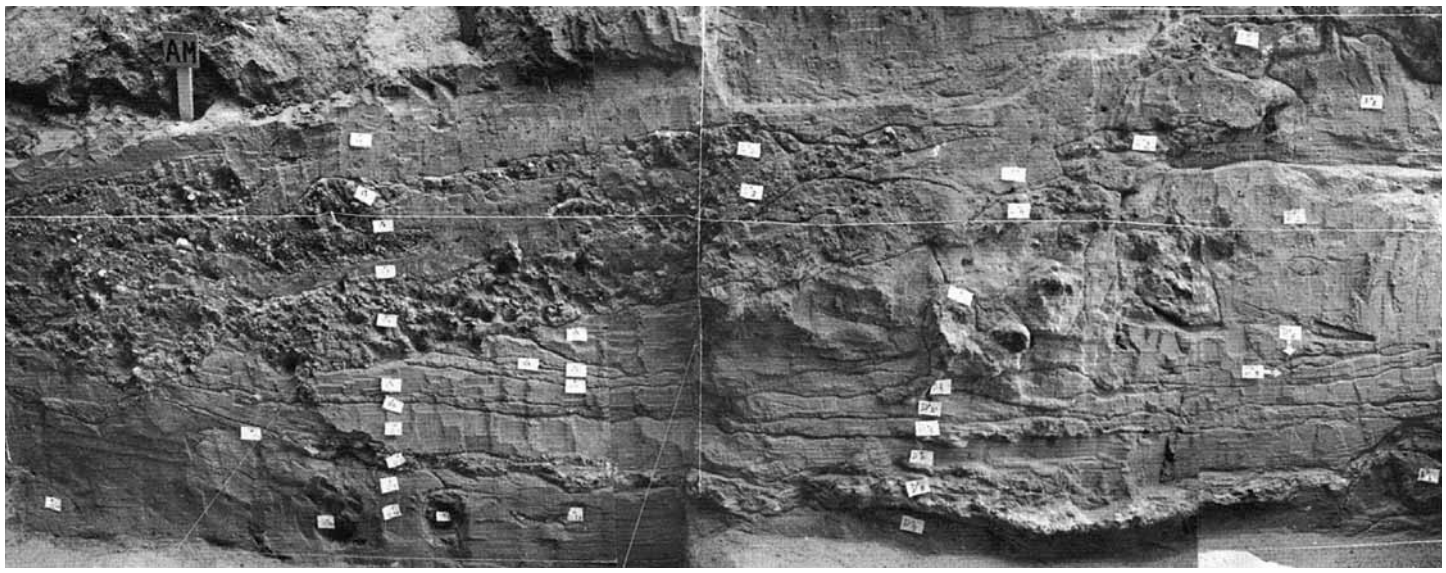


FIG. 5. *Stratigraphic cross-section from Foz do Enxarrique (after Cardoso, 1993).*

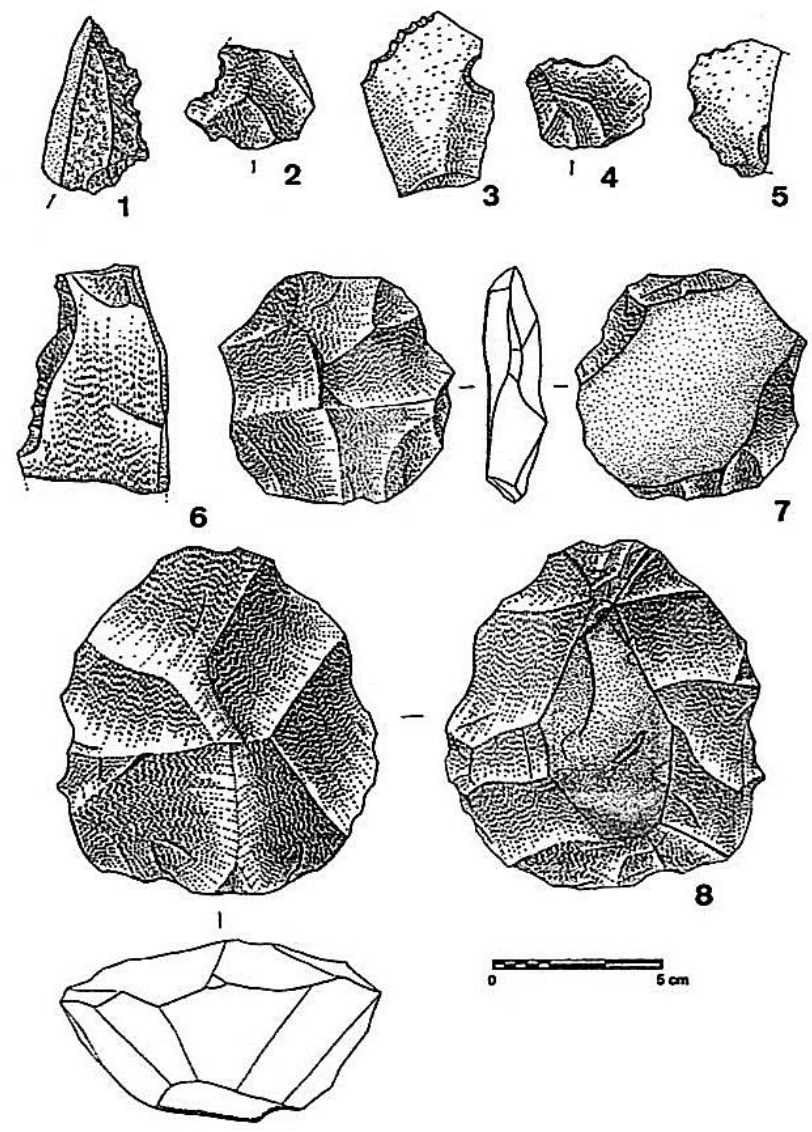


FIG. 6. *Industry from Foz do Enxarrique. 1-5 – denticulates and notches; 6 – single sidescraper; 7, 8 – cores. 1, quartz; 2-8, quartzite (after Raposo, 1995).*

human occupation of this faunal assemblage –including deer, horse, aurochs, rabbit, rhinoceros and elephant (Cardoso, 1993; Brugal & Raposo, 1999), in which the first two species predominate– has been questioned by J. Zilhão (Zilhão, 2001). However the author himself later admitted that although the remains of large animals such as elephant and rhinoceros may have corresponded to a natural accumulation, to which the remains of carnivores such as the hyena, fox and occasionally bear may be added, the remains of the other animals, particularly deer, which represent almost 90% of the total, show signs of cutting and burning (Zilhão, 2006). Therefore, even taking these reservations into account, this association of fauna with lithic remains may still be considered generally valid as an indication of a human encampment in that sector of the river bank, where it is joined on its right-hand bank by the Enxarrique tributary.

The weighted average of three U/Th datings on the teeth of horses (2) and aurochs (1) gave a result of 33,600 years BP ± 500 years. The lithic assemblage, most of which was chipped on site thus establishing the existence of a "work camp", is dominated by the use of quartzite available locally in large amounts from the gravel levels of the terrace.

Approximately 10,000 artefacts were recovered which unfortunately have still not been studied in detail (Fig. 6). The Levallois technique is frequently in evidence, either in the form of centripetal chipping used to work the cores or in the method for removing a predetermined flake or point, with all the stages in the operational chain for preparation and flaking present, as well as the corresponding subproducts, most of which must have been used without transformation, given the scarcity of retouched tools.

Due to the large amount of material it has provided, its stratigraphic features and its absolute

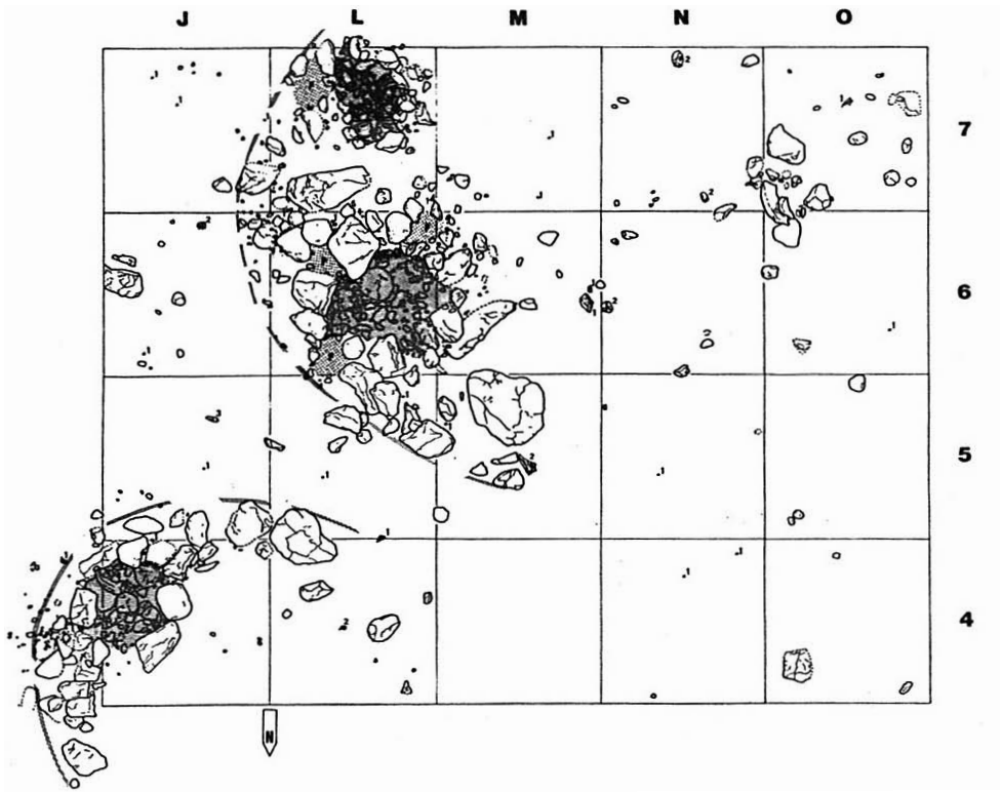


FIG. 7. *Wind breaks at Vilas Ruivas, with firehearths (dark zones) and possible postholes (grey zones). Scale 1/50 (after GEPP, 1983).*

chronology, together with the valuable faunal information it contains, the Foz do Enxarrique site represents one of the most important Upper Middle Paleolithic sites in the Iberian peninsula.

2.2.2. Vilas Ruivas (Vila Velha de Ródão)

Two thermoluminescence datings gave a weighted average of 54,000 years + 12,000; -11,000 years BP for the surface occupation of the remains of a Quaternary terrace downstream from Portas de Ródão and 32 m above the level of the Tejo (Raposo, 1995). The main interest of the site lies in the fact that two arched structures have been preserved, possibly representing the bases for shades to protect fire structures suggested by the accumulation of thermoclast elements. Four negative structures have also been identified, which are circular and approximately 20 cm in diameter and may be interpreted as post holes (Fig. 7). Luís Raposo (L. Raposo, 1995; GEPP, 1977) has no doubts as to the anthropic nature of these structures, not only because of their configuration but also because they are made from pebbles that had been transported to the area, given that the underlying geological deposit consists of fine sandy silt. The Vilas Ruivas site may therefore be associated with a group which exploited the hunting resources of the region adjacent to the great peninsular river, constructing fireplaces –as the aforementioned structures may be interpreted– and using the abundant raw material available locally (particularly quartzite pebbles) for processing in the area (as a "working camp site"). The industry belongs to the Middle Paleolithic and contains Levallois discoid cores, together with their associated subproducts, in addition to some retouched tools, scrapers and denticulates (Fig. 8).

According to J. Zilhão, following L. Binford's ethno-archaeological model, this could be an example of a hunters' camp and he interprets the two arched structures as "hunting blinds", emphasising their similarity to those recorded in the Côa Gravettian sites roughly 150 km to the north (Zilhão, 1992, 2001).

2.2.3. Vale do Forno (Alpiarça)

The middle levels of the middle terrace in Vale do Forno supplied materials that are characteristic of the Upper Acheulean and may be placed towards the end of this technocomplex, between the Late Riss and the Early Würm, in accordance with radiometric dating obtained from two of the levels, VF 7 and VF 8 (Raposo, 1995). This therefore defines the lower chronological limit of the Mousterian period in Portugal, at least in that region. However, a lack of absolute dates prevents any adequate discussion of this question in scientific terms.

One of the sites which has been investigated, Vale do Forno 8, which belongs to the Upper Acheulean and has been placed by Luís Raposo in the Late Riss, has provided, in association with typically Acheulean items such as some bifaces and axes, numerous flake artefacts of Middle Paleolithic pattern in flint and quartzite including Tayac points, scrapers, denticulates, borers and discoid cores (Fig. 9). But their similarities with the sites on the left bank of the Tejo estuary located further downstream are denied by L. Raposo. "This allows the inclusion of these assemblages into a wider idea of the Middle Paleolithic, despite the presence of techno-typological characteristics very different from the real Mousterian industries" (Vega Toscano, Raposo & Santonja, 1999). Nevertheless, the presence of some acheulian artefacts is not a decisive argument against the integration of this industry in the Mousterian complex, having in account the frequence of bifaces in the earlier times of the French Mousterian. On the other hand, L. Raposo stresses the fact that flaking industry predominates, obtained from globulous rather discoid cores, corresponding neither to the typical mousterian nor to an acheulian technology (L. Raposo, personnal information). In conclusion, when more complete data has been gathered, the succession of industries discovered *in situ* in the complex terrace system of the Lower Tejo in the Alpiarça region will open up discussion on the transition of industries from the Lower to the Middle Paleolithic, similar to that which has been observed in other large Peninsular river systems such as the Manzanares an Tormes valleys.

2.2.4. Arneiro Cortiço (Benavente)

In their study of the Quaternary terraces of the Lower Tejo valley area and the corresponding Paleolithic industries, H. Breuil and G. Zbyszewski recorded various Paleolithic materials associated with the terraces of the River Almansor, a tributary on the left bank of the Tejo, although only a small amount had been collected *in situ* (Breuil & Zbyszewski, 1945). Later, the second of these two authors, together with O. da Veiga Ferreira, identified other areas in the same region. In four of these areas, items were recovered *in situ* from the gravel bed deposits of the lower terrace (Q4, between 8 and 20 m). The materials, made exclusively from quartzite pebbles and flakes, were classified as dating from between the Upper Acheulean and the Mousterian period (Zbyszewski & Ferreira, 1967).

Like many others, these occurrences would not merit any special attention in a summary such as this had they not preceded an important archaeological intervention which made them more significant. In fact, as part of the work involved in mitigating the environmental impact of the building of the A13 motorway, various areas containing Paleolithic industries dispersed over the surface have been identified, six of which are of stratigraphic interest, including the site of the previously unknown Arneiro Cortiço, which merits excavation work.

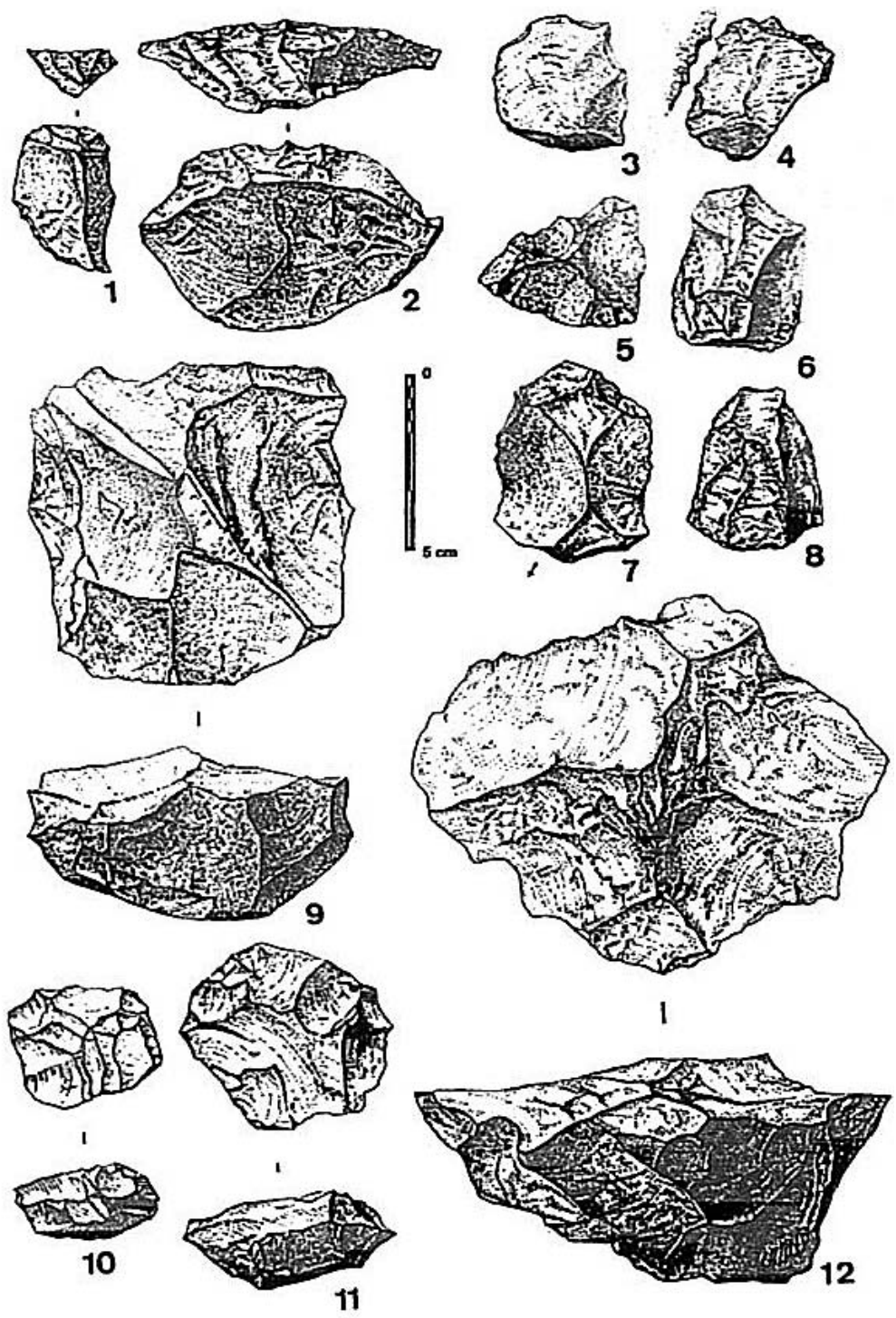


FIG. 8. *Industry from Vilas Ruivas. 1 – endscraper; 2 – sidescraper; 3-5 – denticulates; 6-8 – Levallois flakes; 9-12 – cores. 1-9, 11, 12, quartzite; 10, flint (after Raposo, 1995).*

This site is located at an altitude of 19 m on the remains of a terrace of the left bank of the River Almansor. Surveys have resulted in the recovery of 510 artefacts stratigraphic interest (Gaspar & Aldeias, 2005). It is a characteristic flaking industry of the Middle Paleolithic, with the almost exclusive use of quartzite pebbles with a core/flake ratio of 1/5. Expeditive use has been made of the abundant raw materials that are strewn over large areas of the surface of the several terraces that have been identified.

