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The Archaeo-Palaeontological Sites of the Middle Pleistocene at Ambrona and Torralba (Soria)

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Introduction

There are not many sites supplying significant information in order to enlarge our knowledge of the activities of human groups in the Lower Palaeolithic. Most of them conserve only artefacts of stone together

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Photo 1. General view of Ambrona site.

with chips and flakes produced in their preparation and few sites offer in addition wide-ranging sets of fauna, palaeo-environmental information and other items, such as for instance wood. Torralba and Ambrona, two sites known to scientists since the beginning of the century, correspond to this second category and are particularly distinguished by the abundant presence of faunal remains, particularly elephants. The wealth and variety of the information recovered from these two locations contribute to enlarge our knowledge on the environment of the ages in which these deposits were accumulated, of the fauna and vegetation and, in short, to a better understanding of the ecosystems in which the groups of Palaeolithic humans lived.

From the geological point of view, both sites are between the crossover area of structures from the eastern tip of the Central System of mountains and their boundaries with the Iberian Range and the Tertiary basin of Almazán, in a karstic polje developed on an anticline structure partly faulted on NE side (polje of Conquezuela), where different neogenous corrosion surfaces and fluvial terraces from the Pleistocene can be seen. The surface material (Fig.1) belongs to the Triassic in Germanic facies of

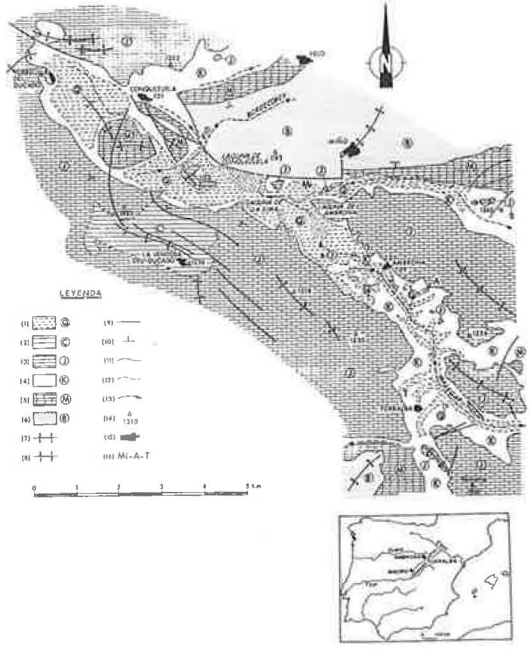

Figure 1. Geological scheme of the Conquezuela-Ambrona-Torralba polje (after the geological maps 434, 435, 461, 462 and own data). Geographical location of Ambrona and Torralba sites. Legend. 1: marls, sands, conglomerates; 2, sandstones, limestones, marls and dolomites; 3 limestones, dolomites, carniolas and marls; 4, marls and gypsum; Dolomites and marls; 6, conglomerates, sandstones and clays; 7, anticline; 8, syncline; 9 fault; 10, direction and inclination of bed; 11, normal contact; 12, unconformity contact; 13, rivers. direction and sense of the flow indicated by arrows; 14, altitude en meters; 15 town; 16 archaeological sites of Miño, Torralba and Ambrona; B, Buntsandstein; M, Muschelkalk; K, Keuper; J, Jurassic; C, Cretaceous; Q, Quaternary.

Buntsandstein, Muschelkalk and Keuper, followed by carbonate deposits at the transition to the Lower Jurassic, comprising the late Triassic Imón Formation (well-bedded dolomites) and the Cortes de Tajuña Formation (massive dolomites and anhidrite deposits, classically known as «Carniolas») as well as some other carbonate formations reaching the upper Lower Jurassic. Cretaceous units are preserved in a syncline structure at the locality of La Ventosa del Ducado. They unconformably overlie the Jurassic beds and range from Albian to, possibly, Coniacian.

Ambrona and Torralba occupy an outstanding place in the development of research of Prehistory. At the beginning of the XXth cen-

tury, they contributed to the foundation of our ideas about the great antiquity of mankind. Later, in the 60's, they were perhaps the main point of support for the defence of the thesis that groups of humans hunted systematically in the Middle Pleistocene, an interpretation that was the subject of lively debates before leading eventually to new approaches.

Historical Background

Discovery and early research

Knowledge of the site of Torralba is due to a slightly fortuitous event as early as 1888. The earthworks arising out of the installation of the railway lines from Madrid to Soria and the old station at Torralba unearthed some large elephant bones which caught the eye of the Belgian engineers enough to send some of the discoveries to the Museum of the Mining School in Madrid.

The news, which spread widely in the district, reached Mr. Enrique de Aguilera y Gamboa (1845-1922), the Marquis of Cerralbo, who spent long periods at the palace belonging to his wife in Santa María de Huerta, approximately 40 Km Northeast of Torralba.

Between 1909 and 1911, Cerralbo excavated approximately 2000 m^2 in Torralba, one of the first attempts to examine open-air Palaeolithic sites. He continued his work between 1914 and 1916 in Ambrona at the Prado Jimeno, 2.5 Km further North, where agricultural activities often brought up large bones, striking for their size.

The results he achieved were of enormous importance, as they showed without any doubt that man was a contemporary of very ancient extinct species, eventually considered Pliocene, at a key moment when in many circles the nature and antiquity of the early stages of mankind were still under discussion. Cerralbo combined certain elements in his hypotheses -hunting, herds of elephants, swamplands- which would come into use later. Yet he paradoxically still maintained the Biblical chronology for Torralba. In his interpretations, strongly influenced by his traditionalist ideology, he applied to the Palaeolithic groups the common schemes and concepts characteristic of the society of Castilian country life at the beginning of this century.

THE EXCAVATIONS OF THE SIXTIES

After 1936, the study of the Palaeolithic was almost totally abandoned in Spain. Only an occasional international meeting, such as the IV Conference on Prehistory and Protohistory in 1954 or the V Quaternary Conference (INQUA) in 1957, stirred the memory of Torralba and Ambrona and instigated certain research work such as the palynological study carried out by J.Menéndez-Amor and F.Florschyz. This led to a first chronological attempt for these sites, which were dated for the first time as Middle Pleistocene.

Contacts between Luis Pericot and Clark Howell at other scientific meetings, specifically the Pan-African Prehistory Conferences, were to lead, almost fifty years after Cerralbo, to the continuation of the research from 1960 to 1963. Howell set up systematic actions in large areas at Torralba and Ambrona which were advanced projects for that time. A truly pluridisciplinary team was built up around Howell, comprising prehistorians, geologists and palaeontologists. The exploration of the Pleistocene in Africa was to make this kind of excavation commonplace by the end of the decade but in 1960 this kind of research was new in Europe, also in Spain.

When work re-started, the area to be excavated at Torralba was assessed at around 3000 m^2. A little more than a third of that area was examined in the campaigns carried out until 1963. At La Loma de los Huesos (Bone Hill) in Ambrona, there were around 6000 m^2 of which 1243 m^2 were excavated at the same period during 28 weeks of activity. Both sites were examined by the same team using similar methodology and reaching conclusions which were largely common to both sites. The geological study, carried out by K. W. Butzer, proposed an identical chronology for both sites. This researcher defined a morphosedimentary unit, the Torralba Formation, that included the stratigraphic sequences of both sites, further referred to as twin locations.

This situation makes it feasible for us to deal in this heading more with Torralba, where the team of Prof. Howell did not longer return to fieldwork. In the following section, devoted to the field work carried out in the 80's, attention will be paid to the site of Ambrona.

Palaeontological excavations in those years provided the first precise indications about the lithic industry, clearly establishing its Acheulian character. For the production of these tools, silex, quartzite and limes-

tone were used, rocks brought in from some distance, particularly flint pebbles. Biberson and Aguirre also pointed out the existence of bone industry, although this is still an open question.

Fragments of wood appearing in the excavations carried out by the Marquis of Cerralbo, mostly *Pinus*, were studied by Howell. At the National Archaeological Museum, together with 19 small items there are another nine larger pieces. The most remarkable tools are a fragment showing a bevelled tip (27.4 x 4.1 x 2.5 cm) and a longer one which shows an apparently sharpened tip. The lenght ranges between 14.4 and 5.8 cm. The use of wood during the lower Palaeolithic is documented in various locations in central Europe, particularly in Northern Germany, at Schöningen, where the findings have included true lances apparently used to spear horses. The precise age, as well as the use of these wooden tools found at Torralba still remain open to discussion. Yet the potential interest of the items, due to the lack of this kind of tools in Acheulian sites is, without doubt, very high.

This stage of the investigations in Torralba and Ambrona led to an overall interpretation of the sites which, curiously, coincided in some aspects with the imaginative vision put forward by Cerralbo. The intimate relation between fauna and industry led to propose the almost exclusive protagonism of man. The location was valued with particular emphasis. By bringing into contact the highlands of the Northern Submeseta with the Ebro Basin, the valley of Mansegal was to constitute a corridor used by the herds of herbivores in their seasonal migrations. The groups of hominids, led by these concentrations and thus showing a planning behaviour using foresight, even to the extent of burning the vegetation in order to lead the groups of animals towards the swampy lands in the bottom of the valley where the undergrowth and the mud would hinder their movements, even trapping some of the animals, so that they could then be killed, butchered and prepared for later consumption.

FIRST DEBATES AND EXCAVATIONS AT AMBRONA IN THE 80'S

The development of prehistoric research in East Africa, on the other hand a key factor in the interruption of the studies in Spain by the team of HOWELL in 1963, radically altered the methods and hypotheses used in Palaeolithic archaeology during the 70's. Many ideas which were not analyzed in depth began to be reviewed, hunting and other acti-

vities related with human behaviour in the Pleistocene were then considered under a more rigorous approach. In this context, Interpretations of Torralba and Ambrona were also the subject of some criticism. First serious critics came from L. R. Binford, who started considering hunting activity as unlikely in the Middle Pleistocene period.

This author did not find solid arguments to justify the alleged role of fire in the leading of herds of elephants to the marshy areas at the bottom of the valley. He also doubted that the many carbon particles observed on the site corresponded to fires or had an artificial origin, while connecting them, as Klein did, with natural phenomena. Binford also questioned another of the key elements on which the interpretation of Torralba had been based, i.e. the idea that the surfaces containing concentrations of remains were unaltered. On the contrary, although no new stratigraphic data were available, he suggested that they must have been subjected to intense modifications by natural agents or by the trampling of the elephants themselves. The abundancy of faunal remains and industry in Torralba including intense traces of rolling also led other authors to consider the decisive role that river transport might have had in the accumulation of remains.

