Recent Research on Paleolithic Arts in Europe and the Multimedia Database

César González Sainz, Roberto Cacho Toca

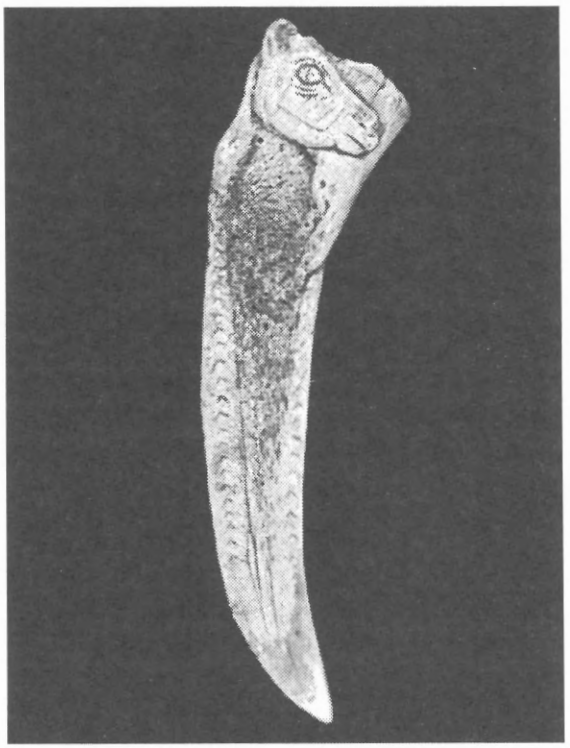
Department of Historical Sciences. University of Cantabria.
Avda. Los Castros s/n. 39005. SANTANDER (Spain)
e-mail: gonzalec@ccaix3.unican.es / cachor@ccaix3.unican.es

Summary.
In this article the authors present the Multimedia PhotoVR Database, made by Texnai, Inc. (Tokyo) and the Department of Historical Sciences of the University of Cantabria (Spain) about the paleolithic art in northern Spain. For this purpose, it's made a short introduction to the modern knowledge about the European paleolithic art (35000-11500 BP), giving special attention to the last research trends and, in which way, the new techniques (computers, digital imaging, database, physics...) are now improving the knowledge about this artistic works. Finally, is made a short explanation about the Multimedia PhotoVR Database and in which way, these databases can improve, not only research and teaching, but also it can promote in the authorities and people the convenience of an adequate conservation and research of these artistic works.

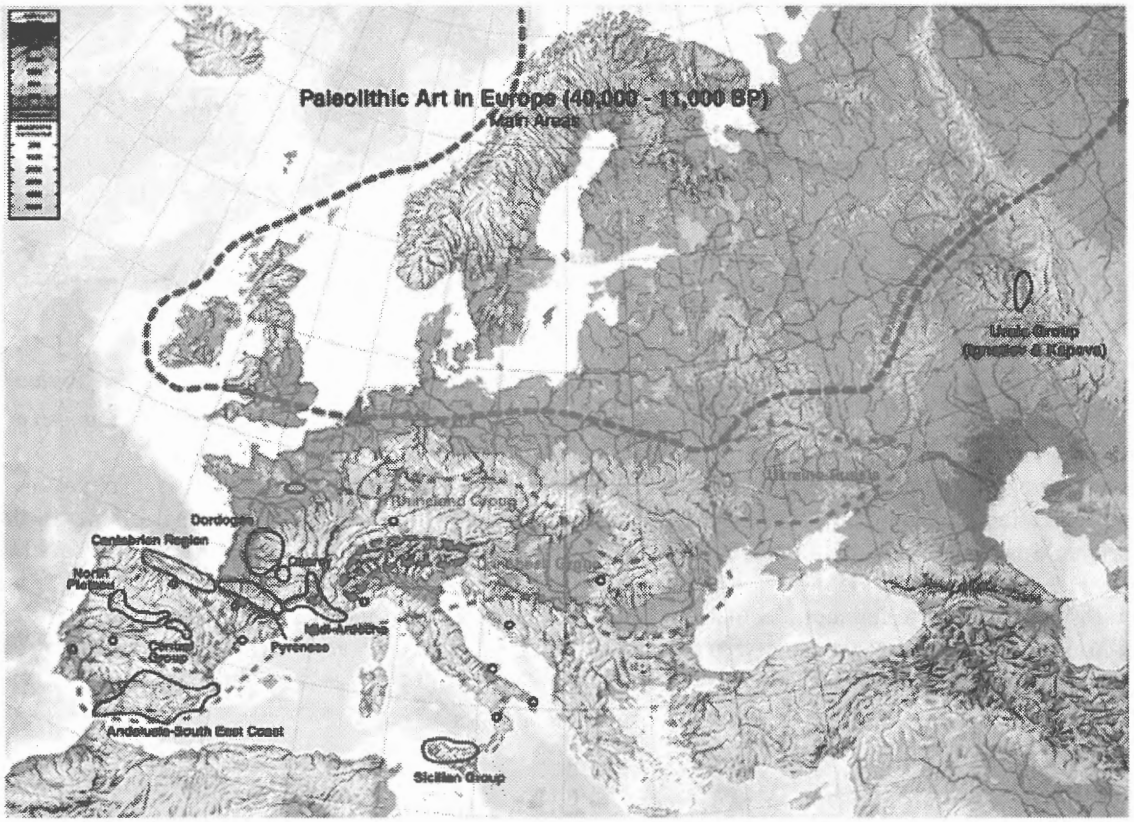
Key Words: Multimedia Database, Paleolithic Art, Europe, North Spain, Research.