The existence of tools is minimal, denoting a context identical to others from the same period in the Lower Tejo valley. The average of 61 items per m^2 reveals heavy chipping activity in the area or nearby, which is another identifying feature of the sites in this region. Unfortunately, the deposit has not been dated and the chronology of the site can only be inferred from the geological conditions, which are similar to those at the Conceição site discussed later.

2.2.5. The Santo Antão do Tojal terrace (Loures)

Mousterian materials have been observed on a 10-15 terrace in Santo Antão do Tojal, Loures, in the valley of the Trancão River, in cuts exposed by the construction of irrigation channels in the 1930s. These are apparently associated with the presence of charcoal and the bones of horses and elephants, slaughtered by the lacustrine area which existed there at the time (Zbyszewski, 1943, 1977).

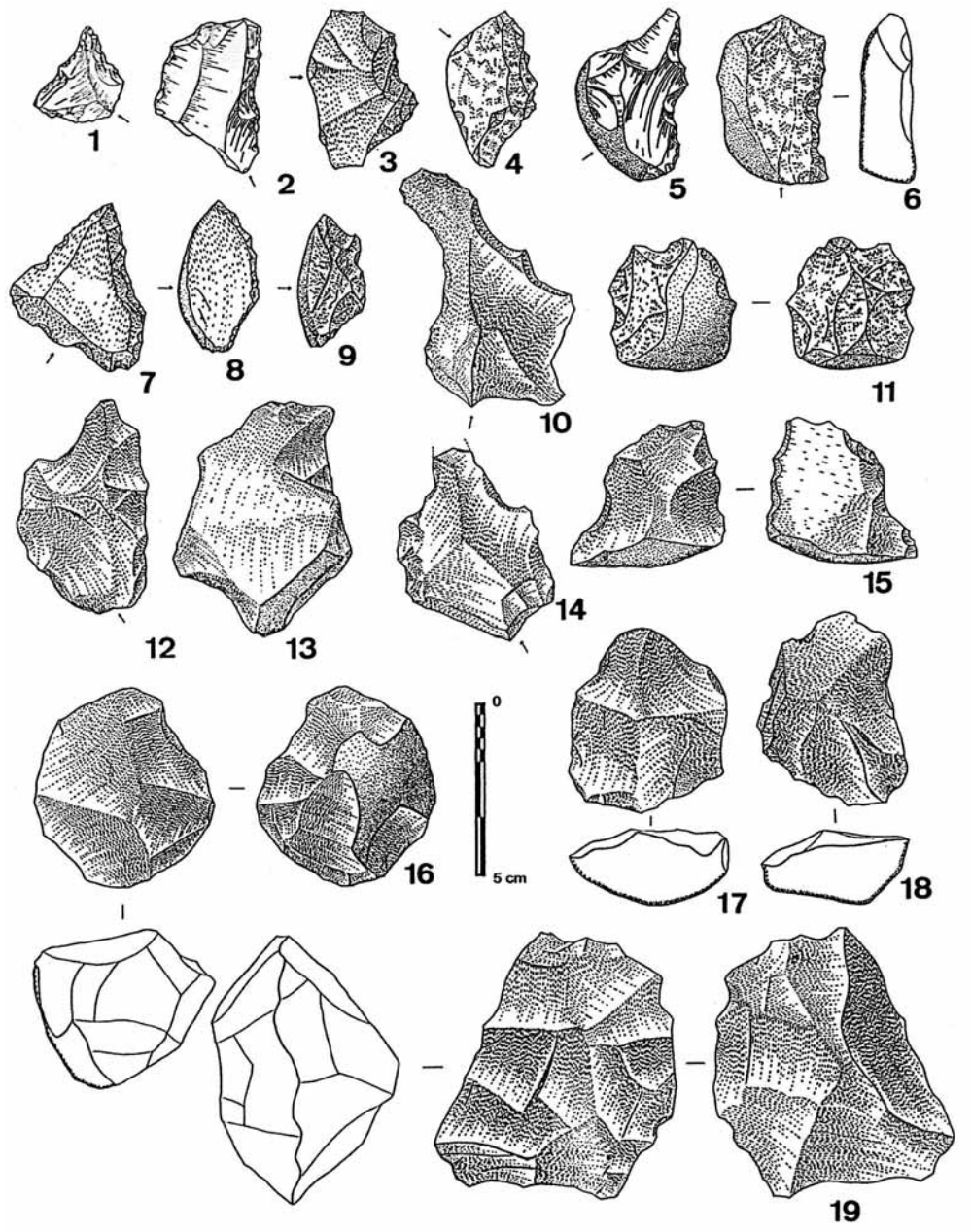


FIG. 9. *Industry from Vale do Forno 8. 1 – Tayac point; 2 – 2-9 – sidescrapers; 10-15 – denticulates; 11 – distal notche; 12-14 – borers or points; 16-19 – cores. 1, 2, 5, flint; 4-6, 9, 11, quartz; 3, 7, 8, 10, 12-19, quartzite (after Raposo, 1995).*

Using the U/Th datation method, elephant bones yielded a result of SMU-305 – 81900 + 4000; -3800 BP (Raposo, 1995), which is compatible with the presence of the aforementioned Mousterian items.

The author developed a model to propose a corresponding model for the occupation and use of the resources existing in the region during the Mousterian period: whilst the banks of the vast alluvial basin of the Tejo were occupied by open-air residential camps specialised in hunting large mammals (horse, elephant), the caves on the top of the limestone hills overlooking the alluvial valleys would have been used less frequently as shelters during the course of the hunting. The raw materials originated locally: in fact, on the lower terraces there was plenty of quartzite and quartz, whilst in the limestone massifs in which the caves and shelters were set, there were good quality flint nodules. Some of these caves in the heart of the limestone area containing flint nodules show signs of low-density occupation. This was the case of the Gruta do Correio-Mor (Loures), where the stratigraphy identifies Mousterian activity using flint nodules at the base of an essentially Holocene archaeological sequence (Zbyszewski, 1987), and the Gruta da Ponte da Laje (Oeiras), overlooking the stream of the same name, where the tools have identical characteristics and positioning (Cardoso, 1995).

2.2.6. Terraces on the left bank of the Tejo estuary

The Pleistocene sequence of terrace systems on the Lower Tejo is most marked in the Alpiarça region where they are over ten kilometres wide and constitute the largest complex of alluvial Pleistocene deposits in Portuguese territory. The terraces in the region further downstream developing in the estuary area are due to oscillations in the sea level, although the geochronological framework proposed in the 1940s and still used today (Zbyszewski, 1946) needs revising in the absence of any updating of the entire succession observed.

Various sites of stratigraphic interest are associated with these deposits, indicative of the settling of numerous human groups dispersed over the surface of the middle terrace, roughly 15 m above the level of the stream, which can be attributed to the last interglacial period in the traditional chronology (Breuil & Zbyszewski, 1945).

Although flake tools occur in Cascalheira (Alcochete), (including points and blades, scrapers, denticulates, single-edged knives and others), it is mainly the discoid cores predominate, featuring typical mousterian centripetal flaking (Fig. 10). Numbering more than 500, they represent the largest collection ever found in Portugal (Carreira & Raposo, 1994).

The Alto da Pacheca site, which is closely related to Cascalheira, is situated in the surrounding area and is associated with the same level of terrace (Cardoso & Monjardino, 1976/1977), where the proliferation of Mousterian nuclei is also marked. Within the context of the stratigraphic sequence defined in the Alpiarça middle terrace, the gravel bed which can be observed in both Cascalheira and Alto da Pacheca, crowning a sandy series, may be related with the beginning of the regressive phase of the deepening of the Tejo river bed, at the beginning of the Würmian glaciation, a classification that is compatible with the type of industry found there.

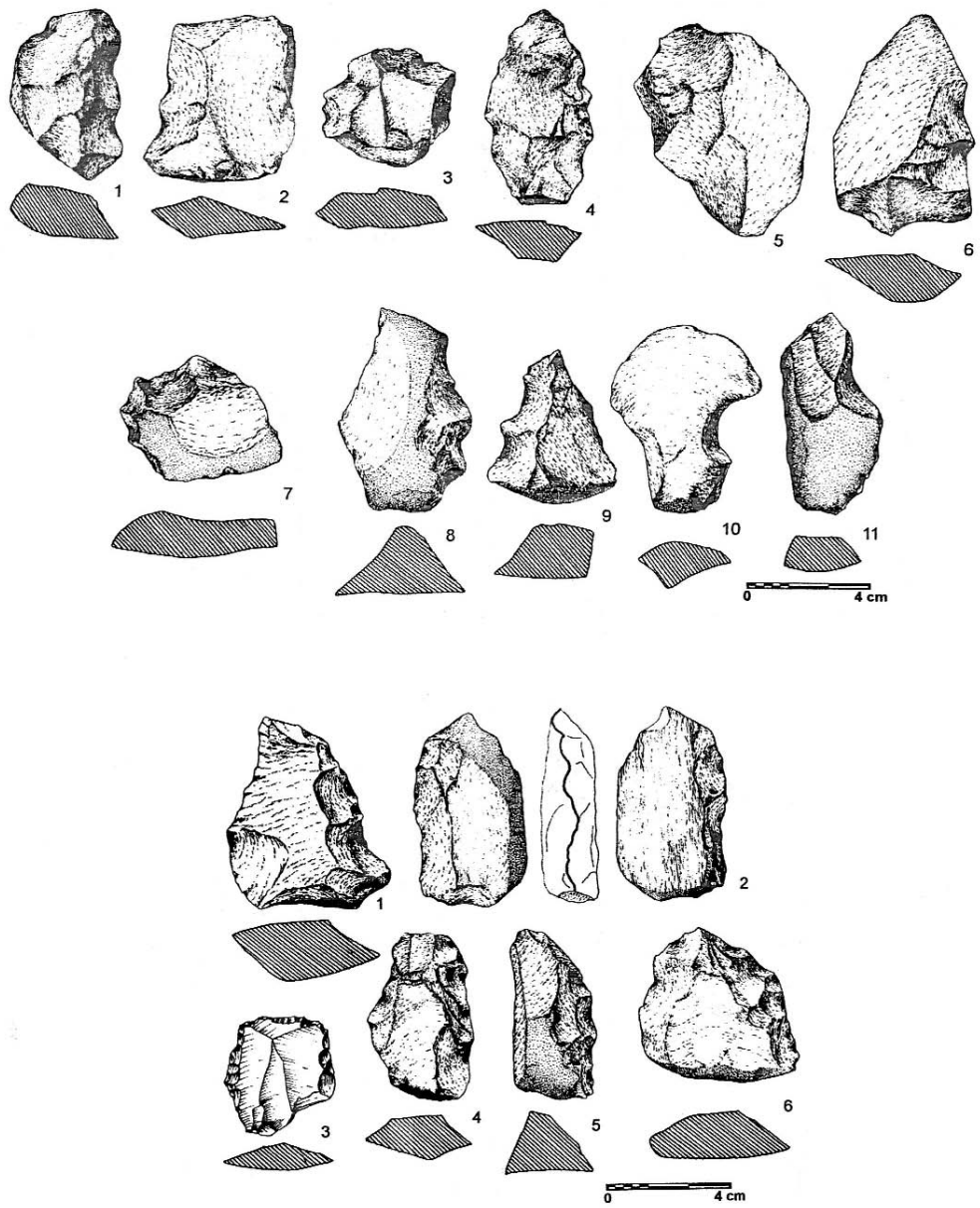


FIG. 10. *Industry from Cascalheira. Above: 1-9 – denticulates; 10, 11 – notches. Below: 1-6 – sidescrapers. All of quartzite (after Carreira & Raposo, 1994).*

However, the best-known Paleolithic site on the left bank of the Tejo estuary is Conceição (Raposo & Cardoso, 1998a), associated with a lower level of terraces located 8 to 10 m above the level of the Tejo in the area where the archaeological site is located, afterwards rising gradually to a height of around 15 m. It is a low terrace, to use the terminology applied by G. Zbyszewski to the Lower Tejo terrace system (Zbyszewski, 1946). During the course of emergency excavation work connected with the building of access roads for the Vasco da Gama bridge, a pebbly level was identified in the highest section of the sequence, on the uppermost part of which occurred abundant of unsmoothed flake items, indicating that they were penecontemporary with the formation of this deposit (Fig. 11).

Two radiometric dates using OSL (Raposo & Cardoso, 1998a) were obtained. A fine clay/silt level lacking in industry corresponding to the lower part of the sequence and associated with the phase in which the valley was filled in, gave a result of 74.5 Ka BP (+11,6; -10,4 Ka), whilst a level of eolic sands immediately re-covering the upper part of the gravel bed where the items lay was dated at 27.2 Ka BP (± 2,5 Ka), probably associated with the climatic deterioration prior to the last pleni-glaciation. However, the stratigraphy indicates that the chronology for the mousterian occupation may be close to the more recent date, given aspect the fresh aspect of the surface of the pieces, indicating that they were rapidly re-covered by the eolic deposit. In addition, the formation of the gravel bed covering the basal deposit of fluvial-marine sands may be associated with the beginning of a regressive episode, which parallels the period of climatic deterioration that later led to the deposition of the eolic sands observed at the top of the sequence. If this is the case, the chronology for human occupation would be the same as the one identified for the Gruta da Figueira Brava discussed later, of approximately 36 Ka BP, thus making it one of a series of sites compatible with a chronology within OIS - 3.

The conclusions that can be drawn from a technical/typological analysis of the many thousands of items collected reveal that the area was occupied intensively given the abundance and quality of the available raw material, consisting mainly of quartzite pebbles ranging from the initial mass used as nuclei to the typically mousterian discoid cores. The Levallois technique is in evidence, leading to flakes obtained and used immediately or transformed into various tools, mainly denticulates and notches but also some scrapers and a few borers. The considerable standardisation of technical procedures should be emphasised, based on economy of action in relation to the intended purpose. This is exemplified in the proliferation of "Mousterian disc cores", an extreme case of simplification of procedure in which advantage is taken of the morphology of the natural stone in order to extract the selected flakes directly from it without the need to shape and prepare striking surfaces (Fig. 12).

In short, the Conceição site fully encapsulates the "work camp site" concept of the Anglo-Saxon writers, in which pre-shaped flake products would have been exported for use in other areas or on routes used to gather resources. In fact the almost exclusive use of quartzite, which could be found in large quantities in the area, produced only 3% of the tools obtained, in contrast with the high percentage of nuclei, representing 24.3% of the total number of artefacts.

FIG. 11. *Conceição. Overview of the excavated surface on the top of the pebble ground, with some artefacts* in situ *(photo by I. C. F. Fernandes).*

2.3. *Other open-air sites in central Portugal*

2.3.1. Estrada do Prado (Tomar)

This is an open-air site located in a middle terrace of the Nabão River. The abundant industry seems to have been developed over successive levels of occupation and has been covered with a fine deposit roughly 2 m deep (Mateus, 1984).

Only a preliminary report has been published of the excavation, in spite of the importance of the site and the amount and diversity of the flint, quartzite and quartz materials. The lithic industry, approximately 3,000 artefacts was found in fine beds formed in a low-energy fluvial environment. The tools show the use of quartzite, quartz, shale, arenite and flint, although only the latter is used in quantity, representing 20% of the total; it was also the only raw material that could be adequately characterised. Analysis of the 584 corresponding artefacts showed that the Levallois technique and the disc (centripetal) variant was used (27 examples). Some nuclei were completely used up, which can be attributed to the fact that flint was a scarce raw material in the immediate vicinity of the site. The flakes reveal a high level of facets on the dorsal face, together with a high incidence of transformation into tools, a fact related to the intensity with which the flint cores were exploited, with a preference for larger sized flakes for processing, totalling 173 items (Fig. 13) and corresponding to 29.6% of the total flint artefacts (Chacón & Raposo, 2001).

2.3.2. Santa Cita (Tomar)

Like the previous site this is also associated with a low terrace on the right bank of the River Nabão, near the mouth of the tributary Bezelga, the sixth and last to be formed (T6b) in a regional sequence. Although there is no chronometric information at present for this deposit, or the Mousterian occupation associated with it, it is obvious that the last phase in the formation of terraces would have occurred during a Würmian interstadial, belonging to OIS 3. Its chronology is set between 60 and 40 Ka BP, corresponding to a positive warm oscillation (Lussu *et al.*, 2001).

After an initial intervention supervised by Nuno Bicho, the excavation work, prompted by the building of an important road axis, was organised according to various objectives including the recovery and preservation of the archaeological structures that had been identified, namely a habitat level.

The general sequence established during recent archaeological work (Lussu *et al.*, 2001) indicates that two Mousterian levels existed there, the most modern of which (B1), interspersed as a fine deposit, can be identified as the top of the Pleistocene terrace, corresponding to the transition from a level of red clay with signs of pedogenesis to a level of yellow silt. However, archaeological materials also exist on the more recent level B2, allowing in some cases the reassembly with materials from level B1. The oldest archaeological assemblage is found beneath this fine deposit, lying on top of the conglomerate deposit in the terrace (C1), with the industries still in their original place. This paleosurface was preserved by moulding.