This debate open, a new stage of investigations started in Ambrona. Before that, in addition to the excavation area opened by Cerralbo, the 1962-63 field works excavated 1243 m^2 and Aguirre, in a month-long intervention, obliged by the need to re-organize the museum built *in situ* ten years earlier, enlarged the excavated area in 207 m^2. In this third stage, under the joint direction of HOWELL and FREEMAN in 1980 and 1981 and HOWELL alone in 1983, another 1267 m^2 were added to the excavation in 203 days. In total, the periods of excavation carried out after Cerralbo, involved an area, until 1983, of 2717 m^2 of the 6000 m^2 calculated for the whole site. Although references are very vague, works were also developed on the opposite slope, half a kilometre to the North, where a surface of 200 m^2 was opened up between 1963 and 1981.

WORKS IN RECENT TIMES

After the palaeontological excavations carried out in the 80's, the deposits at Ambrona have continued to be adscribed to the Torralba Formation comprising two stratigraphic members, the Lower Complex and the Upper Complex. In the Lower Complex are the characteristic con-

centrations of megafauna, particularly elephants, and the lithic industry is also present with low densities. Above that, in the central area of the site, intermediate occupations have been mentioned on occasion, with fauna and sporadic industry which seems to be valued as close or equivalent to that indicated on the slope located half a km to the north of the «Loma de los Huesos», where there were also records of fauna -deer, urus, elephants- and lithic industry. In the Upper Complex, at levels of alluvial and colluvial origin, the artefacts are more frequent and present a more evolved appearance than in the Lower Complex. Elephant is hardly observed, are replaced in importance by *Equus*, particularly in dental pieces.

The interpretations formulated in relation with the lower complex at Ambrona once this stage was concluded took up once more the earlier proposal with few variations. The remnants preserved in these deposits would be derived from the activity of the Acheulian hunters, as the result of planned hunting games and the processing and consumption of the prey achieved. Faunal remains would basically result from these interventions and the hominids would, in addition, have transferred substantial parts of the animals killed to their base camps, which were inferred to be placed on the higher plains dominating the area, over the valley.

CURRENT INVESTIGATIONS AT AMBRONA AND TORRALBA

Years after the end of the excavations of the 80's, controversy about the nature of these sites continued, but the limitations hindering the analysis in depth of the hypotheses proposed were considerable. In the absence of a complete monograph, the published data, the only information available for discussion, were insufficient. There were still substantial unresolved problems concerning the sedimentary processes, the stratigraphy and the spatial distribution of objects.

Unexcavated areas, at least in Ambrona, were known to be quite extensive. This opened up the possibility of contrasting the proposed hypotheses directly. As a result, another project was started in 1990, the fourth attempt since Cerralbo, under the direction of M. Santonja and A. Pérez-González, in order to resolve the scope of the human intervention and the processes leading to the formation of both sites. The research team was formed by C. Sesé and E. Soto, who are in charge of the co-ordination of faunal studies. This involved someother specialists: Mª

T. Aparicio (mollusca), A. Baltanás (ostracods), Mª J. López (diatomites), I. Doadrio (ichthyofauna), B. Sanchiz (amphibia and reptilia) and A. Sánchez Marco (avifauna). Archaeological interpretations were carried out by P.Villa, and R.Mora, whilst other geological and paleoenvironmental studies were taken by J. Gallardo (edaphology), T. Aleixandre (sedimentology) and B. Ruiz Zapata (palinology).

The first stage of our investigation, held between 1990 and 1991 (PÉREZ-GONZÁLEZ *et al.*, 1991; PÉREZ-GONZÁLEZ *et al.*, 1997), allowed tracing the geomorphologic evolution of the surrounding areas and locating the sites of Loma de los Huesos at Ambrona (photo1) and Loma del Saco at Torralba for the first time in a geological reference framework of local scope and capable of being integrated into a wider regional scale.

Excavation works have beenseasonally carried out every year during the month of August from 1993 at Ambrona and from 1994 in Torralba. The work at Ambrona has focused on the Lower Complex where a surface of, roughly, 600 m^2 has been excavated until today. It has been possible to locate the concentrations of fauna and stone working precisely in the stratigraphic sequence and in the palaeo-environmental context. The study of Torralba, constrained by the large volume of sediments from earlier excavations accumulated on the site itself, has advanced more slowly, but it has allowed to recognize the existence of large, non-excavated areas. Also, to locate the position of industry and faunal remains within the fluvial deposits and, in the 1999, to record the existence of a lower, faunal-rich stratigraphic sequence, not registered in former excavations of Cerralbo and Howell.

Geomorphological evolution

Regional geomorphologic analyses of these sectors of the Iberian Range were carried out by Schwenzner in 1937 and more recently by GLADFELTER (1971) and by BENITO *et al.* (1991) at the geological sheet of Arcos del Jalón (sheet number 435). For the present area, a first study by PÉREZ-GONZÁLEZ *et al.* (1991) concluded that the sites at Torralba and Ambrona were related to the complex evolution of the Conquezuela-Ambrona-Torralba polje and that the different geomorphologic position of Ambrona and Torralba probably indicated that they were not the same age (Table 1). This opinion was also shared later by AGUDO and SERRANO (1992).

INTRATERTIARY EROSION SURFACES

Three generalized erosion surfaces have been recognized (Fig. 2), the oldest and topographically highest of these being located at an 1200 m altitude. This erosion surface truncates the Jurassic and Cretaceous structures at Ventosa del Ducado and is also recognized at the Triassic braquianticline of Yelo. It has been interpreted (BENITO *et al.*, 1998a, 1998b) as the plateau M3 of SCHWENZNER (1937) named by-GLADFELTER (1971) as surface B; its age would correspond to Upper Miocene. Island remains or testimonies on the M3 surface include the Ministra peak (1309 m) named by GLADFELTER (*op.cit.*) as surface A (residual hills or mounds), and regarded as equivalent to the summit plateau or Dachfläsche (plateau D) of SCHWENZNER (*op.cit.*). The surface is dated as Oligocene to Lower or Middle Miocene, according to GRACIA-PRIETO *et al.*, (1988). A further denudation surface Squeezed on M3, has been mapped at an altitude of 1180 m on the Cortes de Tajuña Formation («*Carniolas*» unit, Lower Lías) . This surface was correlated by BENITO *et al.*, (1998a , 1998b) with SCHWENZNER's plateau M2 (*op.cit.*) or the equivalent surface C in GLADFELTER (*op.cit.*). Its age would be post-Upper Miocene. The third intraneogene surfaces is located thirty metres below surface M2 at a height of 1150 m and built up on the Upper Triassic Imón Formation (well-bedded dolomites). Southwards from Miño this surface bevels the sandstones and conglomerates of Buntsandstein rocks. Relict reliefs of this area include the hum-like islands emerging from the bottom of the Bordecorex valley, at the area of the Conquezuela lagoon or immediately to the North of km 4 of the Torralba-Soria railway. This surface corresponds to SCHWENZNER's Mesetafläche M1 (*op.cit.*) or surface D of GLADFELTER (*op.cit.*). Its age ranges roughly from Upper Pliocene to Plio-Pleistocene.

GENESIS OF THE QUATERNARY RELIEF

The most relevant process during the Lower Pleistocene period was the degradation of surface M1. This was a chemical and mechanical alteration and the residues were evacuated via the Bordecorex river (a tributary of the Duero River), whose southern watershed possibly followed the Torralba parallel, about 5 km South from its modern position.

Denudation of the carbonate surface M1 led to the development of an erosion level between Torralba and the current valley of the Bordecorex,

CRONOESTRATIGRAFIA			FORMAS, PROCESOS Y YACIMIENTOS
CUATERNARIO	HOLOCENO		LLANURAS ALUVIALES
	PLEISTOCENO	MEDIO + SUPERIOR	CONSTRUCCIÓN POLICÍCLICA DEL VALLE DEL RÍO MASEGAR (= LA MENTIROSA). NIVELES DE TERRAZA + 7-9 m, + 15 m, + 22 m, + 35 m — "YACIMIENTO DE TORRALBA"
			CAPTURA DEL VALLE DEL RÍO BORDECOREX POR EL RÍO MASEGAR (CUENCA DEL EBRO)
			SUPERFICIE DE AMBRONA A 1140 m. "YACIMIENTO DE AMBRONA"
		INFERIOR	DEGRADACIÓN DE M_1 POR LA RED DEL RÍO BORDECOREX (CUENCA DEL DUERO)
TERCIARIO			PLANICIE DE MESETA M_1 (1150 m)
			PLANICIE DE MESETA M_2 (1180 m)
			PLANICIE DE MESETA M_3 (1200 m)
			SUPERFICIE RESIDUAL DEL PICO MINISTRA (1309 m)

Table 1. Chronological position of significant forms, processes and sites in the karstic evolution of Conquezuela polje and valleys of the rivers Bordecorex and Masegar.

which virtually coincides with the stratigraphic contact between the Keuper facies and the bedded dolomite, Upper Triassic unit of Imón Formation. This created a wide impervious area (mean width a little over 1km and a length of 12-13km) with a gentle slope tending northwards. This level of local erosion at 1140 m in the well-preserved area around the watersheds of the Duero and Ebro basins is known as Superficie de Ambrona (S.A. = Surface of Ambrona; Figs. 2, 3). The Middle Pleistocene saw the accumulation of deposits, fauna and Acheulian industry associated with a fluviatile to lagoon-like environment with alluvial cones.

In this situation of relative stability began the uplifting of the Masegar river. Perhaps this tributary of the rivers Jalón had already begun its new course, capturing the valley of the Bordecorex river and progressing towards the current watershed, to the North of the village of Ambrona. This process left the Ambrona site at a relative height of 34 m above the bed of the Masegar river and at an absolute altitude of 1143 m.