There are therefore two levels on which, at separate but close periods of time, various human activities were carried out. In fact, the existence of reassemblages of quartz, quartzite and flint cores in both levels points to this conclusion. No faunal or carbon remains have been preserved. Local quartz and quartzite pebbles predominate in the terrace conglomerate, whilst flint is much rarer.

There does not seem to be evidence of any differences between the materials belonging to the two stratigraphically distinct lithic assemblages (B1/B2 and the top of C1). The quartzite nuclei were chipped using pre-defined reduction techniques in which both the classic Levallois and centripetal techniques are present and the flint nuclei, as in the previous site, appear heavily exploited.

In total over 1,400 items were recovered from level C1, a larger amount than from B1. In both cases, flakes predominate, with evidence of technological differentiation although no evidence of processing into tools.

A study referring to the initial work undertaken in Santa Cita between 1990 and 1997 by a different team also defined two stratigraphically distinct mousterian occupations: level “M”, corresponding to level B2 and the more modern level 6 (Bicho, 1997; Bicho & Ferring, 2001), possibly equivalent to level B1 in the sequence previously described. Level C1 *was* not identified.

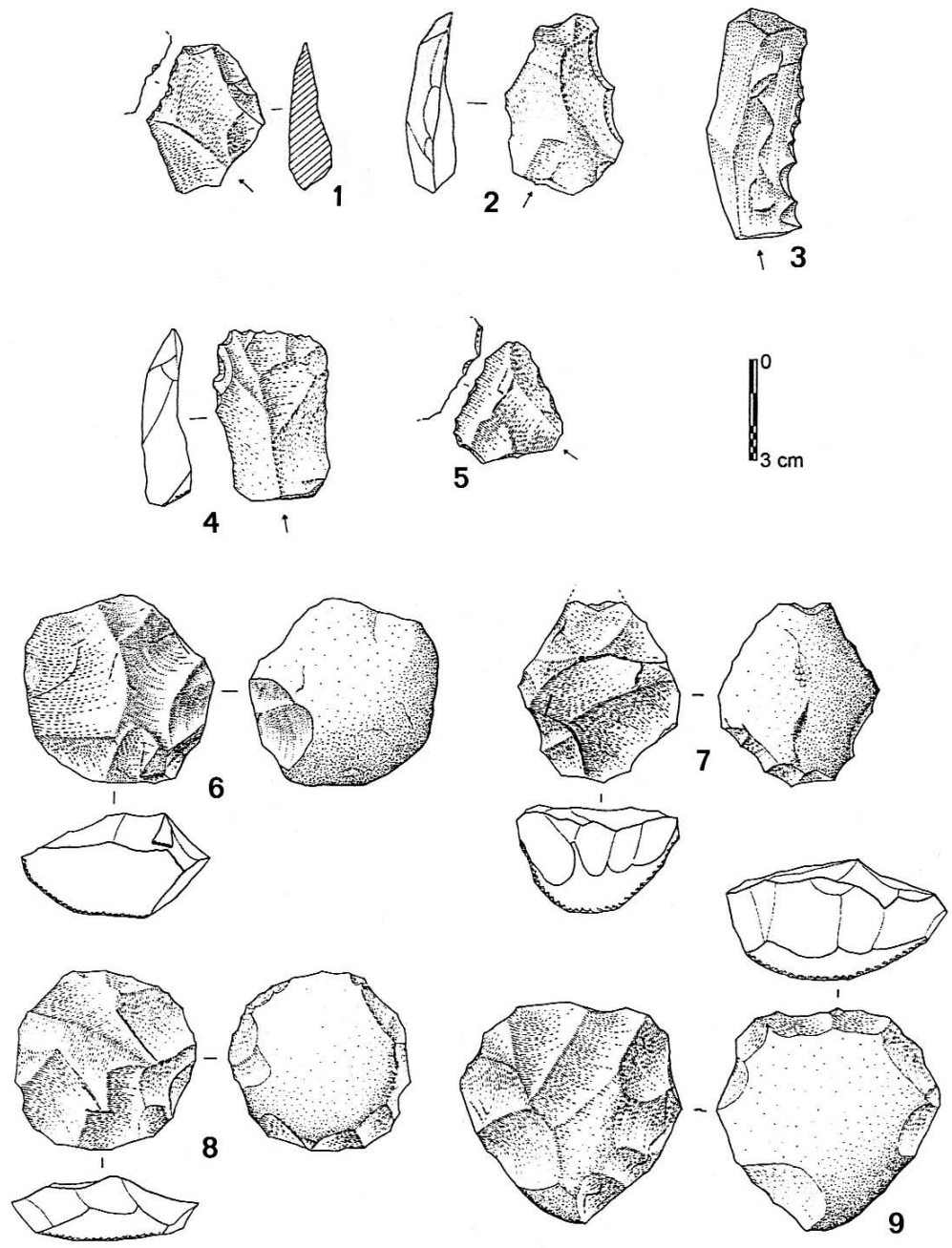


FIG. 12. *Industry from Conceição. Above: 1-5 – denticulates. Below: 6-9 – cores. All of quartzite (after Raposo & Cardoso, 1998a).*

Studies by Nuno Bicho reached different conclusions with regard to the characteristics of the Mousterian occupations, namely that the older level, containing approximately 5,000 artefacts represents a more intensive occupation of the area, associated with the hypothesis of a habitat structure consisting of 5 post holes which, according to the author, describe a trapezoidal circuit. In the upper level, concentrations of small nuclei of materials can be observed, totalling no more than 100 items. Although neither of the Mousterian occupations has been attributed the status of a true occupation level, the conclusions of the technological studies and studies on the supply of raw materials were confirmed in the work cited above. In all the raw materials identified —quartz, quartzite and flint, in that order— there is evidence of the successive phases of operative technological chains featuring the disc core technique and, more rarely, the Levallois technique (obviously used in the more modern level and including a Levallois point), indicating *in situ* production. As previously verified, flint was the most heavily worked of all the raw materials, especially in the most modern level, certainly as a result of its particular suitability for full use of the Levallois technique, involving raw materials which came from two areas that were over 10 kilometres apart. Therefore, despite the scarcity of the sample available in the upper level, there seems to be a quartzite/quartz association in the lower level which is replaced by a quartzite/flint association in the upper level (Bicho & Ferring, 2001).

Scrapers, denticulates and notches were identified amongst other items (Bicho & Ferring, 2001), thus filling in a significant gap in the study produced by Lussu and his collaborators.

The establishment of the site in a strategic area of the Nabão valley plentifully supplied with water and raw materials explains the abundance of artefacts associated with recurrent occupations of the site during the Mousterian period. It should be stressed that the two Mousterian occupations later defined are linked with authentic occupation levels, a very rare situation in the case of open-air sites. The area may therefore have acted as a logistic camp site, similar to Foz do Enxarrique or Vilas Ruivas.

2.3.3. Ribeira da Ponte da Pedra, or Ribeira da Atalaia (Vila Nova da Barquinha)

A short distance away from the right-hand slope of the valley of the Atalaia stream, which flows into the River Tejo, many Paleolithic artefacts have been identified, exposed to the surface by present-day erosion that has cut deeply into the succession of the Pleistocene deposits. Excavations were carried out on the base of the middle terrace (Q3) of the Tejo river system and the upper part of the lower terrace (Q4-1 or Q4a).

The materials collected from the base of Q3 belong to the Lower Paleolithic (and are totally devoid of any evidence of Levallois or disc core centripetal flaking technique). Between the upper part of the lower terrace and the base of the middle terrace important levels of ancient colluvium were noted. By 2000 only 134 artefacts had been excavated from there, including one disc core

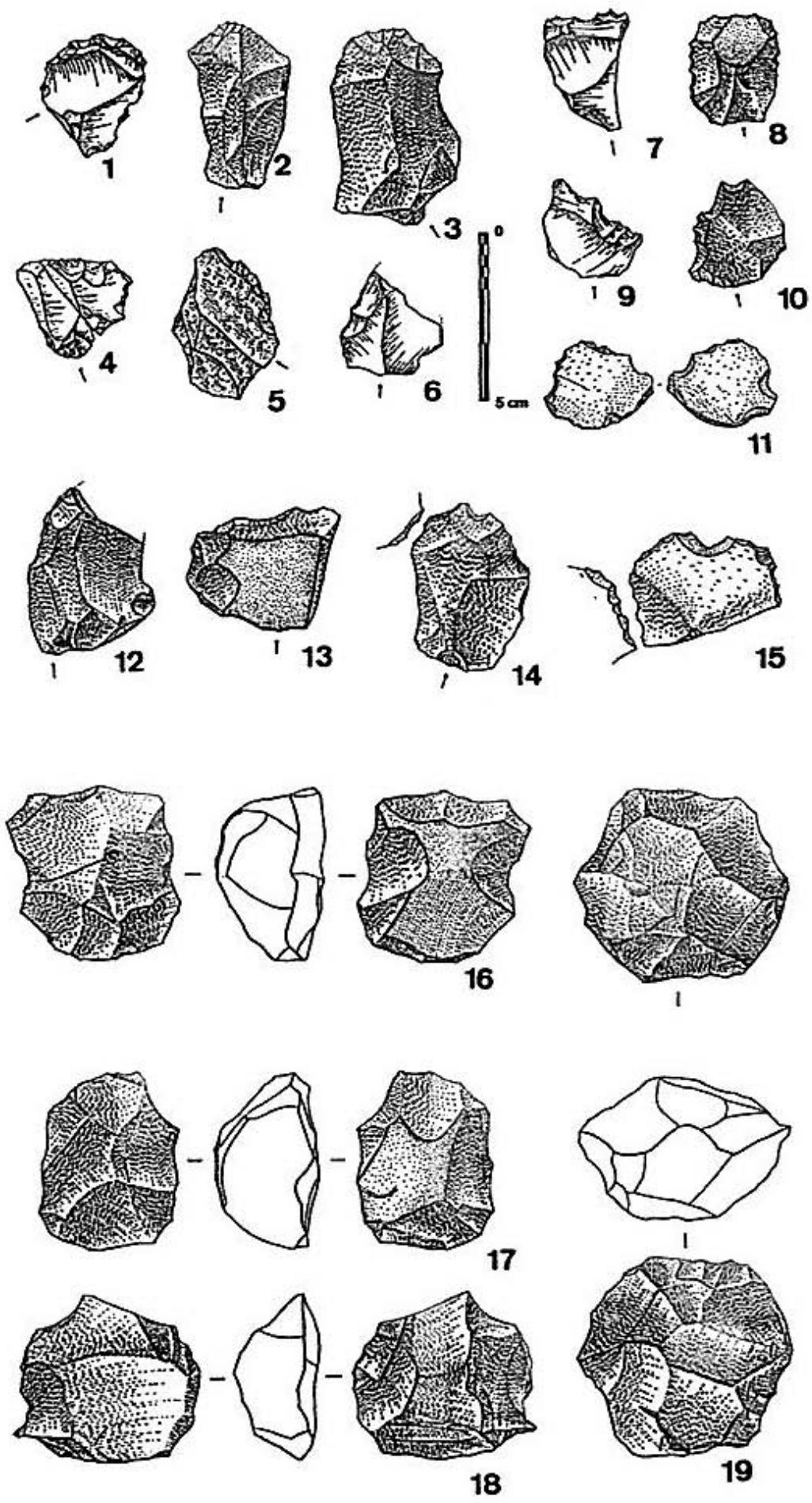


FIG. 13. *Industry from Estrada do Prado. 1-3: endscrapers; 4-6, 12, 13 – sidescrapers; 1-11 – denticulates; 14, 15 – notches; 16-19 – cores. 1, 4, 6, 7, 9, flint; 2, 3, 8, 10-19, quartzite; 5, quartz (after Raposo, 1995).*

and two bifaces, one of which has arcane features (Grimaldi & Rosina, 2001), suggesting a mixture of sediments and materials from various different ages conforming to the correlative nature of the deposit.

An excavation, the results of which have not yet been published, took place on the surface of the lower terrace which, like Santa Cita, belongs chronologically to an interstadial formation from OIS – 3. The identification of a paleo-soil containing a fire structure led to an extension of the area being explored. The presence of this structure (and probably of others which have not yet been identified) enough to consider this site potentially very interesting. It consists of a sub-circular fireplace 0.90 x 1.0 m, defined along its perimeter by local stone elements, with some clear signs of reddening caused by heat. The interior of the structure was filled with an ash sediment arranged in horizontal levels beneath the termoclastic gravels.

Almost all the materials recovered from this sector of the excavation area were attributed to the Middle Paleolithic. They consisted of quartzite pebbles, local in origin, which provided flakes, usually unprocessed, shaped pebbles and nuclei, together with bifacial items and evidence of the Levallois technique and its disc core variant (Figueiredo *et al.*, 2005).

2.3.4. Sites in the area surrounding Rio Maior

Good quality flint in the form of nodules found in the neogenic deposits of Rio Maior basin was used in successive periods, from the Acheulian to more recent times. Large amounts of pinkish-red flint were used in the Mousterian period to make tools, showing evidence of Levallois chipping including some good examples of Levallois and Mousterian cores (Fig. 14), although these were always recovered from the surface, due to the lack of excavation work (Cardoso & Norton, 1995).

2.3.5. Coastal sites

Recent surveys along the coast have led to the identification of a small Mousterian occupation on an east Mira beach with evidence of flakes, nuclei and flint debitage products denoting use of the Levallois technique (Haws *et al.*, 2006). The occupation must have been based in the area above the beach, in a sandy environment which nowadays has an altitude of roughly 35 m. Bearing in mind the regressive sea level at the time, its present position has been interpreted as the result of tectonic phenomena located roughly in the area in question.

A date for charcoal found in a bed of carbonised ashes within the same geological unit, whose relationship to this site has not, however, been clarified, has given a result of 36 ± 750 Ka BP. This result is similar to that obtained for a deposit also situated on the present coast of Vale da Janela (Ferrel, Peniche) further to the south, 38 Ka BP + 1,7; -1,4 Ky, in which a floral association has been identified, evidence of a cool, humid and windy climate. These conditions are also present in the Alentejo coast: the S. Torpes palaeontological site, where an palinological association has been dated from 39,49 ± 2,34 Ka BP and more than 42,24 Ka BP (Schroeder-Lanz, 1971). It should be emphasized the presence of *Myrica* in both associations, a genus with termophile characteristics (Diniz, 1986, 1993).

The discovery of this site suggests the existence and even frequency of occupations with stratigraphic interest along this coastal strip during the Mousterian. This conclusion results the significant number of findings belonging to this period, most of which were recovered from the surface of the gravel beds of Quaternary beaches extending to the south (Breuil & Zbyszewski, 1945).

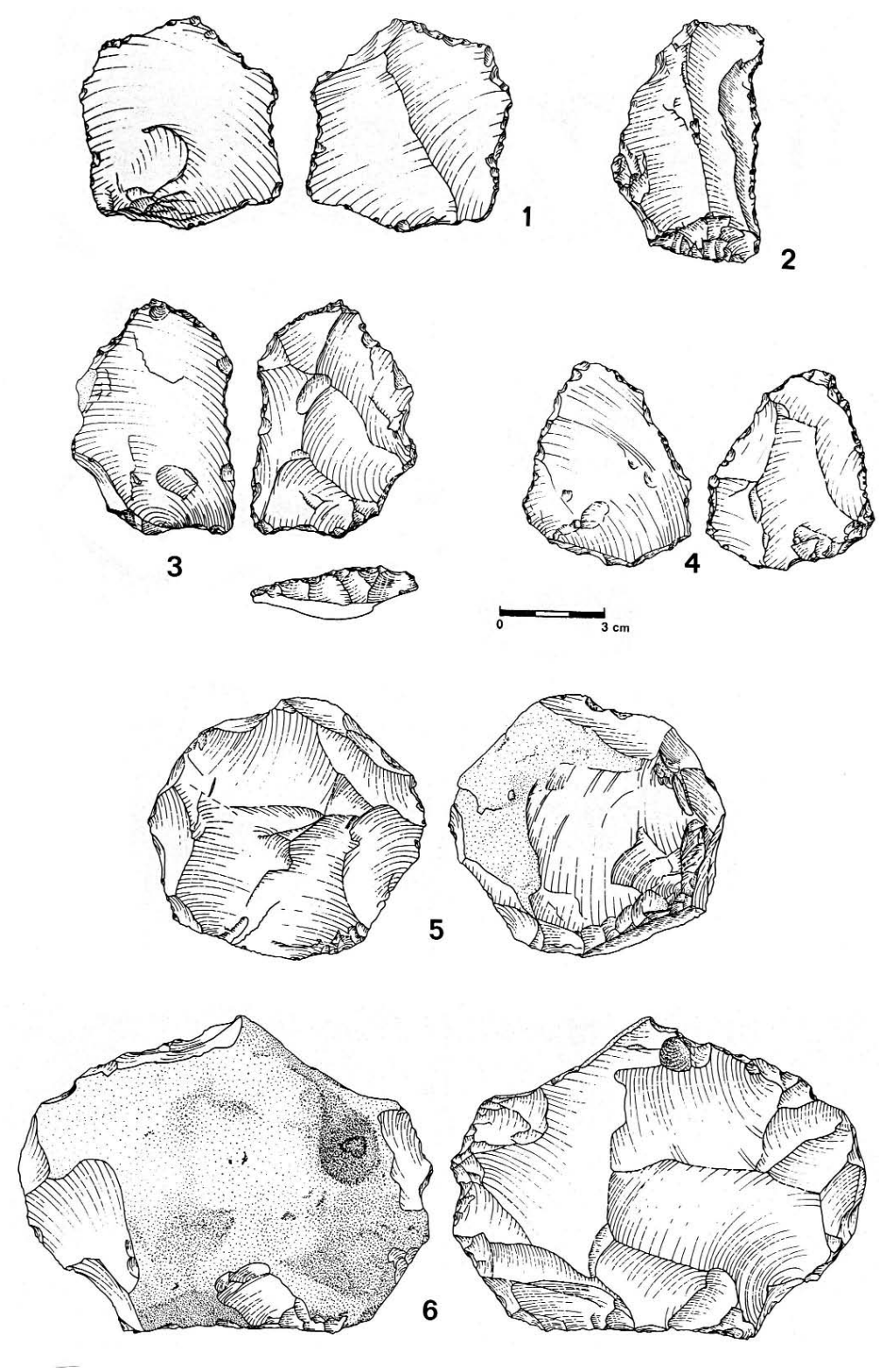


FIG. 14. *Mousterian industry on the outskirts of Rio Maior. 1 – double sidescraper. Vale de Vieira; 2 – single sidescraper. Vale de Vieira; 3 – single sidescraper. Ribeira de Povoas; 4 – double convergent sidescraper. Vale de Vieira; 5, 6 – cores. Vale de Vieira and Ribeira de Povoas. All in flint. Note the large dimensions of the artefacts (after Cardoso & Norton, 1995).*

2.4. *Caves of the Estremadura Limestone Massif and adjacent area*

The karst caves found in the various Mesozoic limestone formations in Estremadura are very striking. They are found rarely in the Algarve crags and in some limestone outcrops in the interior of the country dating from the Palaeozoic era. However the area extending from the Arrábida to the Sicó mountains near Pombal clearly provides valuable information on settlements in present-day Portuguese territory during the Middle Paleolithic. In geographical order, the following caves are therefore described.

FIG. 15. *Gruta da Oliveira. Partial view of the excavated area in the end of 2004 fieldwork (photo supplied by J. Zilhão).*

2.4.1. Gruta da Buraca Escura (Pombal)

Located in the heart of the Sicó mountains, this cave has supplied items in flint and particularly milky quartz from the Middle Paleolithic, at its deepest archaeological levels corresponding to Assemblage 3 under the Gravettian occupation (Aubry & Moura, 1994).

The abundant fauna includes carnivores, raising doubts about the importance attributed to human hunting activity in the aforementioned collection. However, this cannot be the case in terms of the fauna exhumed in a fire area and its immediate vicinity which, together with the structures identified in Vilas Ruivas, constitutes the oldest Paleolithic constructive evidence identified in Portuguese territory. Here splinters from large mammal bones have been identified, together with microfauna, a phalanx and an astragalus from a mountain goat *(Capra pyrenaica)* and an incisor from a young horse *(Equus caballus)*.

2.4.2. Gruta do Caldeirão (Tomar)

This karst cave was excavated under the supervision of João Zilhão between 1979 and 1988. Under an Upper Paleolithic sequence which confers archaeological importance on this cave, a Mousterian sequence has been identified, approximately 1 m deep (Levels N to L), from a lengthy period of climatic improvement and covered by Level K, which has an average depth of 0.45 m. This level is separated from the others by a very marked discontinuity, probably erosive in origin, attributed to the Denekamp interstadial (Zilhão, 1997, Fig. 9.3).

The block of levels N to L contain few artefacts mixed with numerous remains of carnivores, particularly hyena, so that its formation essentially correlates with the activities of these and other carnivores (Davis, 2002). Level K also provided materials that are exclusively Mousterian, featuring the Levallois technique, although they are not numerous, in association with a plentiful supply of bone remains. This also suggests a natural accumulation, perhaps as a result of hyena activity. The direct dating of one bone gave a result of 27.6 ± 0.6 Ka C14 BP, corresponding to the date calibrated at *ca.* 32.4 Ka calBP (Zilhão, 2006). This result, after having been initially accepted by the author, was questioned in his latest work, in which he claims that the date cannot be considered much earlier than *ca.* 35 Ka calBP, due to extrapolations of a paleoclimatic nature. In other words, the chronology of the most modern Mousterian level in the Gruta do Caldeirão is not at present established, and it is accepted that the only bone dating from this level may have intruded from level Jb, which dates from the Early Upper Paleolithic, given that the sample recovered from the middle of this level, roughly 0.22 m deep, gave a result of 30.8 Ka calBP.

A decline in the use of flint may be observed between the older and more modern Mousterian levels. In Levels O-L over 40% of the artefacts are made of flint, in contrast with the more modern Mousterian occupation (Level K), which contains only 13% made of flint. However, the scarcity of artefacts in this level means that the significance of these results is limited. No rodents were found in Levels L to N and the most positive results for these were found in the most modern level in the Mousterian sequence (Level K). Their study (Povoas *et al*., 1992) reveals the existence of very dry open areas (containing *Allocricetus bursae* and a large amount of *Microtus arvalis*) together with forest areas (containing *Apodemus sylvaticus* and *Eliomys quercinus*).

2.4.3. Gruta da Oliveira (Torres Novas)

The action of water in the River Almonda karst system, which is still being formed, led to the opening up of a series of cavities at decreasingly and successively more recent altitudes in the rocky massif that forms part of the "arrife" area of the Aire mountains, overlooking the vast plain formed by Tertiary and Quaternary sediments to the south.

This cave is still being excavated, under the supervision of João Zilhão (Fig. 15), and no definitive results can be presented at the moment. The first published results refer to a deposit initially attributed to an alluvial cone, the "Mousterian cone", found in 1989 and corresponding to a secondary sedimentary accumulation within the karst system above the present entrance to the Almonda cave, due to the collapse of a gallery from a higher level where the Gruta de Oliveira cave is situated. This deposit contains a large amount of faunal remains and lithic industry (around 250 artefacts), mainly made of flint (50%), with a high incidence of the Levallois technique and many retouched tools (scrapers, denticulates). The fauna consists exclusively of ungulates (there is only one example of carnivore amongst the 240 fragments of deer, horse, mountain goat, rhinoceros, rabbit and turtle bones)

and may therefore be attributed to the hunting activities of the human group established there, particularly as around 20% of these remains show signs of burning. Two dates have been obtained by U/Th from a horse's tooth, giving a weighted average result of 61.5 Ka BP, which is compatible with the typological characteristics of the lithic assemblage (Zilhão & McKinney, 1995). The deposit therefore corresponds to the oldest Mousterian occupation of the cave, which, in total, is 6 m deep and is sealed by a thick level of stalagmites.

The most modern Mousterian occupation corresponds to Level 8 in the general sequence, dated at between 38 and 37 Ka calBP (Zilhão, 2006). In contrast to what was found in the "Mousterian cone", the tools, which show evidence of the Levallois technique, are mainly quartzite, followed by flint, then quartz. This trend towards the underepresentation of flint is even more accentuated in the deeper levels (Levels 9, 10, 11 and 12). In Level 9, the radial chipping technology is much more evident in comparison with Level 8, featuring in roughly 54% of the total number of items classified. In both levels it can be seen that the use of raw materials such as quartzite and quartz has not produced items of inferior quality obtained by more expeditious technological means, as is commonly thought to be the case in Peninsular Mousterian contexts (Marks, Monigal & Zilhão, 2001). In fact, it is in the finer-grained pieces of quartzite, rather than in the flint, that the application of a refined Levallois technique can be observed (Fig. 16), and this can also be seen indirectly in the fact that the quartzite flakes are not, on average, larger in size than those made of flint. The Oliveira cave therefore confirms what is already known from previous studies on the Gruta da Figueira Brava and the Gruta Nova da Columbeira, which have always emphasised the important presence of quartz and quartzite in Mousterian associations in Portuguese territory.

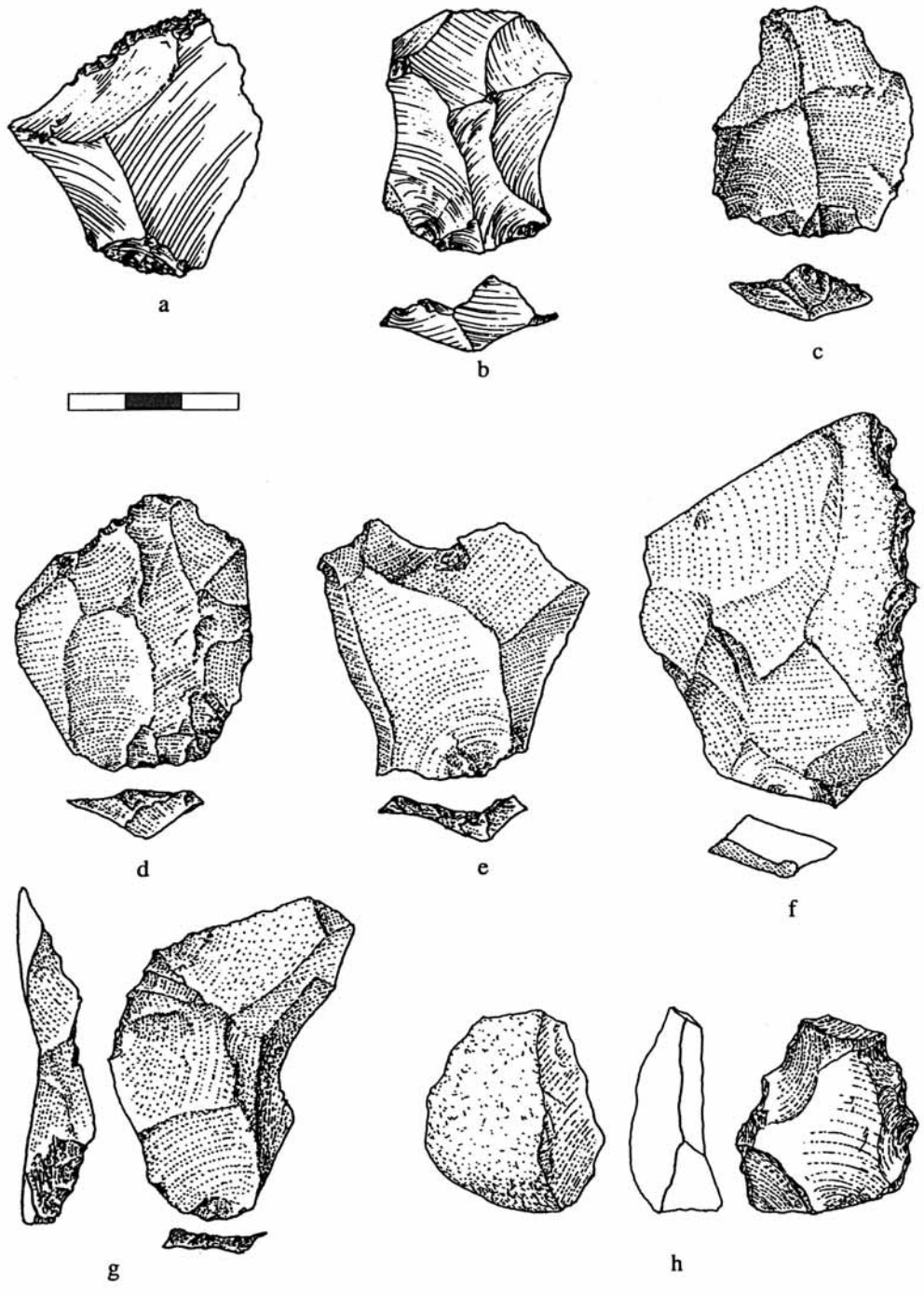


FIG. 16. *Industry from Gruta da Oliveira, Level 9: a – retouched flake; b – Levallois flake; d-f – denticulates; g – debordant Levallois flake; h – inversely retouched Tayac point; a, b, flint; c-g, quartzite; h, quartz (after Marks, Monigal & Zilhão, 2001).*

The deepest levels reveal an abundance of lithic industry, although this has not been properly studied yet, which precedes the date established for Level 9 of 44-43 Ka calBP and probably represents the oldest date of the "Mousterian cone". A large quantity of turtle and rabbit remains have been recovered from these older levels, which show signs of burning, an indication that they had been destined for human consumption (information supplied personally by João Zilhão).

The sedimentation is continuous until Level 9, then between this level and Level 8 there is a stalagmite crust deposit, indicating a significant discontinuity in the sedimentation. This may be linked to climate change since, whilst from Level 10 onwards certain species indicate the existence of open landscapes and a temperate-cold climate (mountain goat, horse and rhinoceros), these are absent in Level 8, in which deer are the only large ungulates present out of roughly 300 remains that have been identified (Brugal, *in* Zilhão, 2001). There is also a low incidence of carnivores (fox, leopard and bear) and, in particular, of a hyena cave. These observations, considered in conjunction with the frequent signs of cutting and burning on

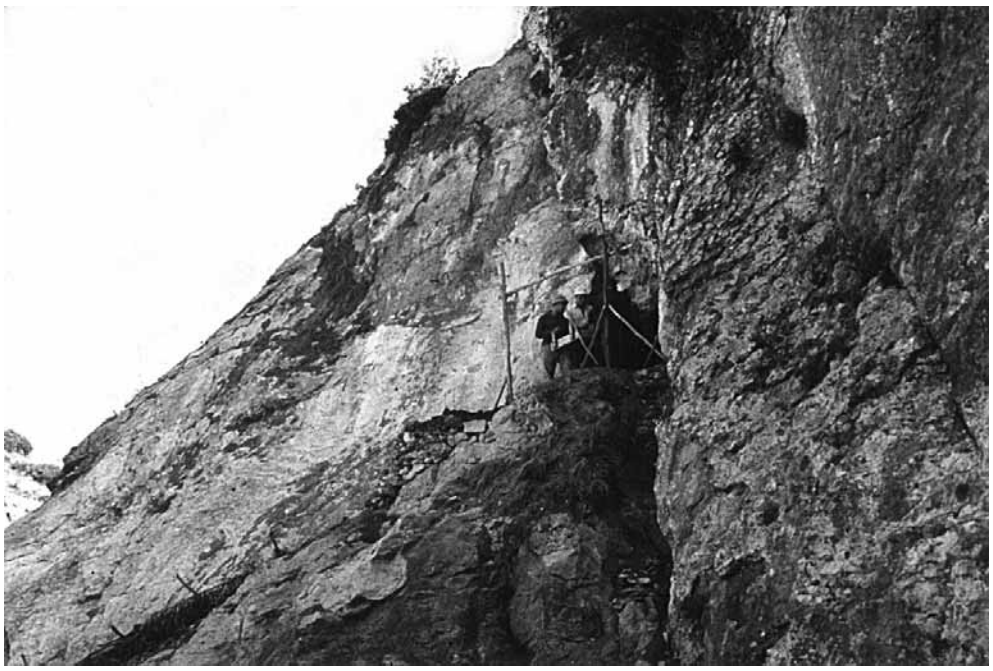


FIG. 17. *Gruta Nova da Columbeira. Entrance. Photo taken in 1962 during the excavations. Archiv of O. da Veiga Ferreira.*

the deer remains, suggest that they are connected with human hunting activity. In terms of small mammals, *Apodemus sylvaticus* and *Eliomys quercinus* together make up approximately 96% of the rodents from this period, indicating a Mediterranean climate (Zilhão, 2006). Moreover, it is this environment that explains the existence of turtle and rabbit remains, which are particularly abundant in the older levels in the sequence. This evidence indicates the non-selective capture of faunistic resources by humans in the immediate vicinity of the cave.

In addition, the reduction of the territories in which these resources could be captured during the Mousterian period is suggested (Zilhão, 2001) by a reduction in the use of flint, between the oldest dated occupation, corresponding to the "Mousterian cone", where, out of the 250 artefacts recovered, around 50% are of flint, 30% quartzite and 20% quartz and the more modern Mousterian occupations, represented by Levels 8 to 12. In support of this theory, the absence of mountain goat in the more modern deposits should be noted, in contrast with its presence in the older levels although its absence may in fact correspond to other causes such as a rise in temperature after an eventual colder period in around 38-37 Ka calBP, as indicated by the exclusive presence of red deer amongst the fauna hunted at that time.

Three human remains recovered from the deeper levels have been classified as Neanderthal, given that the associated lithic technology is clearly Mousterian.

2.4.4. Gruta da Furninha (Peniche)

The formation of this cave, which nowadays overlooks the sea, is related to a platform caused by marine abrasion of approximately 15 m above sea level. The filling in of a vertical aven approximately 10 m high inside the cave is therefore more recent than the marine episode which, using altimetric criteria, correlates with the last interglacial period (Breuil & Zbyszewski, 1942). Excavations carried out in 1879 by J. F. Nery Delgado (Delgado, 1884) were undertaken in compliance with the best scientific standards of the time, and careful records were kept of the stratigraphy and positions of all the lithic industries and bones recovered, which are still preserved today in the Geological Museum in Lisbon. The Pleistocene sequence consisted of a conglomerate at the bottom, containing few faunal remains, followed by a thick sedimentary complex separated from the former by a stalagmite crust, revealing discontinuity in the sedimentation. This succession consisted of seven fossiliferous bone levels, separated by abandonment episodes consisting of eolic sands.

The largest lithic and faunistic assemblage comes from the third and second fossiliferous levels. From level 3 an elongated Upper Acheulean biface was recovered, made from unsmoothed flint. The typology of the associated flint items lies mainly within the Mousterian period, revealing mixtures caused by circulation currents within the cave. These mixtures were noted by Nery Delgado and later assessed by Joaquim Fontes, who carried out a review of the lithic materials and identified some Mousterian items (Fontes, 1916: Pl. 1), later confirmed by Breuil and Zbyszewski (1942).

The existence of Mousterian tools mixed with osteological remains can be explained by the aforementioned mixtures, given that the coexistence of humans with large carnivores, essentially represented by the striped hyena *(Hyaena hyaena prisca)* and a small wolf *(Canis lupus lunellensis)*, is not plausible. Proof of this lies in the fact, Joaquim Fontes emphasised that half a *Canis lupus* radius did not appeared to have been transported to any significant distance and was recovered from the second level whilst the other half was recovered 1.30 m above it from another level. Although it is certain that movement occurred, there are no doubts that this Mousterian cave is contemporary with the striped hyena.

A U/Th date suggests the formation of this sequence c. 80.88 Ka BP (+42.42; -31.26 Ka). Despite a high level of uncertainty, this result is compatible with the older chronology of the last interglacial when the cave was formed; it is also compatible with the Mousterian industry recovered from it.

The upper part of the accumulation, a level 1.5 m deep of fine micaceous eolic sands correlating with the Pleniglacial when the shore lay several kilometres away, revealing a vast and windswept sandy coastal plain. The small amount of industry recovered from the Upper Paleolithic is connected with this final phase in the filling in of the aven, and includes two Solutrean laurel leaves and a single-sided blade, separated by H. Breuil and G. Zbyszewski in 1942 from the assemblage of a Neolithic necropolis later established inside the cave.