The evolution of the course of the Masegar river has followed a polycyclic pattern of development involving repeated processes of flattening/steepening followed by incisive processes. Four levels of fluvial action can be seen in this valley, at relative heights of 1m (alluvial plain),

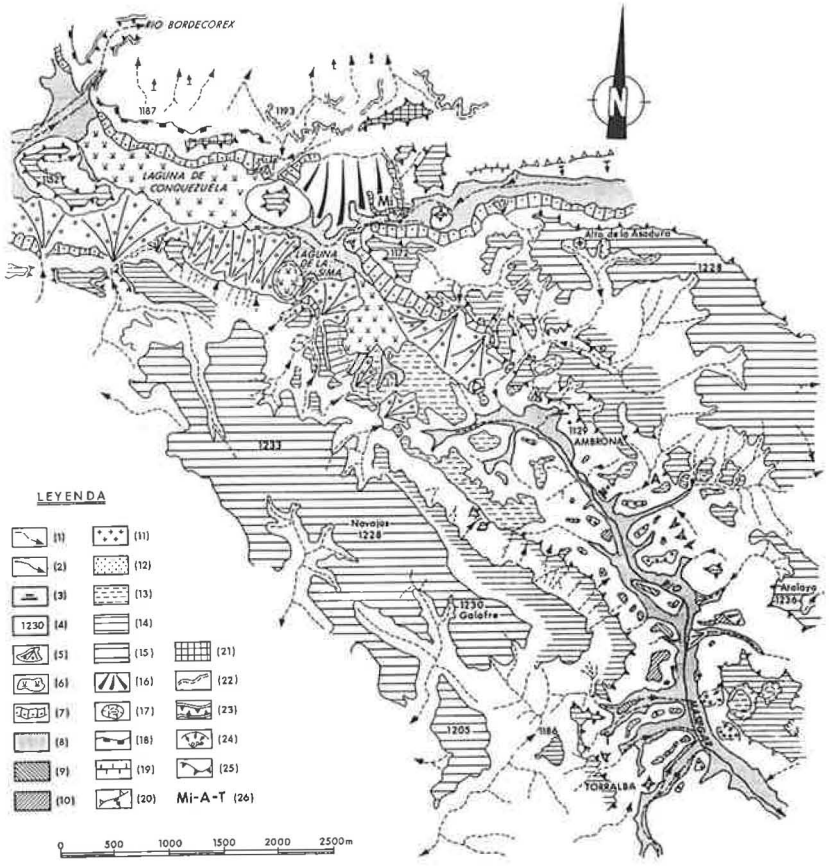

Figure 2. Geomorphological map of the central and southern sector of Conquezuela polje: valleys of the rivers Bordecorex and Masegar. Legend. 1, episodic flow; 2, permanent flow; 3, spring; 4, altitude en meters; 5, alluvial fan; 6, lagoon; 7, colluvium ; 8, alluvial plain; 9, terrace at +7-9 m; 10, terrace at +15 m; 11, terrace at +22 m; 12, terrace at +35 m; 13, Ambrona surface (S.A.); 14, Erosion surfaces M1 and M2, not differentiated; 15, Erosion surface M3; 16, glacis; 17, doline; 18, sandstone cliff; 19, dolomite crest; 20, hogback; 21, structural plane; 22; weathering relief; 23, canyon; 24, mass movement; 24, scarpment; 26, archaelogical sites of Miño, Ambrona and Torralba.

7-9 m, 15 m, 22 m and 35 m. These latter levels do not seem to support any sedimentary deposits (Fig.2). It is normal for these surfaces to appear denuded or with a thin cover of clayey sediment including sparse clasts. Side products as red clays with gravel and angular limestone clasts, can be found on these surfaces when they are alongside the valley slopes. These thinly-covered erosion planes can be classified as rocky or eroded terraces.

The Acheulian site at Torralba (Figs.2, 3) occupies an apparently intermediate morphological position between the terraces at 35 m and 22 m. It lies about 6-7 m into the 35 m level, with its base 28 m above the bed of the Masegar river at an absolute altitude of 1115-1116 m.

Lithostratigraphy of Ambrona (Lower Complex)

Sediments on which the sites of Ambrona and Torralba are located were previously considered, as mentioned above, to be the remains of an eroded Pleistocene deposit filling the valley of the Masegar river, elsewhere referred to as the Mentirosa stream, and therefore being identified as a single formation which was given the name of Torralba For-

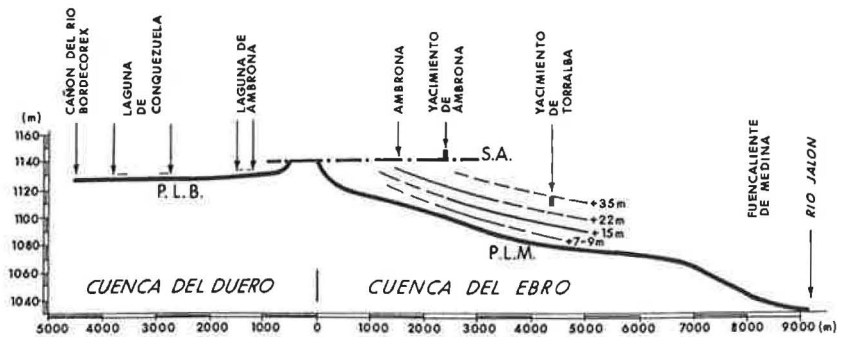

Figure. 3 Geomorphological position of archaelogical sites of Ambrona and Torralba. Explanation. S.A. Ambrona Surface; P.L.B.: Longitudinal profile of River Bordecorex; P.L.M.: Longitudinal profile of River Masegar; +7-9 m: longitudinal projection of terrace levels of the River Masegar valley.

mation (BUTZER, 1965; HOWELL *et al.*, 1995). This meant the proposal of identical chronologies for the two locations. The research carried out within the framework of the current project allowed us to conclude, nonetheless, that Torralba and Ambrona occupy distinct geomorphologic positions (Table1) and, therefore, have different ages (PÉREZ-GONZÁLEZ *et al.*, 1997).

As a result, we refuse the use of the term Torralba Formation because of its connotations of correlation. We shall refer to the stratigraphic studies defining each site separately. Provisionally, however, we shall continue to use for Ambrona the division into Lower Complex and Upper Complex (HOWELL *et al.*, 1995), until more complete knowledge is obtained regarding the preserved sequences and their complete redefinition is possible in both Ambrona and Torralba.

The lithostratigraphy of Ambrona presented here corresponds exclusively to the central area of the Lower Complex excavated since 1993 (Fig.4). In connection with this sector, it is possible to describe a stratigraphic column of about 6.5 m (Fig.5) which has been subdivided into six units, all with archaeological and stratigraphic significance. For the moment, their value is practical and instrumental, until such time as the knowledge of the unexcavated areas contributes more complete data.

DESCRIPTION OF FACIES

At the stratigraphical base of the central facies in Ambrona, within the clay-gypsum unit of the Keuper, from bottom to top three units have been separated, AS.1, AS.1/2 and AS.2, the unit AS.1 being much largely represented than A.S1/2 and AS.2.

AS.1: Clast-supported limestones, sometimes recrystallized, subrounded, with mean sizes (Tm) of the longest axis from 2 to 3cm and maximum size (TM) of 13 cm. The visible thickness is up to 0.20m.

AS.1/2: Presents two sub-facies:

- The first one formed by very fine clay and sandy facies with some floating clasts (Tm=1 cm; TM=3 cm) of grey-brownish (2.5Y 5/2) or grey colour (5Y 5/1).

- They show lateral facies change into sands, occasionally with gravels (Tm=0.5-1 cm; TM=2 cm) which may be laminated. This unit pre-

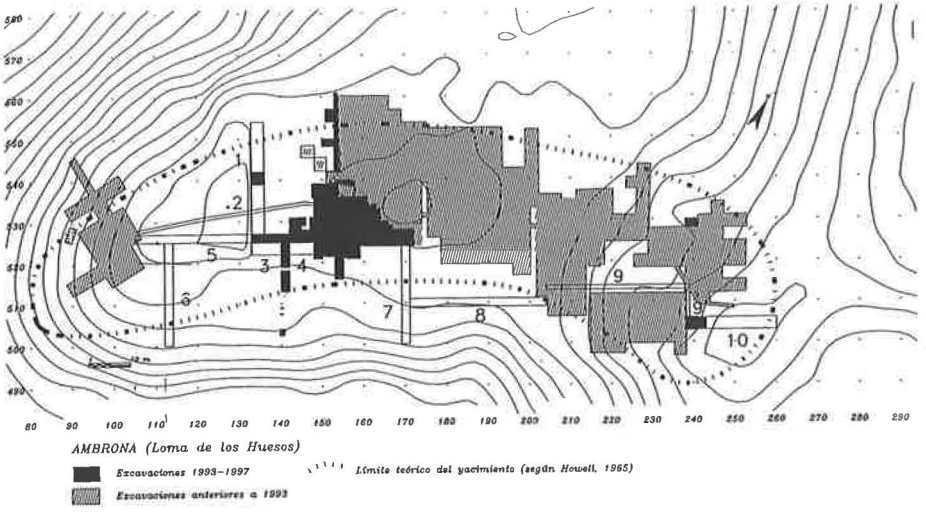

Figure. 4. Archaelogical excavations 1993-1997.

sents clear structures of load-deformation, showing symmetric or flame structures. It has a wedge shape until its disappearance to the North and West. The greatest thickness reaches 0.60 m.

AS.2: Clast-supported limestones or clasts supported by sub-rounded sandy material. Mean sizes range from 1-2cm to a maximum of 9 cm. This unit is also wedge-shaped in line with AS1/2. Its thicknesses ranges between 0 and 0.10m.

AS.3: Clay-sandy deposits containing scarce floating limestone clasts. Mean and maximum sizes are 0.5 and 2 cm, respectively. The gravel increases its presence in percentage terms to 25% on the base of level in grids 153-155/515-522. The colour of this layer is grey (5Y 6/1), and its thickness shows a clear trend to decrease towards the North and West, which might be due to the erosion of the roof of AS.3 by AS.4. This unit is equivalent to the base of IVa (*«marls with channel beds»*) and the informal lithostratigraphic units BB and B (HOWELL *et al.*, 1995). The thickness of the facies of fine clasts at the base ranges from 30 to 40 cm in the grids indicated, and the upper clay-sand areas reach 0.60 to 0.70 m.

AS.4: This decreasing grain unit begins with sub-rounded clast-supported limestones. Mean sizes are 1-2 cm and maximum size reach 5 cm. They may erode the unit AS.3 and show clear scars to become vertically clast-supported by a matrix of sand-mud-clay with a 5Y 7-6/1 colour. Deformation structures can be seen at the top of the sequence, in the transition to clay-mud-sand deposits including few floating pebbles. Unit AS.4 ends with an apparently massive, pale-grey muddy clay interval (5Y 7/1). The total thickness may range from 1.4 to 1.5 m.