2.4.5. Gruta Nova da Columbeira (Bombarral)

Explored in 1962 by O. da Veiga Ferreira and G. Zbyszewski, this constitutes one of the most complete and rich Mousterian stratigraphic successions ever identified in Portugal. The stratigraphic sequence and the associated artefacts from each of the levels identified are clearly defined (contra Marks, Monigal & Zilhão, 2001).

The cave, surrounded by a landscape of Jurassic limestone (Fig. 17), is set halfway up the left-hand slope of the Roto valley, which is cut deeply into the karst landscape. It consists of a high thin gallery, approximately 20 m long, on average 3 to 4 m wide and roughly 10 m high. The stratigraphy observed in successive vertical cuts consists of a maximum of 10 levels (Fig. 18) which are almost always separated by a fine stalagmite film, indicating a possible halt in sedimentation and in occupation (Zbyszewski, 1963; Ferreira, 1966). The last campaign in 1971, under the direction of J. Roche, aimed to record a more detailed stratigraphic succession. Two dates were obtained for the levels corresponding to the base of the sequence, with the following results: 26.4 ± 0.75 Ka C14 BP (Level 7) and 28. 9 ± 0.95 Ka C14 BP (Level 8). The poor quality of the samples was cited by the laboratory (Delibrias *et al.*, 1986). Nevertheless, these two levels, and in particular Level 8, correspond to the most intensive human occupation of the cave, underlined by the presence of a significant accumulation of charcoal and ashes resulting from prolonged burning that had taken place there and whose presence is duly separate and uncontaminated from a stratigraphic point of view (Ferreira, 1984; Cardoso, Raposo & Ferreira, 2002). There appear to be no valid reasons, from an empirical point of view, for rejecting the results that were obtained (contra Zilhão, 2006), which, in addition, agree with the corresponding stratigraphy. It is possible that the reserve expressed by the laboratory where the samples were processed are mainly due to an *a posteriori* attempt to explain the results obtained which would have appeared excessively recent.

Therefore the results which, after calibration, place the Mousterian occupation of the cave within the period between 34 and 31 Ka calBP are relevant to the discussion concerning the last European Neanderthals (Cardoso, Raposo & Ferreira, 2002). As J. Zilhão points out, the fact that these results may fall within the chronology of the Aurignacian and Gravettian periods in the region does not constitute a decisive counter argument, since it is not possible to determine a precise chronology for the start of the Upper Paleolithic in the region.

J. Zilhão also observes that if such a modern chronology is accepted for the two levels that have been dated, then the deposits which follow them must be even more modern, even from the Solutrean period, which would contradict the Mousterian chronology indicated by their respective industries (Zilhão, 2006). In fact, Level 7 corresponds to the most modern effective human occupation of the cave. Level 6 corresponds to the establishment in the cave of a hyena lair indicated by the presence of numerous coprolites, and the amount of artefacts decreases abruptly – a situation which can be observed even more clearly in the two more modern levels. Level 8, containing 2,433 artefacts, is followed by Level 7 which has 1,880; Level 6 contains only 677 artefacts 56 and 107 respectively in Levels 5 and 4, the most modern in the sequence containing lithic industries, indicating the possibility that it continued to be occupied sporadically over a period of time that is impossible to determine but cannot have lasted longer than a few centuries.

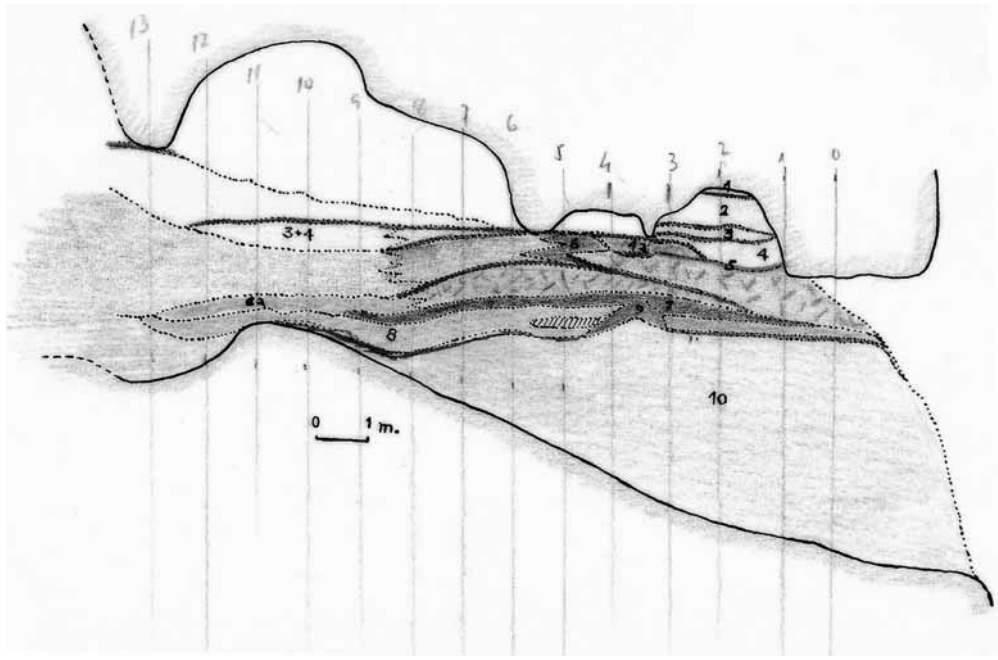


FIG. 18. *Gruta Nova da Columbeira. Longitudinal cross-section. For the stratigraphical description, see text. Archiv of O. da Veiga Ferreira.*

In conclusion, Levels 8 and 7 correspond to the "main levels of human occupation of the cave and the only ones in which it is possible to accept the hypothesis of consistent occupations involving continuous residence" (Cardoso, Raposo & Ferreira, 2002: 50).

The lithic industries of the Gruta Nova de Columbeira were attributed to the techo-typological group known as "Mousterian with denticulates", with Levallois debitage and Levallois facies (Fig. 19).

Given the rarity and the controversy surrounding similar occurrences, it is also worth noting the presence of certain bones which had been broken deliberately and used as tools, as can be deduced by the marks that remain on them (Barandiarán & Ferreira, 1971; Cardoso, Raposo & Ferreira, 2002).

There is a marked diversity in the use of raw materials throughout the entire sequence, revealing a trend towards an increase in the use of flint and a corresponding reduction in the use of quartz and stable levels for quartzite. However, this does not mean that this increase

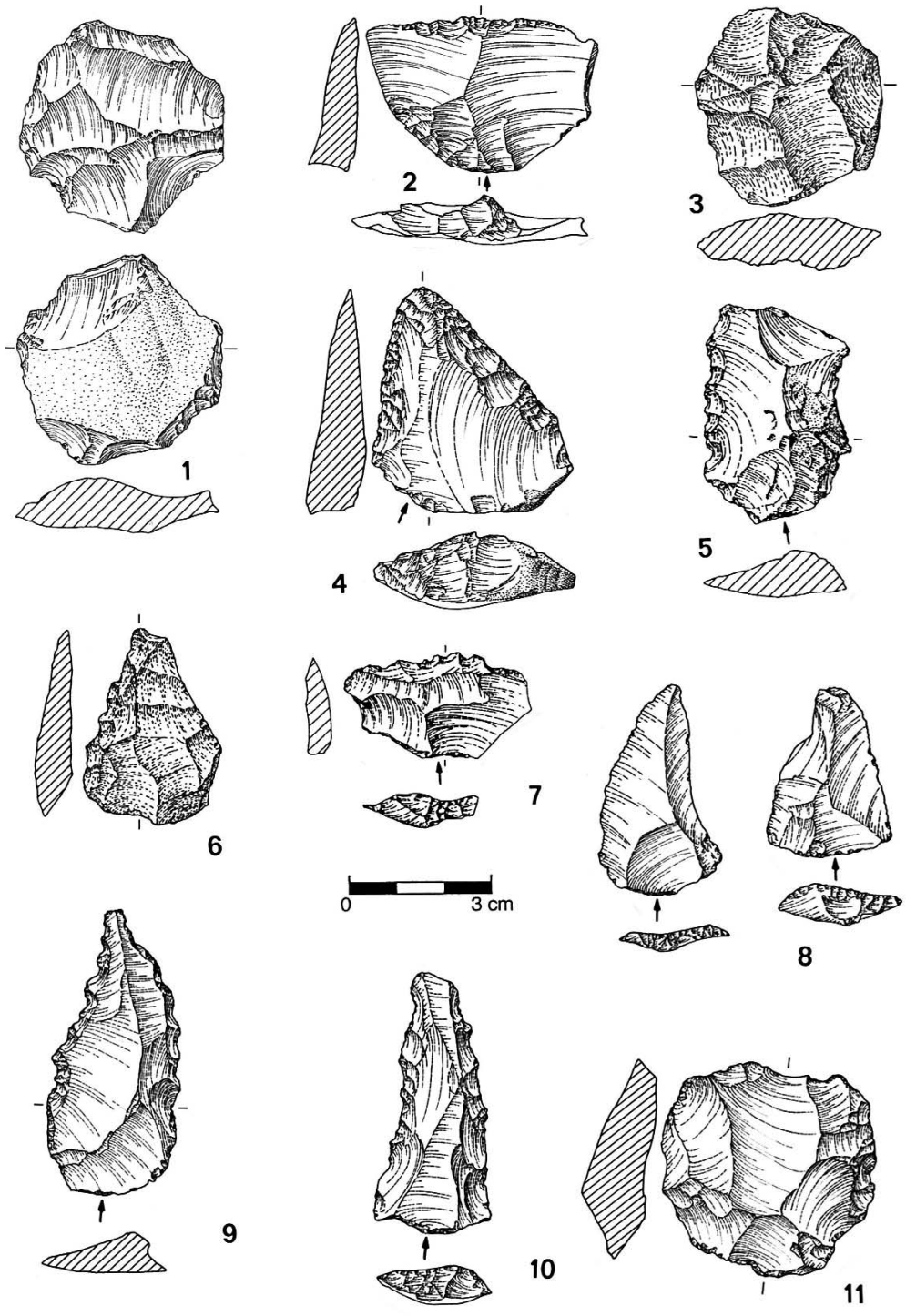


FIG. 19. *Industry from Gruta Nova da Columbeira. Level 6 a: 2 – denticulate; 4 – deviated sidescraper. Level 7: 1, 3 – cores; 5 – denticulate. Level 8: 6, 7 – denticulates; 8 – Levallois flakes; 9, 10 – Tayac points; 11 – core. All of flint, except 3, 6, of quartzite (after Cardoso, Raposo & Ferreira, 2002).*

of flint can be attributed to an extension of the territories from which resources were gathered. The geology of the surrounding area shows that flint could have been obtained in the form of nodules or smoothed pebbles from the limestone outcrops, including the massif in which the cave itself is set, whilst quartz and quartzite were plentiful in the lowlands nearby that extended to the sea. Moreover, this increasing demand for flint is not accompanied by any increase in its use; the rate at which it was processed into tools decreased, in contrast to the use made of quartz and particularly quartzite. Thus, the greater demand for flint did not compromise but, in fact, stimulated the use made of the other raw materials and did not correspond to an evolutionary pattern that heralded the Upper Paleolithic; on the contrary, it was observed in the "Mousterianisation", along the stratigraphic sequence, of the industries.

Evidently alternating use was made of the cave by humans and predators and the levels which reveal the most intensive human occupation are also those which contain the smallest amount of carnivore remains. In Level 8, which has a high concentration of carbon resulting from prolonged burning, only one wolf radius was recovered and in Level 7, three sets of hyena, in contrast with the abundance of lithic industry already mentioned. Conversely, the levels containing the largest collection of carnivore remains in the central part of the fill contained very little lithic industry. Lastly, the upper levels, bearing no traces of human presence, are characterised by the presence of birds, including birds of prey and the remains of the prey with which they are normally associated.

The composition of the large mammal fauna (Cardoso, 1993) suggests temperate climatic conditions, with some cold and dry spells, favourable for the presence of *Capra pyrenaica* (mountain goat) which was also well-adapted to the surrounding stony landscape that forms part of the Estremadura environment of low mountain outcrops under a strong ocean climatic influence. The existence of several rhinoceros *(Dicerorhinus hemitoechus)* milk teeth indicates opportunistic hunting involving the capture of younger and weaker animals. However, as all the examples of this species are restricted to Level 6 (Cardoso, 1993), which corresponds to the hyena lair, these remains may be linked to the activities of this carnivore.

The most interesting of the faunal elements is the terrestrial turtle *(Testudo hermanni)* since this is clearly the Portuguese site which contains the largest amount of remains of this species (Jiménez Fuentes, Cardoso & Crespo, 1998). This species prefers coastal areas at altitudes of no more than 500-600 m and a Mediterranean environment. Nowadays its circum-Mediterranean distribution seems to be influenced in particular by a need for summer, rather than winter, heat and rain. Although the

adults can withstand temperatures of up to 10° or even 20° below zero, embryo development requires high temperatures, with an optimum of around 30 ºC but never below 20 ºC. As the turtles reproduce in summer and incubation lasts roughly 2.5 months, between June and August/September they need temperatures that remain close to this optimum. It is without doubt due to the lack of these conditions that the species became extinct in Portuguese territory long before the end of the last glaciation, as it had been unable to support the climatic deterioration that took place soon after the cave was occupied. Of the 349 remains identified, 338 came from Level 8, which contains the greatest amount of evidence of human presence. There is no doubt that they had been caught by humans and that this had been easy to accomplish, a fact that also lay behind the rapid extinction of the species.

FIG. 20. *Gruta da Figueira Brava seen from the sea (after Antunes & Cardoso, 2000).*

It is important to emphasise the lack of sea molluscs, which would have indicated an opportunistic, non-specialised use of the resources potentially available in the territory immediately adjacent to the cave; however, the importance of the anthropic deposits suggests a residential type of settlement.

In conclusion, although the chronometric information merits additional efforts in terms of revision/conformity, the abundance of lithic industry attributed exclusively to the Mousterian, the abundance of faunal associations that have been recovered and the relationship that may be established between the two assemblages throughout the stratigraphic sequence, one of the most complete in the Mousterian, and finally, the discovery of a human tooth with Neanderthal characteristics on top of Level 9 (Level 10 is sterile), in contact with Level 7 in a sector where Level 8 is missing (Ferreira, 1966; Ferembach, 1964/1965; Antunes *et al*., 2000), are all factors which make this cave an important site in the Late Iberian Mousterian period (Raposo & Cardoso, 1998b; Cardoso, Raposo & Ferreira, 2002: figs. 15-17).

2.4.6. The Salemas cave and quarry (Loures)

The former, which was explored in 1961, became famous as a result of the Upper Paleolithic sequence that was identified there. At the base of the fill, an archaeological level from the Middle Paleolithic period was observed, containing some fairly untypical materials geologically associated with a faunal assemblage also resulting from remobilisations within the cave lasting for an undetermined period of time. A date obtained for a set of these remains –thus revealing the average age of the assemblage itself– gave a result of *ca.* 25 Ka H calBP (Antunes *et al*., 1989), which appears too modern for the industry in question, even though it is not typical. A deciduous human tooth was also recovered from here and studied (Ferembach, 1962) in a recent review, which confirmed that it belonged to a Neanderthal (Antunes, 2000). Nearby a stratigraphic succession was observed which had accumulated in a deep aven in the Cretaceous limestone occurring at the front of a quarry. The base level, containing plentiful faunal remains, also revealed an abundant assemblage of Mousterian materials made from blocks of whitish flint available locally that had never been studied in detail. An assemblage of bones of large mammals was dated at between 27.17 Ka BP (+1.0; -0.9 Ka) and 29.82 Ka BP (+1.13; -0.98 Ka) (Antunes *et al*., 1989), corresponding to an average of c. 34.6 Ka calBP (Zilhão, 2006). Although the faunal assemblage had only a geological relationship with the Mousterian materials, it does not appear to be reasonable to doubt the contemporary nature of both deposits (contra Zilhão, 2006) and we believe that this date is valid for the Mousterian occupation of the limestone outcrops in the region.

2.4.7. Gruta da Figueira Brava (Setúbal)

Directly overlooking the sea and set in a miocenic calcarenite massif on the south side of the Arrábida mountains to the west of Portinho da Arrábida, various excavation campaigns were carried out in this cave at the end of the 1980s (Antunes, 1990/1991). The entrance to the former shelter was gradually filled in by calcium carbonate precipitates (Fig. 20). Only a small part of the interior has been explored but the stratigraphic, faunal and archaeological records emphasise the importance of this site. The stratigraphic sequence in the area excavated consists of materials that have been remobilised from other parts of the interior of the cave.

The base of the sequence corresponds to a conglomerate related to the raised, level beach measuring 5-8 m, which is well preserved in the outer part of the cave, as in the whole of the Arrábida southern coast (Teixeira &

Zbyszewski, 1949) and can be attributed to an interstadial form at the beginning of the last glaciation period. However, two recent radiometric dates on shells from the Forte da Baralha conglomerate deposit to the west of Sesimbra indicate a much more recent chronology of *ca.* 37 Ka calBP e 38 Ka calBP (Pereira & Angelucci, 2004). As the occupation of the shelter had been dated at around 36 Ka calBP –an absolute date for human occupation using limpet shells (*Patella* sp.) gave statistically identical results of 30.05 ± 550 Ka BP e 30.93 ± 0.7 Ka BP (Antunes *et al*., 1989)– it was concluded that this must have taken place immediately after the formation of the conglomerate deposit. However, the results obtained at Forte de Baralha have to be seen as corresponding to the minimum age of the corresponding deposits. In fact, the level of the sea at the time, would have been approximately 60 m lower than its present day level.

The results presented by these two authors also seem incompatible with the actual faunal record identified in the Gruta da Figueira Brava for two reasons. Firstly, it would be impossible, if the sea reached the entrance of the cave, to catch large mammals such as elephant/mammoth, aurochs, rhinoceros or horses, also incompatible with the mountain land overlooking the submerged area of Arrábida. These species could only have been caught on the vast coastal plain if it was exposed and extending to the east to the estuary of the River Sado (Antunes & Cardoso, 2000). Secondly, the aforementioned fossil level contained an abundance of *Patella safiana* remains, clearly a southern mollusc abundant nowadays on the Moroccan rather than the Portuguese coast (Choffat & Dollfus, 1904/1905). The presence of this species, and of *Pectunculus bimaculatu*s, a mediterranean species also present, indicates warmer waters and is obviously incompatible with the opposite indication supplied by the molluscs at the Figueira Brava cave. Therefore, the dates published in 2004 for the 5-8 m level at Forte da Baralha are not acceptable, particularly since previous attempts made by the same laboratory on identical material from the same origin led by a team including the author, proved inconclusive due to lack of collagen.

The conglomerate level, which mainly consists of Jurassic limestone pebbles, was identified inside the cave, lying directly on the miocenic substrate. This conglomerate is followed by a series of fine carbon beds, resulting from the lixiviation and transport of the products of combustion from fireplaces in other areas of the cave, which can also be observed presently in the exterior of the cave. This is followed by a red, fossiliferous level, containing an abundant lithic industry resulting from a similar process, crossed by irregular whitish veins of calcium carbonate (Level 2). The upper part of this level contains Roman and Islamic materials mixed with the remains of domestic mammals, shells and birds, and the series is sealed from above by a stalagmite bed which is still forming today.

From an archaeological point of view, approximately four thousand artefacts have been studied, or approximately two and a half thousand if the splinters from chipping are excluded (Cardoso & Raposo, 1995; Raposo & Cardoso, 2000a, b). Within this assemblage, the lithic industry appears to be expeditious, with no artefacts displaying any notable typological outlines due to the poor quality of the raw material, dominated by quartz pebbles of local origin. Some rare flint items occur, probably originating from the S. Luís mountains 10 kilometres away. Chipping from Mousterian centripetal disc cores predominates; amongst the retouched tools there is a prevalence of scrapers, followed by denticulates and notches. According to the traditional typological diagnostic criteria applied to Middle Paleolithic assemblages, the Figueira Brava industry corresponds to a Typical Mousterian, rich in denticulates of non-Levallois debitage and facies (Fig. 21).

The significant invertebrate marine fauna confirms a strong aquatic element in the diet of the Neanderthal populations based in what was, at the time, a large shelter. In addition to molluscs (indicating waters that were, in general, slightly cooler) there was also included crustaceans such as *Maja squinado* and *Cancer pagurus*, whose pincers have been deliberately broken to enable the soft flesh to be extracted (Callapez, 2000).

The Gruta da Figueira Brava **is** the most important set of paleoclimatic indicators around 36 Ka calBP. All the molluscs belong to species that still exist in the area. Amongst them, the great predominance of *Patella vulgata*, which is common nowadays on the coast of Galicia and the Asturias and has been replaced on the central and southern coast of Portugal by *P. intermedia*, which features rarely in the assemblage, suggests the existence of colder waters than nowadays in the area (Callapez, 2000). The avifauna is also a valuable indicator: in addition to various extinct species, there are 3 species from a colder climate than nowadays and 2 species from a Mediterranean climate that is incompatible with a cold climate. The majority of the species indicate a temperate climate, including 3 species that nest nowadays in more northern regions, but may be found in this area during the winter season. The conclusion reached by authors is that of a climate colder than nowadays but sufficiently warm and with sunny summers, to allow for the existence of Mediterranean species (Mourer-Chauviré & Antunes, 2000). The study of insectivores, chiroptera and lagomorphs (Mein & Antunes, 2000) led to conclusions that were compatible with those previously cited: the association of Mediterranean with nordic elements, indicating a climate colder than nowadays and a fairly substantial amount of forest and rocky terrain. Rodents (Jeannet, 2000) also suggest a cool temperate climate

The faunal record therefore indicates that, as the cave overlooked the coastal plain at the time, it was here that the majority of the animals were caught, including the elephant or even the mammoth (Antunes & Cardoso, 1991), both by humans and by other predators from the cave, such as the leopard, cave lion, hyena, wolf and grizzly bear, alternating with humans in their use of the cave. However, unlike the Gruta Nova da Columbeira, it was not possible to demonstrate clearly how this human occupation alternated with that of the carnivores, given the characteristics of the stratigraphic record.

In the rocky and more mountainous area of the Arrábida range, *Capra pyrenaica* remains were also recognised in the faunal assemblage, representing the second most frequent species of large mammal to be identified (*ca*. 22%) after the red deer *(Cervus elaphus)* (Cardoso, 1993). This situation indicates the exploitation of various biotopes near the cave, a situation that appears identical to that which has been observed in the other Estremadura

caves with significant Mousterian occupations. The human occupation is therefore residential in type, associated with the systematic and non-specialised use of the various food resources available in the surrounding area, from the shore to the mountain area, including the coastal plain. Underlying this proposition is the abundance of marine species, indicating a systematic collection from along the rocky or sandy shore, both in the intertidal and infralitoral areas including crustaceans. The area in which the food resources were obtained would not extended beyond the area surrounding the site. The exception is the whitish or sometimes streaked flint, which came from the São Luís mountains roughly 10 km away in a straight line. However, the scarcity of this raw material (161 cores and debitage products out of a total of 3,848 items and 21 tools out of a total of 358) (Raposo & Cardoso, 2000) is clear proof of the infrequent use made of this resource, despite its obvious advantages given the poor quality of the local rock, and it reinforces the local, though prolonged, nature of the human occupation.

As in the Gruta Nova da Columbeira, bones were identified that had been deliberately broken and used (Cardoso, 1993: fig. 13, n.º 5; Antunes, 2000). The human presence in this cave is also exemplified by a tooth which clearly has Neanderthal characteristics (Antunes *et al.*, 2000).

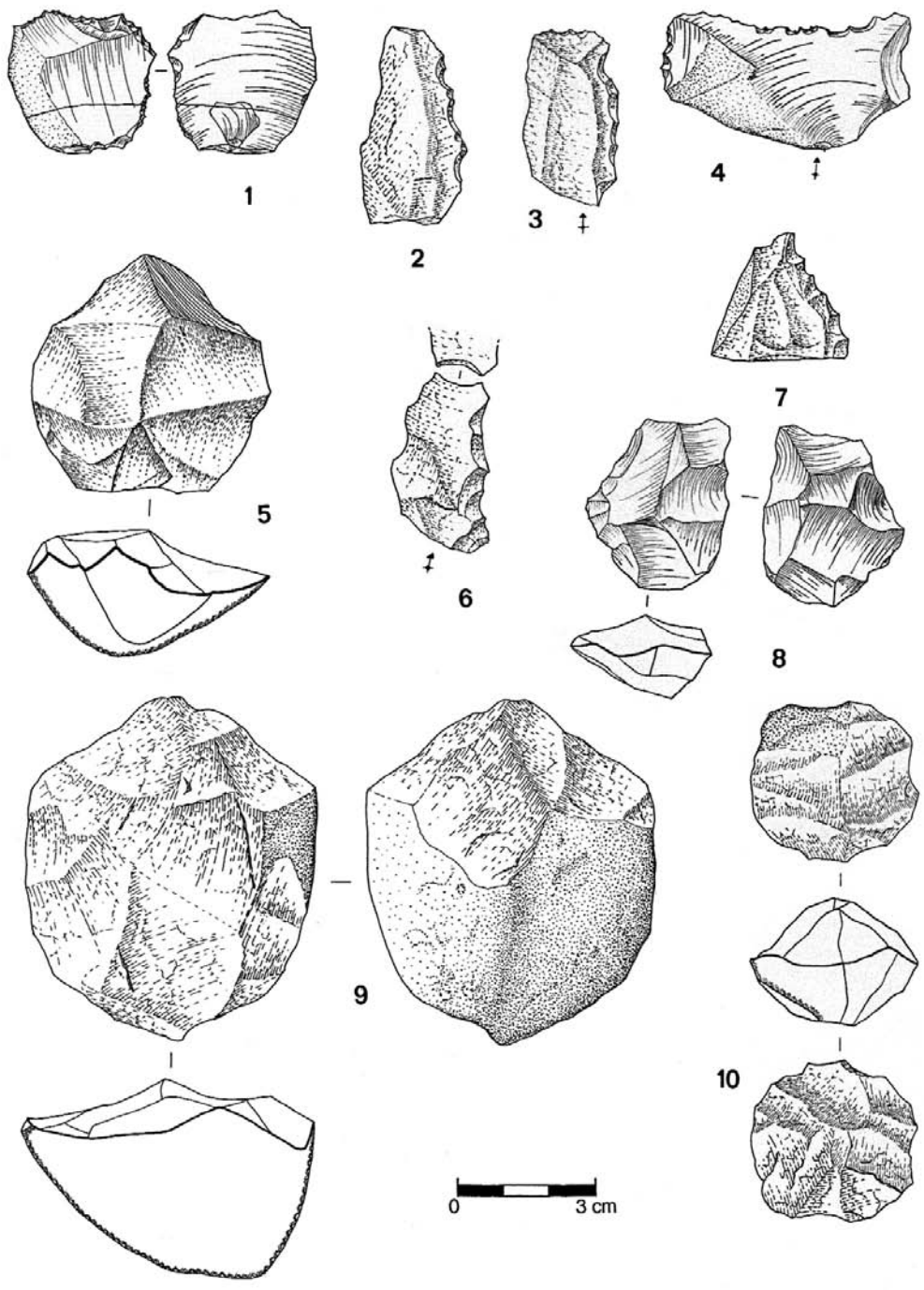


FIG. 21. *Industry from Gruta da Figueira Brava. 1, 4 – transverse sidescrapers; 2, 3, 6 – single sidescrapers; 7 – perfuraring point; 5, 8, 9, 10 – cores. All of quartz, except 1, 4, 8, of flint (after Raposo & Cardoso, 2000).*

2.5. *The Hesperian Massif caves*

2.5.1. Gruta do Escoural (Montemor-o-Novo)

This is the southernmost of the caves bearing evidence of a Mousterian occupation. It is a karst cave accidentally discovered in 1963 during quarry blasting and became famous for the parietal paleolithic art identified shortly afterwards (Santos, 1964). The existence of quartz materials from the Middle Paleolithic, recovered during excavation work carried out under the supervision of M. Farinha dos Santos, including nuclei of various types and retouched flakes, was observed by the author in the National Archaeology museum in 1989.

The Mousterian classification for some of these materials recovered from a fissure in the exterior of the cave (Santos, 1985: 140) is due to the work of M. Farinha dos Santos, so the presence of a Middle Paleolithic occupation was not unknown at the time when the cave was re-excavated between 1989 and 1992. Many quartz artefacts were recovered at this time, near the area already noted by Farinha dos Santos but inside the cave, corresponding to its original entrance area (Silva *et al.*, 1991).

A large amount of hyena remains, in association with coprolites, occurring as a remarkable continuous level inside the cave and related with the aforementioned Middle Paleolithic occupation, show that human occupation of the cave would have been unfeasible for long periods of time, and most of the remains of ungulantes that have been identified must be connected with the activities of these and other carnivores such as the leopard (Cardoso, 1993).

A date obtained using U/Th on a deer's tooth recovered from a stratigraphic cut made in 1992 into the

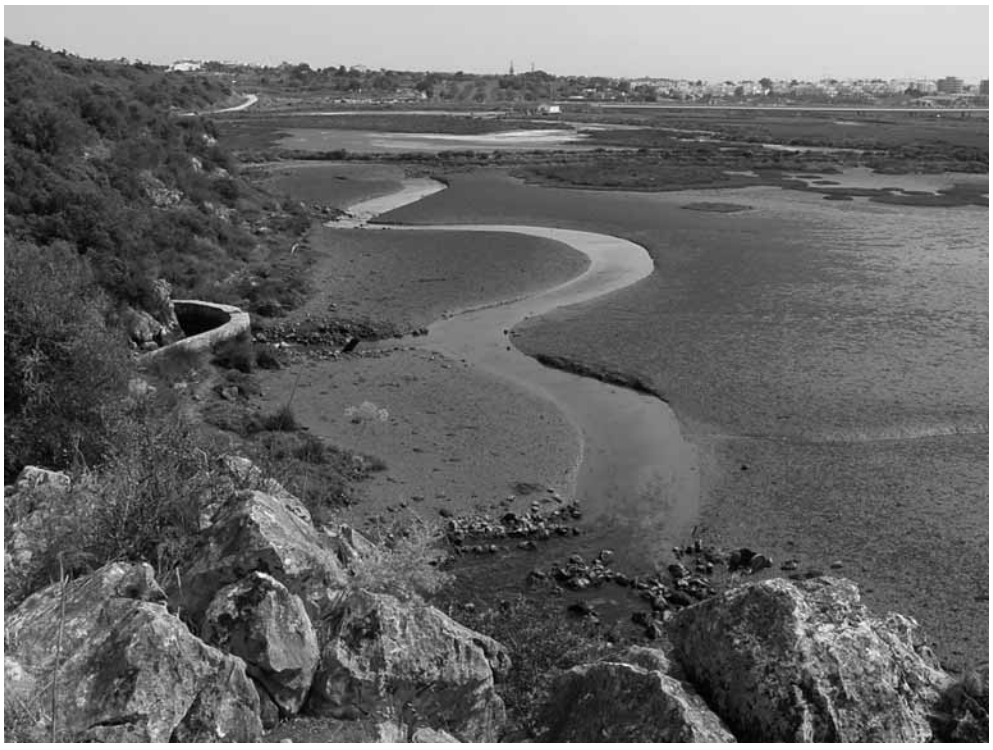


FIG. 22. *View from Gruta de Ibn Amar, showing the spring system in low tide within the Arade River estuary (photo supplied by N. Bicho).*

aforementioned deposits inside the cave gave a result of 48.9 Ka BP (+5.8; -5.5 Ka) (Araújo & Lejeune, 1995), compatible with the characteristics of the lithic industry, still awaiting a detailed publication.

2.6. *The Algarve*

Although mousterian industries were documented some time ago in Algarve, particularly in the eastern area, through the pioneering work of G. Zbyszewski and A. Viana in the 1940s, most of the collected pieces are from surface. Nevertheless, some sites provided some typical samples, with a particular emphasis on centripetal disc cores made from quartzite pebbles, a raw material that was plentiful in the Quaternary gravel beds of ancient beaches along the present coastline (Viana & Zbyszewski, 1949; Raposo, 1997).

Recently a study programme on western part of the Algarve resulted in an preliminary overview of the occupation strategy and of the use of biotic and abiotic resources during the Mousterian (Bicho, 2004). Open air sites have been found at the edge of temporary lagoons such as Lagoa Funda 1, 2 and 3 and Lagoa do Bordoal, at altitudes of no more than 150 m, together coastal areas such as the Praia da Galé and others including Vale Boi (a rocky shelter roughly 3 km away from the ocean coast) and the Ibn Amar cave, now located on the left-hand bank of the estuary of the River Arade, facing Portimão.

The fauna has not been preserved in the open-air sites. Only the Ibn Amar cave and Vale Boi provided a economic indicators of subsistence strategies.

In the former (Fig. 22) it is important to emphasise the presence of fish and mollusc remains, together with medium-sized and small terrestrial mammals which had been caught (deer, ass and rabbit), as evidence non-specialised hunting and compatible with the wide range of resources available, which (as seen in the caves in Estremadura) also included the terrestrial turtle (*Testudo* sp.) and fish. The high density of the occupation is indicated by the fact that only 1 m^2 yelded over 200 artefacts with mousterian characteristics, together with a variety of raw materials, which included mainly quartz but also flint, quartzite and even limestone (a discoid core).

Vale Boi was another site which provided faunal remains. The levels below the oldest Upper Paleolithic occupation, separated by 0.35 m of sterile layer, supplied untypical artefacts of quartz, flint and quartzite. These materials were associated with burnt bones, mainly from rabbits, and shells. Once again, there was evidence of small-scale hunting, as well as a coastal gathering strategy clearly local in range, the best example of which is Gruta da Figueira Brava.

The use of quartz and quartzite is also evidence of local supply strategies, with the exception of flint which, in some cases, may have come from roughly 30 km away. Two flint quarries have been identified for this period (Vale Santo 3 and Curva do Belixe) near the western boundary of the region, yielding flint nodules from the Jurassic limestone, sometimes measuring around 20 cm in diameter (Bicho, 2004). Only nuclei were found at both sites, indicating that debitage products, whether processed or not, would have been exported to other areas, probably including the Praia da Galé site approximately 30 km away.

3. Ecology, economy, subsistence bases, demographic patterns

Important sites from the Mousterian, including both open-air and cave and rock shelters, have been identified and excavated. There were great restrictions on producing any suitable characterisation of the former type due to the effects of erosion, which has prevented the preservation of extensive stratigraphic and faunal elements. It is possible that in most cases site occupation was intensive and lengthy, *of* residential type, given the abundance of the remains that are dispersed, in most cases, over wide areas. This is the case with the sites on the outskirts of Lisbon, in which flint was used intensively, as well as the Cascalheira and Conceição sites, amongst others, on the other side of the large Tejo estuary, with almost exclusive use of raw materials available locally, consisting of quartzite pebbles carried by the Tejo from the Hesperic Massif. However, the shortage of information, due to the lack of extensive excavation works, does not allow the full understanding

of the organisation of the inhabited areas, their limits and the possible existence of intra-site areas devoted to specific activities.

Taking into account the published data, the two open-air sites located in the Upper Portuguese Tejo area (in the Vila Velha de Ródão region) apparently have distinctive characteristics. Both the Foz de Enxarrique and Vilas Ruivas sites appear to correspond mainly to a logistic camp sites, particularly the latter, not only because of the smaller amount of catalogued evidence but also due to the prevailing hunting activities. This can be seen, on the one hand, in the very large percentage of deer bones showing signs of cutting and breaking at Foz do Enxarrique, located on a small platform where the Tejo is joined by the Enxarrique stream, a favourable location for a temporary specialised site periodically flooded. It can also be seen in the structures that may be classified as fireplaces (Raposo, 1995) or hunting blinds (using the terminology of L. Binford) according to João Zilhão (Zilhão, 2001) in Vilas Ruivas, together with the small concentration of materials observed there.