AS.5: At the contact with unit AS.4, this unit shows a thinning upwards facies, formed by a sandy to muddy base with gravel, but very scarce. Upper part about 40 cm is formed by a pale grey clay-mud. The thickness of both intervals reaches 1.3 m.

AS.6: This unit lies by erosive contact on the underlying interval. It is formed by a regular interbedding of two alternating lithologies, sand-mud-clay and clay-mud. Colour grey to pale grey ; it shows load deformation contacts between the sand-mud-clay and clay-mud intervals. The thickness of this rhythmic series reaches 1.2 to 1.3 m. The top of the sequence is formed by soil deposits of vertisol type, in which horizons A, Bw, 2Cg can be seen.

All the described units in the central facies of the Ambrona site are of local origin; they have come from the North, on the limestone slopes of the Upper Triassic and Jurassic periods, bevelled by the intratertiary erosion surface at 1200 m that SCHWENZNER (1937) named M3. This is corroborated by the mineralogical association of the sands, which is the same in all facies (Fig.5). No contamination coming from the Triassic sandstones and conglomerates arising in Miño de Medinaceli to the North of Ambrona is recorded, as the Triassic sediments are rich in tourmaline and anatase while the lightweights are dominated by quartz followed by percentages of up to 25 or 30% of feldspar (ALEIXANDRE *et al.*, 1970 and present data). The carbonate lithology of the clast fraction at Ambrona also indicate that the mother area is to be found on the slopes close to the site. Finally, the measured directions of the channelled facies of AS.3 and AS.4 show a further source of sediment supply from limestones at the North.

As a whole, central deposits of Ambrona correspond to channel and overbank fluviatile facies showing vertical accretion in a regime of backswamp or waning flood. From AS.1 to AS.2 the facies are more clearly tractive, medial, alluvial fans, while AS.3 deposits indicate a less energetic, lacustrine environment. Massive sediments at the top result

from entrance of channelled fluvial facies of limestone clasts and smaller-sized sandy channels than those transporting larger loads. Units AS.5 and AS.6 are composed of fluviatile accretion facies, but less competent and developed than those from lower sequences.

Palaeontological record of Sites

PALYNOLOGY

Earliest data about the evolution of paleo-vegetation in the area date back to 1959 when MENÉNDEZ-AMOR and FLORSCHYTZ (1959, 1963), in

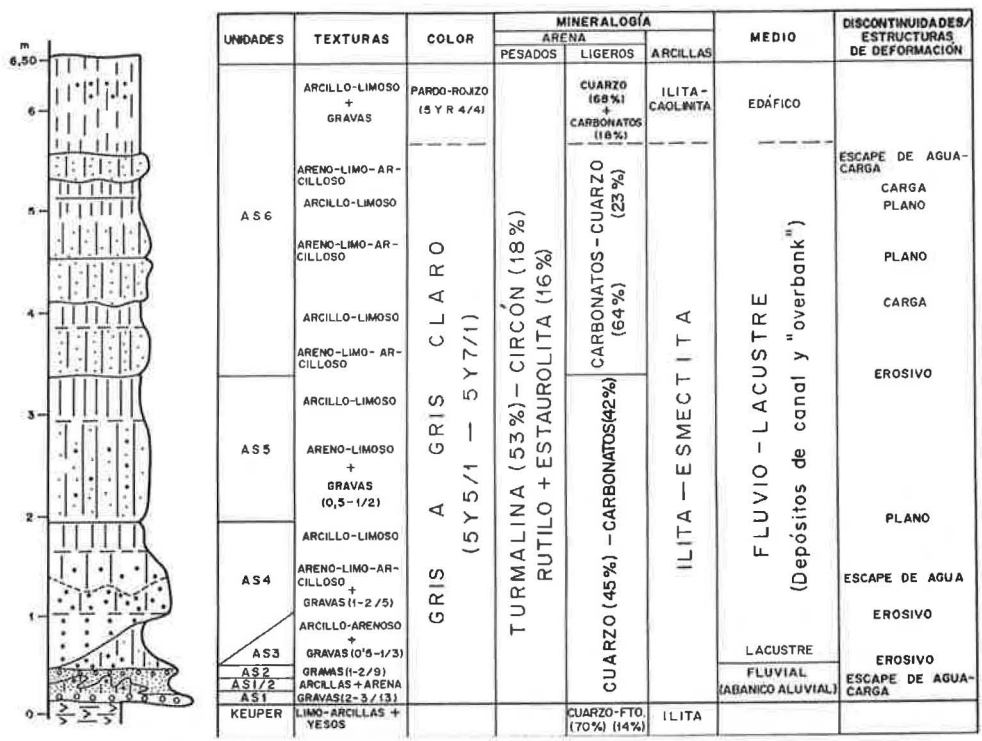

Figure 5. Lithostratigraphic units of the Lower complex (Ambrona site)

a preliminary analysis of the Torralba site, highlighted the existence of a steppe landscape dominated by Gramineae and Chenopodiaceae, including scarce groups of pines together with temperate elements such as birch and mixtum developed during the Mindel-Riss interglacial period.

In Ambrona, results of the excavations carried out in the sixties and eighties, showed that only the so-called Lower Complex offers a continuous pollinic record as opposed to the sporadic presence, or total absence, of pollen at the levels corresponding to what has been called the Upper Complex. The most significant data can be summarized as the presence of a dense pine grove together with heliophytes and grass elements and scarce Chenopodiaceae, all accompanied by riverside vegetation.

Throughout the sequence, a gradual increase in herbaceous vegetation in detriment of the pine forest has been remarked. On the basis of the data obtained, it has been estimated that the mean annual temperature was about 5º C below present day values (HOWELL *et al.*, 1995).

In the studies carried out as part of the current project, starting with the Lower Complex, it is worth noting the continuous presence of pollen throughout the sequence examined. Main components of the landscape are relatively dense pine groves which share the space with extremely varied herbaceous plants including common Poaceae and Asteraceae and a bushy stratum comprising almost exclusively *Juniperus*. Temperate items such as *Castanea, Juglans, Corylus,* deciduous *Quercus* and other typically riverside plants such as *Salix* and *Ulmus* are also common. The evolution of vegetation is confirmed by that of the sedimentary environment, thus, under typically fluvial conditions, the space in the base area is shared by trees, bushes and herbaceous including representatives of families Poaceae, Asteraceae, Papaveraceae, and *Rumex*. There is also a considerable presence of water-based elements such as Cyperaceae. Evolution towards fluvial-lakeland conditions is defined by the takeover of herbaceous plants (Poaceae, Asteraceae, Apiaceae, *Rumex, Artemisia*), a well-developed pine forest and the scarce presence of bushes. From AS.4, there is a gradual disappearance of herbaceous plants, thus allowing an increase in the share of pines and accompanying elements. Units AS.5 and AS.6, show a trend towards pine/ undergrowth of *Juniperus*, in correspondence with the alternating sand-mud-clay and clay-mud facies. All of this seems to indicate a series of fluctuations, relatively moderate conditions, allowing the growth of dense masses of pine forests alternating with more extreme moments defined by an increase in the share of bushes at the expense of woodlands.

Transition between Lower and Upper complexes is characterized only by the presence of pollen grains corresponding to the most representative taxa defining the characteristic vegetation of the Lower Complex. The pollen sterility of the Upper Complex has been confirmed as the response to a more detritical lithology representing greater energy in the environment and a certain degree of oxidation which has not favoured the conservation of the pollen.

Vertebrate Paleontology of Ambrona and Torralba

The vertebrate fauna of the Lower Complex at Ambrona comprises the following taxa: *Discoglossus galganoi, Pelobates cultripes, Pelodytes punctatus, Bufo bufo, Bufo calamita, Hyla* sp., *Rana perezi, Natrix* sp., *Anser anser, Tadorna ferruginea, Fulica cf. atra, Crocidura* sp., *Microtus brecciensis, Arvicola aff. sapidus, Apodemus aff. sylvaticus, Oryctolagus* sp., *Macaca* sp., *Canis lupus mosbachensis, Felis (Lynx) lynx, Panthera leo aff. fossilis, Crocuta crocuta, Elephas (Palaeoloxodon) antiquus, Equus caballus torralbae, Dicerorhinus hemitoechus, Cervus elaphus, Dama dama, Megaceros* sp., *Bos cf. primigenius* (Sanchiz, 1991; Sánchez, 1988; Sesé 1986; Aguirre and Fuentes, 1969).

Tadorna ferruginea, Mergus serrator, Porphyrio porphyrio, Canis lupus mosbachensis, Panthera leo fossilis, Palaeoloxodon antiquus, Equus caballus torralbae, Dicerorhinus hemitoechus, Cervus elaphus, Dama dama, Bos cf. primigenius have been recorded at Torralba (Sánchez, 1988; Aguirre and Fuentes, 1969; Prat, 1977). Sánchez (1988) also mentions *Anas strepera* and *Vanellus vanellus* without specifying whether it comes from Ambrona and/or Torralba.

Among the macromammals, the most outstanding for their abundance at Torralba and in the Lower Complex of Ambrona is the species *Elephas (Palaeoloxodon) antiquus*, for which an M.N.I. of 45 individuals has already been given with reference to the excavations of the sixties and eighties (Howell, 1989, p.589). In the 1995 excavation work, a total of 90 bones were recorded at level AS.3 of Ambrona, belonging to a minimal number of 3 individuals of this species, one of them a young animal, the others an adult female and an adult male. Remains of this latter individual comprise the so-called concentration (Fig.6). Taking as a whole the levels of the Lower Complex, *Elephas (P.) antiquus* is, by far, the dominant taxon with, for instance, 89% of the remains recovered in 1995. With a much smaller representation, there are also findings of *Dama cf. clactoniana* (3%), while

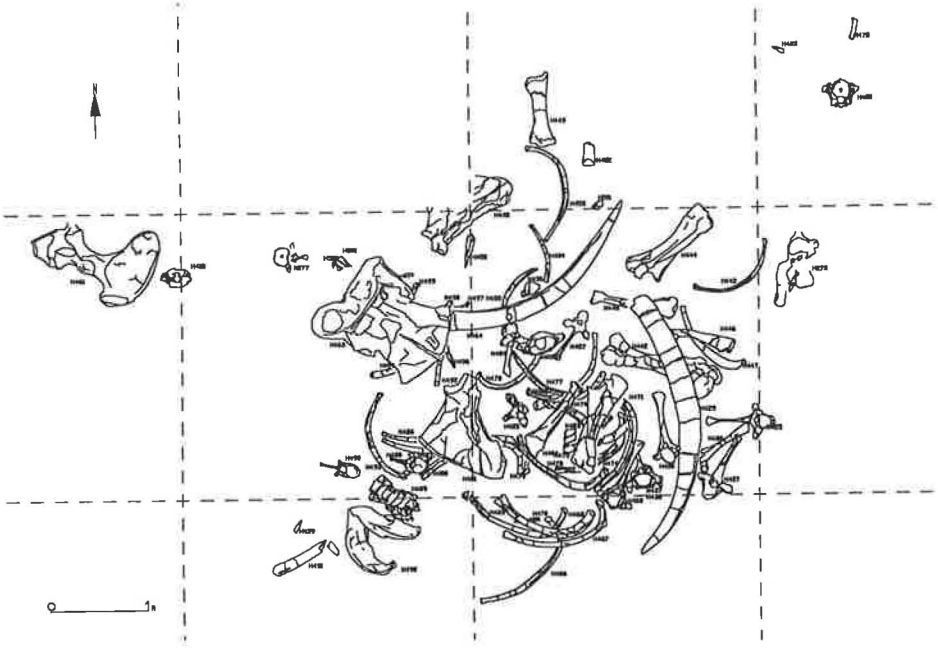

Figure 6. Concentration (in Ambrona site)

the remaining 8% is distributed between the remains attributable to *Equus caballus torralbae, Bos primigenius* and undetermined species.

The predominance of *Elephas (P.) antiquus* is also patent in the accumulation of the remains still displayed today at the *in situ* Museum of Ambrona, dug up during the 1963 excavation, also from level AS.3, where 78 of a total of 82 bones can be attributed to this same species of elephant, represented here by an M.N.I. of 4 individuals, the other elements corresponding to taxa *Bos, Cervus* and *Dicerorhinus.*

From a biostratigraphical point of view, the association of rodents at Ambrona, particularly for the relatively large size of *Arvicola aff. sapidus* and the relatively primitive evolutionary stage of *Microtus brecciensis*, corresponds typically to the Middle Pleistocene (sensu Sesé and Sevilla, 1996). The association of large mammals represented at Ambrona and Torralba, particularly *P.antiquus, D.hemitoechus, E.caballus torralbae and B.primigenius* is also characteristic of Middle Pleistocene.

Lithic artifacts at Ambrona

Fossil remains recovered over the last few years allow us to advance only few observations on the lithic activity at Ambrona, particularly for the Lower Complex and with regard to the density shown in the five lowest levels, since unit AS.5 has so far provided only a single sample of small chips, and unit AS.6 has not yet been excavated.

Fluvial deposits of unit AS.1 offer the highest densities of fossil remains on the site, as has been especially visible this year (1999) Excavations have been carried out at the northern area, where these levels are thickest. They comprise characteristic Acheulian industry -bifaces, flake cleavers- with presence of levallois cores (Fig.7, photo 2).

At AS.1/2, between units AS.1 and AS.2, the lithic material seems frequent, at the site scale, in the southern area, although representative surfaces have not yet been opened up. In AS.2, the frequency of industry seems lower, probably constrained by the scarce potential of this level in the excavated areas.

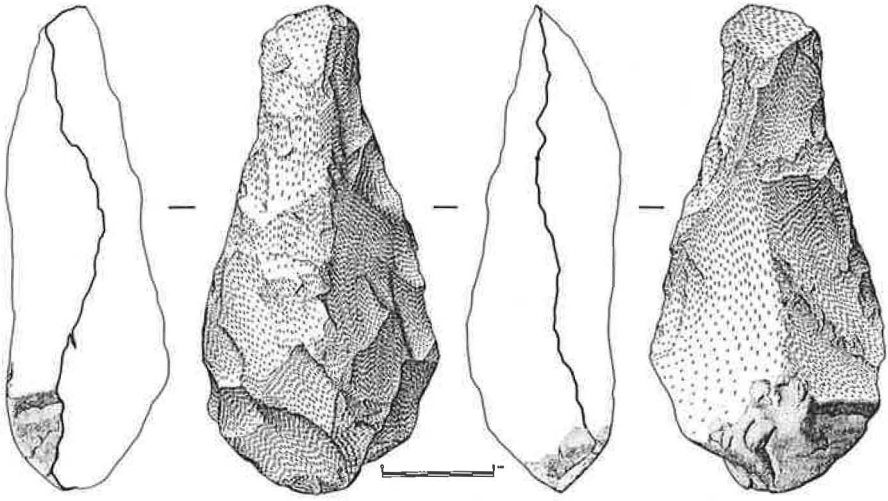

Figure 7. Quartzite biface in AS1 (Ambrona site)

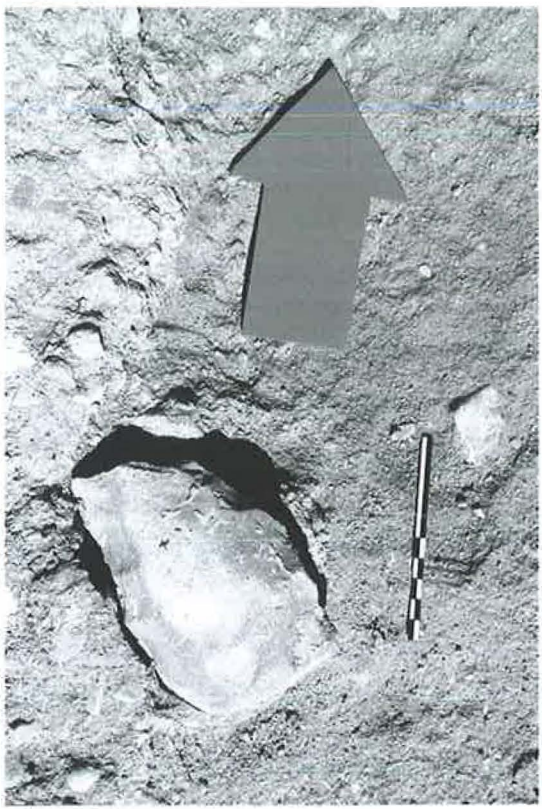

Photo 2.- Limestone biface (AS1, Ambrona site)

The industry is very scarce in unit AS.3 and not all of it appears to be in a primary stratigraphic context, since there are some elements affected by rolling. In this set, it is worth noting the presence of a cordiform biface of silex, as well as various non-cortical flakes, in some cases with wide retouches.

Industry is relatively abundant once more in the detrital sections of unit AS.4. The un-retouched flakes of all kinds are the most numerous group. There is a significant proportion of cores, including a levallois core preferential flake, and particularly heterogeneous core residues (chunks), as well as rounded pebbles of quartzite with clear evidence of having been used as a hammer. Also remarkable is the presence of products characteristic of the preparation core -semitablets, core side fla-

kes-, knapping chips and the relative frequency of cortical flakes, both in silex and in quartz and quartzite.

Tools are generally small: scrapers, denticulated tools, retouched flakes, end-scrapers, notches and beaks, in some cases multiple and also sometimes with a double patina. None of the bifaces collected so far are a part of this series, characterized by the small size of the items, in general with clear signs of rolling. The length of the items ranges between 3 and 99 mm, and a mean of 25,4 mm. These figures coincide with the gravel at this level, thus corroborating their likely character of transported clasts.

The data shown for the whole of the Lower Complex recently excavated give a mean density for items of 1 per square metre. In the excavations in the sixties and eighties (HOWELL *et al.*, 1995: 71-72), the mean value achieved was 0.72 items per square metre in 1773 m^2, in 85% of which the figure was less than 1 per square metre (the data available refer to grids of 3x3 metres), in 11% density values ranged between 1 and 2, and from 2 to 6 items in the remaining 4%. These are certainly representative amounts of the large area taken into account. In any case, the existence of independent levels reduces the interest of these overall figures. Such represented values would only be relevant if plotted referring to specific stratigraphic units. As mentioned above, the materials found in units AS.1, AS.2 and AS.4 were fluvially transported, so that the recorded densities are not directly comparable to those of AS.1/2 and AS.3, which are partly preserved in primary position.

The presence of regular bifaces, finished at times using a soft hammer, preferential levallois method flakes or assemblage on very defined and intensely retouched flake types (scrapers, end-scrapers) all reveal that we are facing a non-primitive Acheulian industry, typical of the Iberian Peninsula in the Middle Pleistocene.

In contrast, tools obtained from the Upper Complex, in the excavated surfaces during 1993 and 1994, provide greater representativity than those of the Lower Complex, even if we include unit AS.4 in the comparison. Preservation is much more integral with quite complete knapping and shapping production chains, taking into account the high share represented by the remains. Thirteen square metres of level AS.8, a low-energy fluvial deposit, facies of flooding plain, thus permitting the fundamentally primary position of the records, supplied ninety items, an average of almost seven per square metre. Of these, 75 are flakes and fragments -including 27 small flakes obtained by retouching blanks-, eleven tools -six scrapers, with the use of a soft hammer, three denticulated tools and two retouched flakes- and four exhausted cores,

two levallois, one discoid and another unclassifiable item. Level AS.7, of which a limited sector (only 7m^2) has been excavated, provided 95 lithic items, almost 14 per square metre. These include good quality levallois products -as in level AS.8-, a high percentage of retouched tools on flakes and occasional, less characteristic bifaces.

Both samples, if we also take into account the results obtained in the excavations of the eighties at levels V.a and V.b (HOWELL and FREEMAN, 1982; RUBIO, 1996), display a skillful levallois technology, superior Acheulian style bifaces and regular flake-tools, in the context of the Middle Palaeolithic. As a whole, They show certain progressive features compared to the Acheulian of the Meseta (the high plains), and to the industries of the Lower Complex of Ambrona and Torralba. In our opinion, their closest parallels are to be found in the terrace at 18 m of the Manzanares river (SANTONJA and VILLA,1990).