The importance of the stratigraphic sequences of some of the caves, such as the Gruta da Oliveira and the Gruta Nova da Columbeira indicate residential types of sites, with prolonged and recurrent characteristics. The Gruta da Figueira Brava also appears to indicate this type of occupation, although clearly it is not possible in any of these cases to determine the duration of human presence nor, in most cases, any possible seasonal occupation. However, whilst certain sites indicate short-term occupation due to the scarcity of the artefacts found and the poor stratigraphic record –as in the case of Lapa dos Furos, where only seven artefacts were identified, corresponding to a date of 40 Ka calBP as a *terminus post quem* for the Mousterian occupation (Zilhão, 2006)– the Gruta da Figueira Brava was certainly occupied in spring and summer, given the abundance of young rabbits that had clearly been caught by humans (Mein & Antunes, 2000). It is clear that their occupation of the cave alternated with that of carnivores, as observed in other caves dating from the same period (Gruta do Caldeirão, Gruta do Escoural, Gruta Nova da Columbeira).

The area in which resources were gathered –including raw material for manufacturing artefacts– was always restricted to the area surrounding each site and was characterised by a non-specialised economy of hunting-gathering. Medium-sized mammals clearly predominated, such as red deer and horse, common at the time in their respective biotopes and indicative of open land, or corresponding more to forest areas. The scarcity of certain species such as auroch is mainly due to the difficulty involved in capturing them.

Six deciduous rhinoceros teeth *(D. hemitoechus)* were recovered from Level 6 of the Gruta Nova da Columbeira; however, as the human presence is slight in this level, the presence of this species may be attributed to the activities of large predators and the same may be true of a fragment of jawbone containing two molars worn to the roots at Gruta da Figueira Brava, corresponding to an old individual. This was also the pattern witnessed in Lorga de Dine, where there is no evidence of any compatible human occupation (Cardoso, 1993).

Nevertheless, the hunting of large mammals is clearly documented by the aurochs (and eventually by the elephant and the mammoth); some deliberately broken auroch bones had been transformed into various tools.

The hunting of medium-sized prey is documented both in Gruta Nova da Columbeira and Gruta da Figueira Brava. The majority of the remains consisted of deer (almost 60% in the former and 34% in the latter) whilst other species such as horse and mountain goat were also present but in differing amounts due to the nature of their respective biotopes (the contribution made by carnivores cannot be quantified, but would have been much lower, bearing in mind the number of remains preserved, particularly in Levels 8 and 9 of the Gruta Nova da Columbeira, as previously emphasised).

The exclusive presence of red deer amongst the fauna hunted at Gruta da Oliveira in the most modern Mousterian levels dated at 38-37 Ka calBP indicates a more temperate climate, perhaps warmer than the one corresponding to the presence of this species in the two previous caves (36 Ka calBP for Gruta da Figueira Brava and 34-31 Ka calBP for Gruta Nova da Columbeira, if these results are to be accepted, given the reasons previously explained), both of which indicate a temperate but cooler climate than nowadays, due to the presence of the mountain goat. Thus a climatic cooling would have begun *ca.* 36 Ka calBP, leading gradually to the full pleniglacial, a conclusion that has been presented previously on the basis of the study of large Pleistocene mammals (Cardoso, 1993).

The frequent presence of the terrestrial turtle, which is largest in terms of amount in Level 8 of Gruta Nova da Columbeira indicates a higher anthropic incidence. The same conclusion may be extended to the remains of this species originating in the deeper levels of the Gruta da Oliveira, which are carbonised, like the rabbit remains associated with them. In fact, both species are plentiful in most of the caves showing human mousterian occupation –and also marked in the Gruta de Ibn Amar (Bicho, 2004)– although they differ in quantity, indicating a practice of the hunting of small animals, which seems to have been common throughout the Late Mousterian period.

In addition, the importance of gathering molluscs from the shore should also be stressed in the areas nearest to the coast, such as Gruta da Figueira Brava and Gruta de Ibn Amar, where fishing has also been recorded. In the former, the marine prey also extended to crustaceans *(Maja squinado*, *Cancer pagurus)*, whose pincers were found deliberately broken (Callapez, 2000), and marine mammals such as the common dolphin *(Delphinus delphis)* and the ringed seal *(Pusa hispida)*, both represented by one individual (Antunes, 2000). These may correspond to the secondary exploitation of animals washed up on the shore (or captured on it, in the case of the seal), with the the latter species indicating a colder climate than nowadays. This is a clear indication of the importance of the marine resources gathered and consumed in the cave, at present a unique evidence in Portuguese territory in terms of the variety and abundance of the remains preserved.

It can therefore be concluded that the claim made by Nuno Bicho (Bicho, 2004) cannot be confirmed, according to whom the pattern for settlements in the Algarve during the Mousterian period would have been very different to that of Estremadura, on the basis of the presence of small prey (turtle and rabbit), in association with

aquatic fauna. This association can also be seen in Estremadura where the aquatic contribution could even be more significative.

The fact that this practise has not been recorded in the Gruta Nova da Columbeira, located approximately 10 km away from the present coastline indicates that the corresponding territories were, in fact, restricted in size.

These territories may also have varied in size over time. Taking as comparison the percentage of flint items –a rock whose specific features were preferred in general to others– found in the two most complete stratigraphic sequences studied, it can be seen that the use of flint declined in the Gruta da Oliveira between the earliest and most modern Mousterian occupations. It may therefore be concluded that the respective territories for gathering resources may have been reduced in size (Zilhão, 2001: fig. 2). However, a closer observation shows only a decline in the presence of flint from the "Mousterian cone" and the assemblage from Levels 8 to 12. As N. Bicho points out (Bicho, 2004), the trend is positive, showing a consistent increase in time between Level 11 and Level 8.

The dubious legitimacy of an indicator of this kind should also be noted: in Gruta Nova da Columbeira there was also an increase in the use of flint but this was not related to any true need for supplies of this superior quality raw material, since there was no increase in the number of tools manufactured from it, unlike the numbers for those made from quartz or quartzite (Cardoso, Raposo & Ferreira, 2002: fig. 18).

The scarcity of flint artefacts in the assemblage from Gruta da Figueira Brava –only 161 nuclei and products from debitage out of 3,848, or 21 tools out of a total of 358 (Raposo & Cardoso, 2000)– has led J. Zilhão (Zilhão, 2006) to contemplate a restricted territory in which resources were gathered. However, the low visibility of this resource should also be emphasised, since it occurs in fine beds interstratified in the limestone that have only recently been exposed with the opening up of extensive quarrying areas, meaning that its scarcity cannot be used as an argument to support this conclusion.

Whatever the case may be, other variables should also be taken into consideration, such as exchanges amongst groups and cultural aspects that may have led to a preference for a particular type of rock, obviously without excluding the mobility factor itself and, together with this, the size of the corresponding territories. These factors, possibly interacting with each other may, as a whole, explain the almost exclusive use of quartz during the Mousterian period, replaced by flint in the Upper Paleolithic occupations in the Gruta do Escoural (Otte, *in* Zilhão, 2001).

Given the current state of knowledge, the general conclusion that may be advanced is that during the Mousterian period the territories must have, in fact, been relatively restricted.

In the Algarve, the sites discovered so far are located no more than 10 km away from the present coastline (Bicho, 2004), meaning that most of the inland Algarve area would have been covered at the time by dense maquis and forests, making travelling and hunting in that area difficult. The exceptions would have been the water courses which, as in the case of Estremadura, would have been a good means of penetrating and travelling into the area, favouring hunting and, therefore, open-air establishments of groups of people, a situation that is particularly well-evidenced by finds recovered in the Tejo valley and its tributaries or sub-tributaries, such as the River Nabão in the Tomar area or the River Almansor in the Benavente-Santo Estevão area.

After a warm period, corresponding to the formation of the deposits of Furninha cave, *ca.* 80 Ka calBP, with the stripped hyena, the is no relevant paleoclimatic information until *ca.* 45 Ka calBP. The Estremadura coast would have been at that time mainly covered by pine and Ericaceae, followed by *Quercus*, *Corylus*, *Myrtus*, *Ilex* and *Myrica*, indicating an open, windy landscape and a temperate-cool humid climate (Diniz, 1993). The same conclusion is valid to the Alentejo coast (Diniz, 1986; Schroeder-Lanz, 1971). However, it should be emphazise the presence in both sites of *Myrica*, a genus with thermophilic characteristics.

After this cool period, also suggested by the mountain goat in the lower levels of Gruta da Oliveira, older than 43 Ka calBP, the climate would generally have been Mediterranean *ca.* 39/40 calBP up to 38-37 Ka calBP as shown by the presence of rodents of mediterranean characteristics in Level 8 of Gruta da Oliveira (38-37 Ka calBP) and of *Cepaea nemoralis*, a land snail, recovered in large amounts from the Lapa dos Furos (Tomar), dated around 40 Ka calBP (Callapez, 1999). Meanwhile, as expected, the mountain goat disappeared from Gruta da Oliveira.

These conditions were slightly modified up to 34-31 Ka calBP, coinciding with the end of the Mousterian, considering the dates from Gruta Nova da Columbeira. In fact, although the presence of the turtle in most of the important caves that have been studied (Gruta Nova da Columbeira, Gruta da Oliveira, Gruta de Ibn Amar and Gruta da Figueira Brava) is an indicator of a warm temperate climate, the mountain goat reappearing afterwards (Gruta da Figueira Brava, Gruta Nova da Columbeira) corresponds to a cooler climate. The microfauna in Level K of the Gruta do Caldeirão (Póvoas *et al.*, 1993), with *Allocricetus bursae*, discovered in Portugal for the first time, demonstrates the extension of eurasiatic steppes in the Iberian peninsula *ca*. 35 Ka calBP. In conclusion, we can admit that until 36 Ka calBP there was a progressive climatic cooling that became more severe during the establishment of the first industries of the Upper Paleolithic c. 34 Ka calBP.

The fact that the first biologically modern human populations did not occupy the centre, south and west of the Iberian Peninsula until around 34 Ka calBP must have been due to the combined effects of two factors: the possible difficulty of adapting to the respective natural environments and, above all, the fact that these environments were occupied by populations that were biologically progressive (not in the sense that they were approaching the status of *sapiens sapiens*, but in the strictly biological sense and within a Neanderthal frame of reference), although possibly technologically and culturally less developed. In this context, it would be expected that the size of the respective territories would have played a decisive role: the smaller and geographically more accessible territories would have generated all the phenomena of

acculturation and/or a rapid decrease in population and the extinction of the less well-equipped population. The less geographically accessible territories would have led to the preservation of cultural traits and a longer survival of the older populations who could make use of sufficiently large areas for reproduction. This would have been the case in the east (Greece and Italy) and the west (Portugal and Mediterranean Spain) respectively. Their faunal associations, especially in the Iberian case, which document the survival of ancient mega-fauna remains until very recent times (note, for example, the occurrence of *Palaeoloxodon antiquus* close to 33,6 Ka calBP at the Foz do Enxarrique site, afterwards replaced by a common fauna, of a modern type), are proof of these particularities, with the Neanderthal population constituting only one element in the broader geographical and natural framework. Moreover, the role played by the present-day Portuguese territory as an area of refuge originates in much earlier times: in this context it is important to remember the presence of large numbers of *Hyaena hyaena prisca* (the antecedent of the present-day African striped hyena), as well as the ancient subspecies of small wolf *(Canis lupus lunellensis)* in the Furninha cave (Peniche) at the start of the last Ice Age (around 80 Ka BP), whilst in the area of Europe beyond the Pyrenees records only exist up to the Mindel-Riss interglacial period, as they were unable to survive the rigours of the Rissian cold that began around 250 Ka BP.

The past decade and beginning of this one contributed with theoretical models to explain the late survival of the last Neanderthals in the south and southwest of the Peninsula. This situation may at least be partly explained by ecological reasons and the behavioural preferences of the two human groups, which has been called the "Ebro frontier", an imaginary geographical line that would act as a stable barrier between the region to the north and the rest of the Peninsular territory inhabited by the last Iberian Neanderthals (Zilhão & Trinkaus, 2002: 567).

However, this demographic model based on a lasting and stable separation between two populations has also been questioned recently (Jöris, Álvarez Fernández & Weninger, 2003). The authors verify that (1) there is a clear discrepancy between the radiocarbon dates obtained for bones and charcoal, with the latter being several thousands of years more modern; 2) as a consequence, they conclude that there is no proof of the duration of Middle Paleolithic industries in the southwest of the Iberian Peninsula during the oldest phases of the Aurignacian, a conclusion which contradicts the "Ebro frontier" model which, as previously stated, distinguished between the Late Mousterian industries of the southwest and those of the Early Aurignacian in the north east; 3) in fact, the available dates imply a model of population dynamics which shrank during the most intensely arid and cold phases and expanded during the warmer interstadial phases, giving rise to the idea of regional development during the Aurignacian in south-east Europe based on Late Mousterian industries produced by Neanderthals. These transitional industries are, however, completely absent from Portuguese territory, in which the Aurignacian is at present known only in its developed state and whose absolute chronology is still very imprecise. In common with the previous model, the geographical interpenetration of the territories occupied by the two human groups depended on climatic causes.

This new vision of the transition from the Middle/Upper Paleolithic in the Iberian Peninsula, has already been the object of an initial and full discussion (Zilhão, 2006).

Other contributions will certainly be added in the near future, as a result of the research that this subject has stimulated in recent years and on the basis of new information obtained from excavations currently taking place, new results will be produced so that the present limitations referred in this summary will be overcome.

Acknowledgments

I am deeply greatful to João Zilhão, Nuno Bicho and Luís Raposo who provided photos and informations. I also thank to my wife Teresa, for her help in the preparation of the manuscript.

Final note. With this work already in press, there was an oral communication addressing two new Middle Palaeolithic sites having stratigraphic interest on the left bank of the middle Tagus river valley, azinhal and Pego do Tejo II (Nisa county), almost in front of Vilas Ruivas site. The first site had an association of micoquian bifaces with denticulates and was dated by OSL from 61 +/-7 Ka. The second site presented an association of mousterian cores with denticulates, and was dated from 135 +/-21 Ka, also by OSL. We thank the author, Nelson Almeida, the possibility to refer these results before their publication.

Bibliography

ANTUNES, M. T. (1990/1991): "O Homem da Gruta da Figueira Brava (ca. 30 000 BP). Contexto ecológico, alimentação, canibalismo", *Memórias da Academia das Ciências de Lisboa. Classe de Ciências*, 31, pp. 487-536. Lisboa.

– (2000a): "Bone implements, modified bones and teeth (late Mousterian) from Gruta da Figueira Brava (Arrábida, Portugal)". In ANTUNES, M. T. (ed.): *Últimos Neandertais em Portugal – evidência, odontológica e outra*. Lisboa: Academia das Ciências de Lisboa, pp. 339-379.

– (2000b): "Gruta da Figueira Brava: pleistocene marina mammals". In ANTUNES, M. T. (ed.) (2000): *Últimos Neandertais em Portugal – evidência, odontológica e outra*. Lisboa: Academia das Ciências de Lisboa, pp. 245-257.

ANTUNES, M. T.; CABRAL, J. M. P.; CARDOSO, J. L.; PAIS, J. & SOARES, A. M. Monge (1989): "Paleolítico Médio e Superior em Portugal: datas 14 C, estado actual dos conhecimentos, síntese e discussão", *Ciências da Terra*, 10, pp. 127-138. Lisboa.

ANTUNES, M. T. & CARDOSO, J. L. (1991): "Quaternary elephants in Portugal: new data", *Ciências da Terra*, 11, pp. 65-76. Lisboa.

– (2000): "Gruta Nova da Columbeira, Gruta das Salemas and Gruta da Figueira Brava: stratigraphy, and chronology of the pleistocene deposits". In ANTUNES, M. T. (ed.): *Últimos Neandertais em Portugal – evidência, odontológica e outra.* Lisboa: Academia das Ciências de Lisboa, pp. 23-67.

ANTUNES, M. T.; CUNHA, A. S.; SCHWARTZ, J. & TATTERSALL, I. (2000): "The latest Neanderthals: evidence from

Portugal". In ANTUNES, M. T. (ed.): *Últimos Neandertais em Portugal – evidência, odontológica e outra*. Lisboa: Academia das Ciências de Lisboa, pp. 283-318.

ARAÚJO, A. C. & LEJEUNE, M. (1995): *Gruta do Escoural: necrópole neolítica e arte rupestre paleolítica*. Lisboa: Instituto Português do Património Arquitectónico e Arqueológico.

AUBRY, T. & MOURA, M. H. (1994): "Paleolítico da Serra de Sicó". In *1.º Congresso de Arqueologia Peninsular*, 4. Porto, pp. 43-60.

BARANDIARÁN, I. & FERREIRA, O. da Veiga (1971): "Huesos labrados en el Paleolítico Antíguo y Médio de Portugal", *Arqueologia e História*, Série IX, 3, pp. 31-54. Lisboa.

BICHO, N. (1997): "A escavação de emergência do sítio paleolítico de Santa Cita/Tomar". In *Em busca do Passado 1994/1997*. Lisboa: Junta Autónoma das Estradas, pp. 10-29.

– (2004): "The Middle Paleolithic occupation of southern Portugal". In CONNARD, N. J. (ed.): *Settlement dynamics of the Middle Paleolithic and Middle Stone Age*, *2*. Tübingen: Kerns Verlag, pp. 513-531.

BICHO, N. F. & FERRING, C. R. (2001): "O sítio arqueológico de Santa Cita, Tomar: as intervenções arqueológicas de 1990 a 1997", *Arkeos*, 11, pp. 71-115. Tomar.

BREUIL, H. & ZBYSZEWSKI, G. (1942): "Contribution à l'étude des industries paléolithiques du Portugal et de leurs rapports avec la géologie du Quaternaire. Les principaux gisements des deux rives de l'ancien estuaire du Tage", *Comunicações dos Serviços Geológicos de Portugal*, 23, pp. 3-328. Lisboa.