Some comments on the dispersion of fauna

Although it is still premature to discuss overall hypotheses on this complex issue, we can, however, put forward the idea that any reinterpretation of this respect, as in the case of the lithic industry, must start from assessing the stratigraphic context. It is essential to estimate the possible influence of natural processes, and in particular the effect of the sedimentary dynamics and the atmospheric exposure on the formation and later evolution of any accumulation of remains. The information published so far is still insufficient to define synchronic spatial configurations in Ambrona.

The megafauna, particularly *Elephas antiquus*, is especially frequent in the marly intervals of levels AS.3 and AS.4 (photo 3). The distribution of fauna in these levels is not at all uniform. Evidence on these points range from wide areas free of remains to areas of high density. The most outstanding case of concentration (PÉREZ-GONZÁLEZ *et al.*, 1999) is a surface of about 50 m^2 containing practically all bone remains of an adult-senile male elephant. Positive evidence that might indicate activity, or the presence of humans in this area is still lacking. In fact in that bones, that are complete and in relatively acceptable conditions of preservation, no cut-marks or clearly relatable lithic industry are observed.

Photo 3. Mandible of *E. antiquus* (AS4, Ambrona site).

Studies carried out in Ambrona from 1993 to1999 provide arguments that confirm the complexity of the site and highlight the basic need for hypotheses to be formulated in close relation with well-defined areas, both stratigraphically and spatially. Even if we consider the remains concentrated in areas occupying similar stratigraphic positions, there might be a clear time-shift between them, that would have a decisive effect on any hypothesis. It is possible that the site of Loma de los Huesos (bone Hill) at Ambrona has not yet been sufficiently explored. There is no argument to support that the scenario outlined for bone concentration in this point (a process not related to human activity), could be automatically generalized to the rest of the so-called Main occupation (HOWELL *et al.*, 1995).

In any case, there is no evidence so far in the Lower Complex at Ambrona to support that groups of humans may have played a significant role in the accumulation of faunal remains. Rather it seems that they had a limited role, almost always marginal, that might have different intensity in some sporadic circumstances. The current models for accumulation of elephant and bovid remains in certain regions of southern Africa in connection with waterholes and small lagoons during periods of prolonged drought (HAYNES, 1991) show in principle, as has already been suggested (KLEIN, 1987; HAYNES 1987), similarities requiring further investigation with the general configurations observed in the Lower Complex of Ambrona.

Museological adaptation

The interventions carried out and planned for Ambrona and Torralba include among their main medium-term purposes the exhibition of the remains in a site-museum, so that the excavation strategy and the restoration processes to be applied would be direct to this project.

After the1963 field work, Howell and Aguirre put up a building over one of the excavated areas that presented the greatest density of findings in order to preserve them *in situ* and allow visits to the site. This was a very noteworthy initiative, particularly taking into account that at the time there were very few comparable site museums. Nowadays, with greater experience in the conservation of this kind of place site -the closest parallels are some of the Italian palaeolithic localities such as Notarchirico, in Venosa, and other in the surroundings of Rome-, it is possible to consider the permanent exhibition of a wide area representing the site as a whole. It may even be possible to try to return some of the fossil remains currently stored in museums in Soria and Madrid to its original location. Within a short space of time, the province of Soria could have new museums in Torralba and Ambrona which would be unique in the Peninsula and almost in Europe, capable of attracting more visitors to the region which could, in economic and social terms, be a first-rate source of dynamism.

Acknowledgements

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Bibliography

ADELL, F., GONZÁLEZ LODEIRO, F. & TENA-DAVILA, M. (1981). Mapa Geológico de España, E. 1:50.000, (461), IGME.

ADELL, F. TENA-DAVILA, M. & GONZÁLEZ LODEIRO, F. (1982). Mapa Geológico de España, E. 1:50.000, (434), IGME.

AGUDO, C. & SERRANO, E. (1992). *In* Estudios de Geomorfología en España, I: 291-298.

AGUIRRE, E. (1966). Las primeras huellas de lo humano. *In*: *La Evolución* (M.Crusafont, B. Meléndez y E. Aguirre, eds.): 617-675. B.A.C. Madrid.

AGUIRRE, E. (1966). Torralba y Ambrona. Vestigios de actividad humana en el Pleistoceno medio. *Celtiberia*, 31: 7-19. Soria.

AGUIRRE, E. (1968-9). Revisión sistemática de los Elephantidae por su morfología y morfometría dentaria. *Estudios Geológicos*, 24: 109-167; 25: 123-177 y 317-367. Madrid.

AGUIRRE, E. (1973). Industries ostéïques anciennes: méthode et un essai de typologie. *VIII Congrés Int. S. Préhist. et Protohist.* II: 57-68. Belgrado.

AGUIRRE, E. (1984).: Industria ósea de Torralba: criterios para su estudio. *Primeras Jornadas de metodología de investigación prehistórica*: 175-182. Ministerio de Cultura.

AGUIRRE, E. (1985). Torralba: Débitage d'ossements d'elephants. Approche d'une analyse morphotechnique. In Outillage peu elaboré en os et en bois de cervidés. *Artefact*, 1: 33-44. Ed. Centre d´Études et de Documentation Archéologiques. Viroinval, Belgique.

AGUIRRE, E. (1986). Format et technique dans la fracturation d'ossement a Torralba (Soria, Espagne). In Outillage peu elaboré en os et en bois de cervidés II. *Artefact*, 3: 81-92. Editions du Centre d´études et de Documentation Archéologiques. Viroinval, Belgique.

AGUIRRE, E. (1989). Ambrona y Torralba. *In*: *Diez años de Arqueología soriana*, J. L. Argente ed., pp. 23-36. Museo Numantino. Soria.

AGUIRRE, E. & FUENTES, C. (1971: Los vertebrados fósiles de Torralba y Ambrona. In Etudes sur le Quaternaire dans le monde. *VIII Congrés INQUA*, vol I: 433-437. Paris.

AGUIRRE, E. & HOYOS, M. (1977). Observations méthodiques sur outillage osseux du Paléolithique inférieur. *In*: *Méthodologie appliquée à l'industrie de l'os préhistorique*: 55-59. Colloque Int. du CNRS (nº 586). Paris.

ALEIXANDRE, T.; PINILLA, A. & LEIVA, A. de (1970). «Areniscas triásicas del Bundtsandstein de la provincia de Guadalajara. Sigüenza» *Bol. R. Soc. Española Hist. Nat.* (Geol.), v. 68, pp. 73-109.

AMENDOLEA, B. (1996). *I Siti Archeologici. Un problema di Mussealizzazione all'aperto.* Grupo Editoriale Internazionale. Roma.

ÁLVARO CHIRVECHES, C. (1994). Extracción de una defensa de Elefante Antiguo en Ambrona, Soria. Valoración de las condiciones de extracción, almacenamiento y exhibición. *En*: A. Escalera y Mª C. Pérez García (eds.), *Actas del X Congreso de Conservación y Restauración de Bienes Culturales*: 23-26. Cuenca.

BASCONES, L. & MARTÍNEZ ALVAREZ, F. (1981). *Mapa Geológico de España*, E. 1:50.000, (462), IGME .

BENITO, G., GUTIÉRREZ ELORZA, M. & SANCHO, C. (1991). *Mapa Geológico de España*, E. 1:50.000, (461).

BENITO CALVO, A.; PÉREZ-GONZÁLEZ, A. & SANTONJA, M. (1998a). Evolución geomorfológica de la región del Alto Henares en la Cordillera Ibérica Occidental. *Investigaciones recientes de la Geomorfología española* (A. Gómez Ortiz y F. Salvador Franch eds.): 347-356.

BENITO CALVO, A.; PÉREZ-GONZÁLEZ, A. & SANTONJA, M. (1998b). Evolución del medio físico del valle alto del río Henares: rasgos y características geomorfológicas. *Actas del VI Encuentro de historiadores del valle del Henares*: 17-31.

BENITO CALVO, A.; PÉREZ-GONZÁLEZ, A. & SANTONJA, M. (1998c). Terrazas rocosas, aluviales y travertínicas del valle alto del río Henares (Guadalajara, España). *Geogaceta*, 24: 55-58.

BIBERSON, P. (1964). Torralba et Ambrona. Notes sur deux stations acheuléennes de chasseurs d'elephants de la Vieille Castille. *Homenaje H.Breuil*, vol. I: 201-248. Dip. de Barcelona. Inst. de Prehistoria y Arqueología. Barcelona.

BIBERSON, P. (1968).Les gisements Acheuléens de Torralba et Ambrona (Espagne). Nouvelles précisions. *L'Anthropologie*, 72 (3/4): 241-278. Paris.

BIBERSON, P. & AGUIRRE, E. (1965). Expériences de taille d'outils préhistoriques dans des os d'elephant. *Quaternaria*, VII: 165-183. Roma.

BIBERSON, P.; BUTZER, K. W. & LYNCH, T. F. (1970). El yacimiento Acheulense de Ambrona (prov. de Soria). *Pub. del Dep. de Paleontología*, 10: 1-23. Univ. Complutense. Madrid. (the name of D.Collins mistakenly appears instead of that of T. F. Lynch, v. Freeman 1975, p. 736).

BINFORD, L. R. (1981). *Bones: Ancient Men Modern Myths.* Academic Press. New York.

BINFORD, L. R. (1987). *Were There Elephant Hunters at Torralba?. In The Evolution of Human Hunting*, M. H. Nitecki & D. V. Nitecki eds: 47-105. Plenum Press. New York.

BORDES, F. (1992). *Leçons sur le Paléolithique. Paléolithique en Europe* (Tome II). Presses du CNRS. (pp. 102-108).

BREUIL, H. (1910). Nous descubriments · Espanya: Batuecas, Albarracín, Torralba. *Butlletí del Centre Excursionista de Lleida*, .3: 18-22. Traducido de *L'Anthropologie.*

BUTZER, K. W. (1964). *Environment and archaeology: An introduction to Pleistocene Geography.* Aldine. Chicago.

BUTZER, K. W. (1965). Acheulian Occupation Sites at Torralba and Ambrona, Spain. Their Geology. *Science*, 150: 1718-1722.

BUTZER, K. W. (1969). Comentario sobre D. Collins: «Culture traditions and environment of early man». *Current Anthropology*, 10: 303-304.

BUTZER, K. W. (1971). *Environment and Archaeology. An ecological approach to prehistory.* Aldine. Chicago.

BUTZER, K. W. (1975). Pleistocene Littoral-Sedimentary Cycles of the Mediterranean Basin: A Mallorquin View. *In: After the Australopithecines*, K. W. Butzer and G. Ll. Isaac eds.: .25-71. Mouton Publ. The Hague-Paris.

BUTZER, K. W. (1977). Environment, culture and human evolution. *American Scientist*, 65: 572-584.

BUTZER, K. W. (1982; 2ª ed: 1984). Archaeology as Human Ecology. Cambridge Univ.Press. Spanish Translation: *Arqueología. Una ecología del hombre: método y teoría para un enfoque contextual.* Ediciones Bellaterra. Barcelona, 1989.

CABRE-AGUIL, J. (1915). *El Arte rupestre en España. Comisión de Investigaciones Paleontológicas y Prehistóricas*, 1. Museo Nacional de Ciencias Naturales. Madrid. (cf. p. 41-44).

CABRE-AGUIL, J. (1917). *Catálogo Monumental de la provincia de Soria.* Tomo I. Paleolítico. Inédito.

CABRE-AGUIL, J. (1922). El Marqués de Cerralbo. (II). Sus descubrimientos arqueológicos. *Ibérica,* XVIII, nº 453: 314-317. 1922 (25 de Noviembre).

CABRE-AGUIL, J. (1941). Pinturas y grabados rupestres esquemáticos de las provincias de Segovia y Soria. *Archivo de Arqueología,* 43: 316-344.

CARBONELL, E., DIEZ, C. ENAMORADO, J. & ORTEGA, A. (1987). Análisis morfotécnico de la industria lítica de Torralba (Soria). Antropología/Etnografía, 4: 201-216. Eusko Ikaskuntza. San Sebastián.

CARBONELL, E.; GIRALT, S.; MÁRQUEZ, B.; MARTÍN, A.; MOSQUERA, M.; OLLE, RODRÍGUEZ, A.;, X.P.; SALA, R.; VAQUERO, M.; VERGES, J. Mª & ZARAGOZA, J. (1995). El conjunto lito-técnico de la Sierra de Atapuerca en el marco del Pleistoceno Medio europeo. *In*: Bermúdez, J. Mª. Arsuaga, J. L. & Carbonell, E. (eds.): *Evolución humana en Europa y los yacimientos de la Sierra de Atapuerca*: 445-555. Junta de Castilla y León. Valladolid.

CERRALBO, Marqués de (1909). *El Alto Jalón. Descubrimientos arqueológicos.* Imp. Fortanet. Madrid.

CERRALBO, Marqués de (1911). *Páginas de la Historia patria por mis excavaciones arqueológicas.* T.I: Torralba. Inédito.

CERRALBO, Marqués de (1913). Torralba, la plus ancienne station humaine de l'Europe?. Congrés Int. Anthropol. Archéol. Prehist., Genéve, c.r. XIV sess.: 277-290.

CERRALBO, Marqués de, 1913a: Torralba, la estación más antigua de Europa entre las hoy conocidas. *Asoc. Esp. Progreso de las Ciencias,* I, (4): 197-210.

COLE, S. (1962). A Spanish camp of Stone Age elephant hunters. *New Scientist,* 309: 160-162.

DÍEZ FERNÁNDEZ-LOMANA, J. C. (1992). El yacimiento achelense de Torralba. Nuevas interpretaciones tafonómicas y paleoeconómicas. *II Simp. de Arqueología Soriana*: 137-152. Soria.

DÍEZ FERNÁNDEZ-LOMANA, J. C. (1995). Acumulaciones faunísticas y homínidos en los yacimientos arqueológicos españoles. *In*: Bermúdez, J. Mª, Arsuaga, J. L. & Carbonell, E. (eds), *Evolución humana en Europa y los yacimientos de la Sierra de Atapuerca*: 557-604. Junta de Castilla y León. Valladolid.

DÍEZ, J. C., AGUIRRE, E. & MORA, R. (1985). Zooarqueología de Torralba (Soria). *Celtiberia,* 69: 7-34. Soria.

FLORES FERNÁNDEZ, R. (1997). Las investigaciones de Cerralbo en Torralba y Ambrona. *Bol. de la Asoc. Esp. de Amigos de la Arqueología.*, 37: 11-16. Madrid.

FREEMAN, L. G. (1975). *Acheulian Sites and Stratigraphy in Iberia and the Maghreb. In After the Australopithecines*, Butzer e Isaac eds.: 661-744. Mouton Pub. The Hague-Paris.

FREEMAN. L. G. (1978). The analysis of some occupation floor distributions from Earlier and Middle Paleolithic sites in Spain. In L. G. Freeman (ed.): *Views of the Past: Essays in Old World Prehistory and Paleoanthropology*: 57-115. Mouton. The Hague.

FREEMAN, L. G. (1981). The fat of the land: Notes on Palaeolithic diet in Iberia. *In*: R. S. Harding & G.Teleki (eds.): *Omnivorous Primates: Gathering and Hunting in Human Evolution:* 104-165. Columbia Univ. Press. New York.

FREEMAN, L. G. (1991). What mean these stones? Remarks on raw material use in the Spanish Paleolithic. *In*: A. Montet-White & S. Holen (eds.): *Raw Materials Economy among Prehistoric Hunter-Gatherers*: 73-125. Univ. of Kansas Press. Lawrence.

FREEMAN, L. G. (1994). Torralba and Ambrona: A Review of Discoveries. *In*: *Integrative Paths to the Past.* R. S. Corruccini & R. L. Ciochon (eds): 597-637. Prentice Hall, Englewood Cliffs, New Jersey.

FREEMAN, L. G. & BUTZER, K. W. (1966). The Acheulian station of Torralba, Spain: A progress report. *Quaternaria,* 8: 9-21. Rome.

FREEMAN, L. G. & HOWELL, F. C. (1981). Acheulian occupation at Ambrona (Spain). *46 th. Annual SAA Meetings Abstract.* San Diego.

FREEMAN, L. G. & HOWELL, F. C. (1982). Acheulian hunters on the Spanish Meseta: Torralba and Ambrona Reconsidered. *A.A.A. Meeting Abstracts.* Washington DC.

FUENTES VIDARTE, C. (1994). Contribución al conocimiento de la fauna fósil de Torralba-Ambrona, Soria (España). Parte I . *Studia Geologica Salmanticensia,* XXIX: 115-125.

GLADFELTER, B. G. (1971). Meseta and Campiña landforms in Central Spain. A geomorphology of the Alto Henares Basin. *Research Paper* 130. Univ. of Chicago.

GLADFELTER, B. G. (1972). Pleistocene terraces of the Alto Henares (Guadalajara, Spain). *Quaternary Research,* 2: 473-486.

GONZÁLEZ ECHEGARAY, J. & FREEMAN, L. G. (1998). *Le Paléolithique inférieur et moyen en Espagne.* Editions Jerome Millon. Grenoble.

HARLE, E. (1910). Ossements découverts par M. de Cerralbo, Alcalde et Carballo en Espagne. *Bull. Soc. Géol. de France*, s.4, v.10: 746-747.

HARLE, E. (1911). L'ossuaire d'elephants du Marquis de Cerralbo . Torralba (Espagne). *C. r. somm. Soc. Géol. Française*, 6 nov.: 163-164.

HARLE, E. (1911a). Ensayo de una lista de mamíferos y aves del Cuaternario conocidos hasta ahora en la Península ibérica. *Bol. del Instituto Geológico y Minero de España*, 32: 135-163. Madrid.

HAYNES, G. (1987). Proboscidean die-offs and die-outs: age profiles in fossil collections. *Journal of Archaeological Science*, 14: 659-668.

HAYNES, G., 1991: *Mammouths, Mastodons and Elephants: Biology, behavior and the fossil record.* Cambridge University Press.

HERNANDEZ-PACHECO, E. (1959). Prehistoria del solar hispano. *Reports of the Royal Academy of Physics, Exact and Natural Sciences*, Madrid, series: *Ciencias Naturales*, v.20. Madrid.

HOWELL, F. C. (1962). El yacimiento achelense de Torralba (Soria). *VII Congreso Nacional de Arqueología*: 110-116. Zaragoza.

HOWELL, F. C. (1965). Yacimiento achelense de Ambrona. *Not. Arq. Hispánica*, VII: 7-23. Madrid. (Note: this article is identical to Biberson, Butzer and Lynch, 1970, quoted above; *In*: Howell *et al.* 1995 (Reference is made solely to Biberson *et al.*, 1970).

HOWELL, F. C. (1966). Observations on the earlier phases of the European Lower Paleolithic. *American Anthropologist*, 68 (2/2): 88-201.

HOWELL, F. C. (1966a). Early Man. *Time-Life Int.* The Netherlands.

HOWELL, F. C. (1989). Review of M. Nitecki and D. Nitecki, «The Evolution of Human Hunting». *J. Hum. Evol.*, 18: 583-594.

HOWELL, F. C.; BUTZER, K. W. & AGUIRRE, E. (1962). Noticia preliminar sobre el emplazamiento Achelense de Torralba. *Exc. Arq. en España*, 10. Ministerio de Cultura. Madrid.

HOWELL, F. C.; BUTZER, K. W.; FREEMAN, L. G. & KLEIN R. G. (1995). Observations on the Acheulian occupation site of Ambrona (Soria Province, Spain), with particular reference to recent investigation (1980-1983) and the lower occupation. *Jahrbuch des Römisch-Germanischen Zentralmuseum Mainz*, 38: 33-82.

HOWELL, F. C. & FREEMAN, L. G. (1982). Ambrona: an early Stone Age site on the Spanish Meseta. *The L. S. B. Leakey Foundation News*, 22: 11-13.

HOWELL, F. C. & FREEMAN, L. G. (1983). Ivory points from the earlier Acheulian of the Spanish Meseta. *Homenaje al Prof. Martìn Almagro Basch*, I: 41-61. Ministerio de Cultura. Madrid.

IMPERATORI, L. (1971). Coprolitos en el Cuaternario de Ambrona. *Bol. R. Soc. Esp. Historia Natural*, 69 (Geología): 187-190. Madrid.

JANOSSY, V. D. (1983). Die mittelpleistozäne Vogelfauna von Prezletice bei Prag (CSSR). *Schriftenr. geol. Wiss.* 19/20: 247-269. Berlin.