– (1945): "Contribution à l'étude des industries paléolithiques du Portugal et de leurs rapports avec la géologie du Quaternaire. Les principaux gisements des plages quaternaires du littoral d'Estremadura et des terrasses fluviales de la basse valée du Tage", *Comunicações dos Serviços Geológicos de Portugal*, 26, pp. 3-662. Lisboa.

BRUGAL, J. P. & RAPOSO, L. (1999): "Foz do Enxarrique (Ródão, Portugal): first results of the analysis of a bone assemblage from a Middle Paleolithic open site". In *The role of early humans in the accumulation of European Lower and Middle Paleolithic bone assemblages*. Mainz. Monographien des Römisch-Germanischen Zentralmuseums 42, pp. 367-379.

CALLAPEZ, P. (1999): "Paleoecologia e polimorfismo do helicídeo *Cepaea (Cepaea) nemoralis* (Linné, 1758) *(Mollusca, Gastropoda)* do Plistocénico Superior da Lapa dos Furos (Ourém, Portugal)", *Revista Portuguesa de Arqueologia*, 2 (2), pp. 5-14. Lisboa.

– (2000): "Upper Pleistocene marine invertebrates from Gruta da Figueira Brava (Arrábida, Portugal)". In ANTUNES, M. T. (ed.): *Últimos Neandertais em Portugal – evidência, odontológica e outra*. Lisboa: Academia das Ciências de Lisboa, pp. 83-103.

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

– (1994): "O litoral sesimbrense da Arrábida. Resenha dos conhecimentos da sua evolução quaternária e das ocupações humanas correlativas", *Sesimbra Cultural*, 4, pp. 5-12. Sesimbra.

– (1995): "Novas escavações na Gruta da Ponte da Lage (Oeiras). Revisão dos materiais paleolíticos", *Estudos Arqueológicos de Oeiras*, 5, pp. 49-66. Lisboa.

– (2002): *Pré-História de Portugal*. Lisboa: Editorial Verbo.

CARDOSO, J. L. & MONJARDINO, J. (1976/1977): "Novas jazidas paleolíticas dos arredores de Alcochete", *Setúbal Arqueológica*, 2/3, pp. 7-47.

CARDOSO, J. L. & NORTON, J. (1995): "Achados do Paleolítico Inferior e Médio da região de Rio Maior", *Al-madan*, Série 2, 4, pp. 5-9. Almada.

CARDOSO, J. L. & RAPOSO, L. (1995): "As indústrias paleolíticas da Gruta da Figueira Brava (Setúbal)". In *3.ª Reunião do Quaternário Ibérico*. Coimbra, pp. 451-456.

CARDOSO, J. L.; RAPOSO, L. & FERREIRA, O. da Veiga (2002): *A Gruta Nova da Columbeira – Bombarral*. Cadaval: Câmara Municipal do Bombarral.

CARDOSO, J. L. & ZBYSZEWSKI, G. (1995): "Três jazidas paleolíticas do Complexo Basáltico de Lisboa: Damaia, Venteira e Casal da Barroca (Amadora)", *Estudos Arqueológicos de Oeiras*, 5, pp. 23-37.

CARDOSO, J. L.; ZBYSZEWSKI, G. & ANDRÉ, M. C. (1992): "O Paleolítico do Complexo Basáltico de Lisboa", *Estudos Arqueológicos de Oeiras*, 3, pp. 15-645. Lisboa.

CARREIRA, J. R. & RAPOSO, L. (1994): "Os utensílios sobre lasca da indústria do Paleolítico Médio do sítio da Cascalheira (Benavente)", *Al-madan*, Série 2, 3, pp. 22-29. Almada.

CHACÓN, M. G. & RAPOSO, L. (2001): "Análisis comparativo de la industria lítica en sílex del yacimiento de Estrada do Prado (Portugal) y del nível K del Abric Romani (España)", *Arkeos*, 11, pp. 141-161. Tomar.

CHOFFAT, P. & DOLLFUS, G. F. (1905): "Quelques cordons littoraux marins du Pléistocène du Portugal", *Communicações da Commissão do Serviço Geológico de Portugal*, 6 (1), pp. 158-173. Lisboa.

CORREIA, V. (1912): "O Paleolítico em Portugal. Estado actual do seu estudo", *O Arqueólogo Português*, 17, pp. 55-62. Lisboa.

DAVIS, S. (2002): "The mammals and birds from the Gruta do Caldeirão, Portugal", *Revista Portuguesa de Arqueologia*, 5 (2), pp. 29-98. Lisboa.

DELGADO, J. F. Nery (1884): "La grotte de Furninha a Peniche". In *Congrès Internationale d'Anthropologie et d'Archéologie Préhistoriques. IX Session*. Lisboa, pp. 207-278.

DELIBRIAS, G. *et al*. (1986): "Gif natural radiocarbon measurements X", *Radiocarbon*, 28 (1), pp. 9-68.

DINIZ, F. (1986): "Paleoambiente vegetal do depósito quaternário de S. Torpes", *Maleo*, 2 (13), p. 19.

– (1993): "Aspectos da vegetação e do clima de formações quaternárias entre Óbidos e Peniche". In *El Cuaternario en España y Portugal (1)*. Madrid: Instituto Tecnológico Geominero de España; Asociación Española para el Estudio del Cuaternario, pp. 337-344.

FEREMBACH, D. (1964/1965): "La molaire humaine inférieure moustérienne de Bombarral (Portugal)", *Comunicações dos Serviços Geológicos de Portugal*, 48, pp. 185-190. Lisboa.

FERREIRA, O. da Veiga (1966): "Acerca dos primeiros restos de *Homo neanderthalensis* encontrados no Mustierense de Portugal", *Lucerna*, 5, pp. 361-375. Porto.

– (1984): "O mais importante nível de ocupação do caçador Neandertal da Gruta Nova da Columbeira (Bombarral)". In *Volume d'Hommage au géologues G. Zbyszewski*. Paris: Éditions Recherche sur les Civilisations, pp. 365-370.

FIGUEIREDO, A.; OOSTERBEEK, L.; GUIZI, G.; AZARELLO, M.; WESTENGAARD, S.; CURA, S.; BURENHULT, G.; MINELLI, A.; THUN HOHENSTEIN, U. & PERETTO, C. (2005): "The architectural evolution in Prehistory: the Momentpast Project", *Journal of Iberian Archaeology*, *7*, pp. 77-99. Porto.

FONTES, J. (1910): "Estação paleolítica do Casal do Monte", *O Arqueólogo Português*, 10, pp. 93-96. Lisboa.

– (1912): "Subsídios para o estudo do Paleolítico português", *O Arqueólogo Português*, 17, pp. 22-41. Lisboa.

– (1913): "Note sur le Moustérien au Portugal". In *Huitième Congrès préhistorique de France*. Le Mans, pp. 342-350.

– (1916): "Instruments paléolithiques dans la collection de préhistoire du Service Géologique", *Comunicações do Serviço Geológico de Portugal*, 12, pp. 1-16. Lisboa.

GASPAR, R. & ALDEIAS, V. (2005): "O sítio paleolítico de Arneiro Cortiço (Benavente): intervenções de emergência nos contextos dos terraços do Tejo". In *IV Congresso de Arqueologia Peninsular*, 2. Faro, pp. 385-396.

GEPP (1983): "A estação paleolítica de Vilas Ruivas (Ródão). Campanha de 1979", *O Arqueólogo Português*, Série IV, 11, pp. 15-38.

GRIMALDI, S. & ROSINA, P. (2001): "O Pleistoceno Médio final no Alto Ribatejo (Portugal Central): o sítio da Ribeira da Ponte da Pedra", *Arkeos*, 11, pp. 89-115. Tomar.

HAWS, J.; HOCKETT, B.; FUNK, C. L.; DANIELS, J. M.; BENEDETTI, M. M. & BICHO, N. F. (2006): "Neandertals at the beach: Late Pleistocene coastal settlement of central Portugal". In *Annual Meeting of the Paleontological Society*. San Juan, Puerto Rico (USA).

JALHAY, E. & PAÇO, A. do (1941): "Páleo e Mesolítico português", *Anais Academia Portuguesa da História*, 4, pp. 7-101. Lisboa.

JEANNET, M. (2000): "Gruta da Figueira Brava: les rongeurs". In ANTUNES, M. T. (ed.): *Últimos Neandertais em Portugal – evidência, odontológica e outra*. Lisboa: Academia das Ciências de Lisboa, pp. 179-243.

JIMÉNEZ FUENTES, E.; CARDOSO, J. L. & CRESPO, E. G. (1998): "Presencia de *Agryonemis* (=*Testudo*) *hermanni* (Gmelin, 1789) en el Paleolítico Medio de la Gruta Nova de Columbeira (Bombarral, provincia de Estremadura, Portugal)", *Studia Geológica Salmanticensia*, 34, pp. 123-139. Salamanca.

JÖRIS, O.; ÁLVAREZ, E. & WENINGER, B. (2003): "Radiocarbon evidence of the Middle to Upper Paleolithic transition in Southwestern Europe", *Trabajos de Prehistoria*, 60 (2), pp. 15-38. Madrid.

LUSSU, T.; ROSINA, P.; OOSTERBEEK, L. & COSTA, F. (2001): "O Mustierense de Santa Cita (Tomar, Alto Ribatejo, Portugal): investigação e conservação", *Arkeos*, 11, pp. 13-70. Tomar.

MARKS, A.; MONIGAL, K. & ZILHÃO, J. (2002): "The lithic assemblages of the Late Mousterian at Gruta da Oliveira, Almonda, Portugal". In ZILHÃO, J.; AUBRY, T. & CARVALHO, A. F. (eds.): *Les premiers homes modernes de la Péninsule Ibérique*. Lisboa: Instituto Português de Arqueologia, pp. 145-154.

MATEUS, J. (1984): "Intervenção arqueológica de emergência na estação paleolítica da Estrada do Prado (Tomar)", *Informação Arqueológica*, 4, pp. 158-164. Lisboa.

MEIN, P. & ANTUNES, M. T. (2000): "Gruta da Figueira Brava: petits mammifères – Insectívora, Chiroptera, Lagomorpha". In ANTUNES, M. T. (ed.): *Últimos Neandertais em Portugal – evidência, odontológica e outra*. Lisboa: Academia das Ciências de Lisboa, pp. 163-177.

MOURER-CHAUVIRÉ, C. & ANTUNES, M. T. (2000): "L'avifaune pléistocène et holocène de Gruta da Figueira Brava (Arrábida, Portugal)". In ANTUNES, M. T. (ed.): *Últimos Neandertais em Portugal – evidência, odontológica e outra*. Lisboa: Academia das Ciências de Lisboa, pp. 129-161.

PAÇO, A. do (1934): "Carta paleolítica e epipaleolítica de Portugal", *Trabalhos da Associação dos Arqueólogos Portugueses*, 1, pp. 43-47. Lisboa.

– (1940): "Revisão dos problemas do Paleolítico, Mesolítico e Asturiense". In *Congresso do Mundo Português*, 1. Lisboa, pp. 233-251.

PEREIRA, A. R. & ANGELUCCI, D. E. (2004): "Formações dunares no litoral português, do final do Plistocénico e inícios do Holocénico, como indicadores paleoclimáticos e paleogeográficos". In TAVARES, A. A.; TAVARES, M. J. F. & CARDOSO, J. L. (eds.): *Evolução geohistórica do litoral português e fenómenos correlativos*. Lisboa: Universidade Aberta, pp. 221-256.

PÓVOAS, L.; ZILHÃO, J.; CHALINE, J. & BRUNET-LECOMPTE, P. (1992): "La faune de rongeurs du Pléistocène Supérieur de la grotte de Caldeirão (Tomar, Portugal)", *Quaternaire*, 3 (1), pp. 40-47. Paris.

RAPOSO, L. (1993): "O Paleolítico Médio". In CARVALHO, G. S.; FERREIRA, A. B. & SENNA-MARTINEZ, J. C. (eds.): *O Quaternário em Portugal. Balanço e perspectivas*. Lisboa: Colibri, pp. 147-161.

– (1995): "Ambientes, territorios y subsistencia en el Paleolítico Médio de Portugal", *Complutum*, 6, pp. 57-77. Madrid.

– (1997): "Paleolítico do Algarve". In BARATA, M. F. (coord.): *Noventa Séculos entre a serra e o mar*. Lisboa: Instituto Português do Património Arqueológico, pp. 137-154.

RAPOSO, L. & CARDOSO, J. L. (1998a): *O Paleolítico Médio da Conceição (Alcochete)*. Lisboa: Lusoponte/CEMA.

– (1998b): "Las industrias líticas de la Gruta Nova da Columbeira (Bombarral, Portugal) en el contexto del Musteriense Final de la Península Ibérica", *Trabajos de Prehistoria*, 55 (1), pp. 39-62. Madrid.

– (2000a): "A Gruta da Figueira Brava no contexto do Paleolítico Médio final do sul e ocidente ibéricos". In *Encontro sobre a Arrábida*. Lisboa: Instituto Português de Arqueologia, pp. 7-19.

– (2000b): "Mousterian industries of the Gruta da Figueira Brava". In ANTUNES, M. T. (ed.): *Últimos Neandertais em Portugal – evidência, odontológica e outra*. Lisboa: Academia das Ciências de Lisboa, pp. 319-337.

RAPOSO, L.; SILVA, A. C. & SALVADOR, M. (1985): "Notícia da descoberta da estação mustierense da Foz do Enxarrique (Ródão)". In *I Reunião do Quaternário Ibérico*, 2. Lisboa, pp. 41-60.

SANTOS, M. Farinha dos (1964): "Vestígios de pinturas rupestres descobertas na Gruta do Escoural", *O Arqueólogo Português*, Série 2, 5, pp. 5-47. Lisboa.

– (1985): "Manifestações neolíticas no contexto dos testemunhos pré-históricos do Outeiro da Herdade da Sala (Escoural. Montemor-o-Novo. Portugal)". In *17.º Congreso Nacional de Arqueología*. Zamora, pp. 135-144.

SCHROEDER-LANZ, H. (1971): "Die ersten 14 C datierten Mittelwürm –bildungen von der südlichen Alentejo Küste (Portugal)", *Eiszeitalter u. Gegenwart*, 22, pp. 35-42.

SILVA, A. C.; OTTE, M.; ARAÚJO, A. C.; CAWE, N.; LÉOTARD, J. M.; LEJEUNE, M.; LACROIX, P. & COLLIN, F. (1991): "A Gruta do Escoural, novas perspectivas para o seu estudo e valorização". In *4.ª Jornadas Arqueológicas da Associação dos Arqueólogos Portugueses*. Lisboa, pp. 173-181.

TEIXEIRA, C. & ZBYSZEWSKI, G. (1949): "Le niveau quaternaire marin de 5-8 m au Portugal", *Boletim da Sociedade Geológica de Portugal*, 8 (1/2), pp. 1-6.

VEGA TOSCANO, L. G.; RAPOSO, L. & SANTONJA, M. (1999): "Environments and settlements in the Middle Paleolithic of the Iberian Peninsula". In ROEBROEKS, W. & GAMBLE, C. (eds.): *The Middle Paleolithic occupation of Europe*. Leiden: University of Leiden, pp. 23-48.

ZBYSZEWSKI, G. (1943): "Les eléphants quaternaires du Portugal", *Comunicações dos Serviços Geológicos de Portugal*, 24, pp. 71-89. Lisboa.

– (1946): "Étude géologique de la région d'Alpiarça", *Comunicações dos Serviços Geológicos de Portugal*, 27, pp. 145-268. Lisboa.

– (1963): "Jazidas quaternárias de Salemas (Loures) e de Columbeira (Bombarral)", *Boletim da Academia das Ciências de Lisboa*, N. S., 35, pp. 137-147. Lisboa.

– (1974): "L'Âge de la pierre taillée au Portugal", *Les Dossiers de l'Archéologie*, 4, pp. 19-30. Dijon.

– (1977): "Três ossos de vertebrados quaternários", *Comunicações dos Serviços Geológicos de Portugal*, 61, pp. 191-194. Lisboa.

ZBYSZEWSKI, G. & FERREIRA, O. da Veiga (1967): "Le Paléolithique dês terrasses du Sorraia à l'Est de Benavente", *Comu-*

nicações dos Serviços Geológicos de Portugal, 52, pp. 95-107. Lisboa.

ZBYSZEWSKI, G.; FERREIRA, O. da Veiga; LEITÃO, M. & NORTH, C. T. (1987): "O Paleolítico da Gruta do Correio-Mor", *Setúbal Arqueológica*, 8, pp. 7-27. Setúbal.

ZILHÃO, J. (1992): "Estratégias de povoamento e subsistência no Paleolítico e no Mesolítico de Portugal". In MOURE ROMANILLO, A. (ed.): *Elefantes, Ciervos y ovicaprinos. Economía y aprovechamiento del medio en la prehistoria de España y Portugal*. Santander: Universidad de Cantabria, pp. 149-162.

– (1997): *O Paleolítico Superior da Estremadura Portuguesa*. Lisboa: Colibri (2 vols.).

– (2001): "Middle Paleolithic settlement patterns in Portugal". In CONARD, N. (ed.): *Settlement dynamics of the Middle Paleolithic and Middle Stone Age*. Tübingen: Kerns Verlag, pp. 597-608.

– (2006): "Chronostratigraphy of the Middle-to-Upper Paleolithic Transition in the Iberian Peninsula", *Pyrenae*, 37 (1). In press.

ZILHÃO, J. & MCKINNEY, C. (1995): "Uranium-Thorium dating of Lower and Middle Paleolithic sites in the Almonda karstic system (Torres Novas, Portugal)". In *3.ª Reunião do Quaternário Ibérico*. Coimbra, pp. 513-516.

ZILHÃO, J. & TRINKAUS, E. (2002): "Historical implications". In ZILHÃO, J. & TRINKAUS, E. (eds.): *Portrait of the artist as a child. The gravettian human skeleton from the Abrigo do Lagar Velho and its archeological context*. Lisboa: Instituto Português de Arqueologia, pp. 542-558.