KAHLKE, H. D. (1975). The Macro-faunas of continental Europe during the Middle Pleistocene: Stratigraphic sequence and problems of intercorrelation. *In*: *After the Australopithecines*, Butzer e Isaac eds.: 309-374. Mouton Pub. The Hague-Paris.

KLEIN, R. G. (1987). Reconstructing How Early People Exploited Animals. Problems & Prospects. *In*: M. H. Nitecki & D.V. Nitecki (eds.), *The Evolution of Human Hunting*: 11-45. Plenum Press. New York.

LÓPEZ DE AZCONA, M. C. & HUESCAR, L. de (1992). Estudio petrológico de nódulos y calcos de Ambrona (Soria) y procesos de restauración. *II Simp. de Arq. Soriana*: 153-162. Soria.

MENÉNDEZ AMOR, J. & FLORSCHYTZ, F. (1959). Algunas noticias sobre el ambiente en que vivió el hombre en dos zonas de ambas Castillas durante el Gran Interglaciar. *Estudios Geológicos*, 15: 277-282. Madrid.

MENÉNDEZ AMOR, J. & FLORSCHYTZ, F. (1963). Sur les Eléments steppiques dans la végétations Quaternaire de l'Espagne. *Bol. Real Soc. Española de Historia Natural*, 61 (Geología): 121-133. Madrid.

MOSQUERA, M. (1998). Differential raw material use in the Middle Pleistocene of Spain. Evidence from Sierra de Atapuerca, Torralba, Ambrona and Aridos. Cambridge *Archaeological Journal*, 8, 1: 15-28.

NAVASCUES BENLLOCH, P. de; CONDE DE BERODILGEN GEYR, C. & JIMÉNEZ SANZ, C. (1996). *El Marqués de Cerralbo.* Subdirección de Museos Estatales. Ministerio de Cultura. Madrid.

OBERMAIER, H. (1916). *El Hombre Fósil.* Comisión de Inv. Paleont. y Prehistóricas. Mem. 9. Madrid (Enlarged 2nd edition: 1925). Facsimile re-issue of the 2nd edition: Ediciones Istmo. Madrid 1985.

ORTEGA MARTÍNEZ, A. I. (1992). Revisión de la industria lítica del yacimiento achelense de Torralba del Moral (Soria). *II Simp. de Arq. Soriana*: 123-136. Soria.

ORTEGA MARTÍNEZ, A. I. (1994). La industria lítica de Torralba del Moral (Soria). *Studia Archaeologica*, v. 82. Universidad de Valladolid.

PANERA GALLEGO, J. (1996). Caracterización tecnomorfológica de la industria lítica del complejo inferior de Ambrona. *Espacio, Tiempo y Forma* (Serie I: *Prehistoria y Arqueología*), 9: 103-138. Madrid.

PANERA GALLEGO, J. (1996 a). Contextualización del complejo inferior de Ambrona en el Achelense de la Península Ibérica. *Complutum*, 7: 17-36.

PANERA GALLEGO, J. & RUBIO JARA, S., (1997). Estudio tecnomorfológico de la industria lítica de Ambrona (Soria). *Trabajos de Prehistoria*, 54 (1): 71-97. Madrid.

PÉREZ-GONZÁLEZ, A; & SANTONJA, M. (directores) (1996). Aproximación a los paleo-ambientes del hombre en el Pleistoceno medio e inferior. Los yacimientos de Ambrona y Torralba. *IX Reunión Nacional sobre Cuaternario. Excursión post Reunión.* AEQUA y CSIC.

PÉREZ-GONZÁLEZ, A.; SANTONJA, M.; GALLARDO, J. & ALEIXANDRE, T. (1991). Los yacimientos pleistocenos de Torralba y Ambrona y sus relaciones con la evolución geomorfológica del polje de Conquezuela. Resúmenes de las Comunicaciones. *VIII Reunión Nacional del Cuaternario* (no page numbers). Valencia.

PÉREZ-GONZÁLEZ, A.; SANTONJA, M.; GALLARDO J.; ALEIXANDRE T.; SESÉ C.; SOTO E.; MORA R. & VILLA P. (1997). Los yacimientos pleistocenos de Torralba y Ambrona y sus relaciones con la evolución geomorfológica del polje de Conquezuela. *Geogaceta*, 21: 175-178. Madrid.

PÉREZ-GONZÁLEZ, A.; SANTONJA, M.; MORA, R.; SESÉ, C.; SOTO, E.; ALEIXANDRE, T.; VILLA, P. & GALLARDO, J. (1997). Ambrona y Torralba. Actividad humana y procesos naturales. *In*: J. Rodríguez Vidal (ed.), *Cuaternario Ibérico*: 235-247. AEQUA. Huelva.

PÉREZ-GONZÁLEZ, A.; SANTONJA, M.; MORA, R.; SOTO, E.; SESÉ, C.; RUÍZ ZAPATA, Mª B.; ALEIXANDRE, T.; VILLA, P. & GALLARDO, J. (1999). Investigaciones recientes (1990-1997) en los yacimientos achelenses de Ambrona y Torralba (Soria, España). Aproximación al Complejo estratigráfico inferior de Ambrona. *O Arqueólogo Português*, IV, 13/15 (1995-1997): 11-34.

PRAT, F. (1977). L'Equide du gisement Acheuléen de Torralba (Soria,Espagne). Equus caballus torralbae nov. subspec. *Bull. Ass. Française pour l'Etude du Quaternaire Sup.* Recherches Françaises sur le Quaternaire (INQUA, 1977): 33-46. Paris.

QUEROL, A. & SANTONJA, M. (1978). Los hendedores en el Achelense de la Meseta española. *Sautuola* II: 3-39. Santander.

RINCÓN, A. & AGUIRRE, E. (1974). Analyse comparative et discriminante des assemblages de fragments osseux pour vérification d'hypothese d'action culturelle. I *Coll. Int.sur l'industrie de l'os dans la Préhistoire*: 111-117. Ed. Univ. de Provence.

RODRÍGUEZ DE TEMBLEQUE, J. (1998). Aportaciones al Paleolítico Inferior en la provincia de Soria. *Celtiberia*, 92:7-54. Soria.

RUBIO JARA, S. (1996). Ambrona (Soria): la industria lítica del Complejo Superior. *Espacio, Tiempo y Forma;* (: Prehistoria y Arqueología) 9: 75-102. Madrid.

RUBIO JARA, S. (1996). Identificación de cadenas operativas líticas en el Complejo Superior de Ambrona (Soria). *Complutum*, 7: 37-50.

SÁNCHEZ MARCO, A. (1990). Aves de los yacimientos mesopleistocenos de Torralba y Ambrona (Soria, España). *Actas de las IV Jornadas de Paleontología*: 349-357. Salamanca.

SÁNCHEZ MARCO, A. (1996). Aves fósiles del Pleistoceno ibérico: rasgos climáticos, ecológicos y zoogeográficos. *Ardeola*, 43 (2): 207-219.

SÁNCHEZ MARCO, A. (1999). Nuevas aves fósiles del yacimiento mesopleistoceno de Ambrona (Soria, España). *Trabajos de Prehistoria*, 56, 1:115-118.

SANCHIZ, B. (1991). Algunas herpetofaunas de yacimientos del Pleistoceno medio ibérico. *Revista Española de Herpetología*, 5: 9-13. Salamanca.

SANTONJA, M., (1989). Torralba y Ambrona, nuevos argumentos. *Bol.Soc.A.Arqueol.*, LV: 5-13. Universidad de Valladolid.

SANTONJA, M. (1992). La adaptación al medio en el Paleolítico inferior de la Península ibérica. Elementos para una reflexión. *In*: A. Moure Romanillo (ed.), *Elefantes, ciervos y ovicaprinos*: 37-76. Universidad de Cantabria. Santander.

SANTONJA, M. & PÉREZ-GONZÁLEZ, A. (1998). Un siglo de investigaciones en Torralba y Ambrona (Soria). *Revista de Soria*, 21: 67-75.

SANTONJA, M.; PÉREZ-GONZÁLEZ, A.; MORA, R.; VILLA, P.; SOTO, E. & SESÉ, C. (1997). Estado actual de la investigación en Ambrona y Torralba (Soria). *In*:R. de Balbín & P. Bueno (eds.), *Actas del II Congreso de Arqueología Peninsular.* (I) Paleolítico y Epipaleolítico: 51-65. Fundación Rei Afonso Henriques. Zamora.

SANTONJA, M.; SOTO, E.; VILLA, P.; SESÉ, C.; PÉREZ-GONZÁLEZ, A.& MORA, R. (*in litt.*). Human activity and Middle Pleistocene faunal assemblages from the central region of the Iberian Peninsula. *In*: E. Turner & S. Gaudzinski (eds.), *The role of early humans in the accumulation of European Lower and*

Middle Palaeolithic bone assemblages. Römisch-Germanischen Zentralmuseum Mainz. Neuwied.

SANTONJA, M. & VILLA,P. (1990). The Lower Paleolithic of Spain and Portugal. Journal of World Prehistory, 4 (1): 45-94. New York.

SCHWENZNER, J. (1937). Zur Morphologie das Zentralspanischen Hochlandes. *Geogr. Abhandl.*, 3ª ser., X (3).

SESÉ, C. (1986). Insectívoros, roedores y lagomorfos (Mammalia) del sitio de ocupación achelense de Ambrona (Soria, España). *Estudios Geológicos,* 42: 355-359. Madrid.

SONNEVILLE-BORDES, D. (1965). Stations acheuléennes de la Vieille Castille: Torralba et Ambrona. *L'Anthropologie,* 69: 600-601. París.

SHIPMAN, P. & ROSE, J. (1983). Evidence of butchery and hominid activities at Torralba and Ambrona: An evaluation using microscopic techniques. *J. Archaeol. Sci.*, 10: 465-474.

VILLA, P. (1976).Sols et niveaux d´habitat du Paléolithique Inférieur en Europe et au Proche-Orient. *In:* l´ *evolution de l'Acheuléen en Europe* (J. Combier, dir.): 139-155. Colloque X. IX Congrés UISPP.

VILLA, P. (1983). *Terra Amata and the Middle Pleistocene Archaeological Record of Southern France.* Univ. of California Press. Berkeley.

VILLA, P. (1990). Torralba and Aridos: elephant explotation in Middle Pleistocene Spain. *Journal of Human Evolution,* 19: 299-309.