1. Introduction. The paleolithic European art.

Between approximately 35000 and 11500 years BP, during the last glacial phases, the European continent saw to be born a first artistic cycle of surprising aesthetic achievements. The expressive force reached in the representation of a great variety of wild animals, with some very simple techniques, has been rarely reached in the history of the western art. We find this figurative art in caves, rock-shelters and sites in the open air, and at the same time, on very different objects of the daily life (pendants, spatulas, points of javelin, harpoons, perforated baton, estatues or simple stone plates).
The distribution all over the continent of those varieties is different: the cave art is concentrated in the SW (Spain, Portugal, France and Italy, mainly), while the portable art is much more extended.
This artistic cycle was developed by groups of hunters that lived in more open and cold territories than the current, where were using very various wild resources through the hunting, the fishing and the gathering. Such economic base demanded a relatively high mobility, of people, objects and ideas. This allowed the interaction to long distance, and permitted to fix a graphic style with many common elements all over Europe, in a moment when they were not stable roads, but only migration routes of the herds of ungulates, and when the only one way of transmitting images to distance were the personal adornments, some little



[A **goat engraved on a bone , Garma Cave**]



objects that did not hinder the march and, indeed, the retina and the mind of the hunter-artist.

The development of this first figurative art is not only consequence of the greater intellectual capacities of our kind, *Homo sapiens sapiens*, extended at the beginning of the Upper Paleolithic (since 38000 BP in the Iberian peninsula, in the western extreme of Eurasia). But also of some forms of social organization of the groups of hunters more complex and flexible, extended through much more large geographic areas. This demanded the development of formulations to maintain the social cohesion, and for the transmission and exchange of information, more sophisticated than until that moment. The cave art, and the ceremonies to those which –sometimes - could be linked its accomplishment, was a part probably of this set of cohesion tools, for fixing and transmitting understable information for this people. This does not exclude its paper as artistic expression, and of personal and specially, collective affirmation.

The figurative art appears, therefore, within a novelties package that have been experienced by the human groups of the Upper Paleolithic. These novelties are well reflected in the archaeological record in referred what is to the technology (new materials –development of the instrumental on bone, antler and ivory - and more complex transformation procedures, greater selection of the qualities to work, new technical supports, more various and specialized tools...), but that also affect to the subsistence (in many regions are observed important intensification processes) and that, without doubt, implied also more complex, versatile and differentiated regionally social structures. It is in that novelties context, and of now accelerated cultural change, in which is developed this new capacity –specific of our kind - of creating and reproducing graphic symbols.

2.The paleolithic art of the Cantabrian Region (Northern Spain).

The Cantabrian Region is one of the classic areas of the paleolithic art since the discovery of the paintings of the Altamira Cave between 1876 and 1879. It is a narrow corridor East-West orientated, in the north of the Iberian Peninsula, opened between Cantabrian Mountains, in the south, and the coast line in the north. It is a small region, with a length of 400 km. and a mean width of 40 km, communicated through the eastern extreme with the regions of the SW of France (Dordogne, Pyrenees), with which is verified an intensive interaction during the Upper Paleolithic. On the contrary, the glacier development in the southern

mountains closed the southward communication during great part of that period, specially in the central and western zones of the mountain chain. Nowadays the cantabrian region is organized in several administrative territories, that are from West to East: Asturias, Cantabria, Basque Country and the northernmost Navarra.

This region had an important human population during the Upper Paleolithic due to its good environmental conditions –because the nearness of the sea - and to the abundance of cynegetic, fishing, mollusks, vegetables, etc. resources, available for those groups of hunters-gatherers in some very variable ecological environments and located to short distance. This and the great quantity of caves in the territory allows to understand the abundance of well preserved archaeological deposits, as well as portable and rock art in those caves. The distribution of remains shows a certain concentration of the habitat in the coastal band –with a smoother weather, rich in resources and better communicated - and traffic zones in the inner valleys, between 0 and 200 meters over the sea level. Only exceptionally some caves can reach 500 m of altitude.

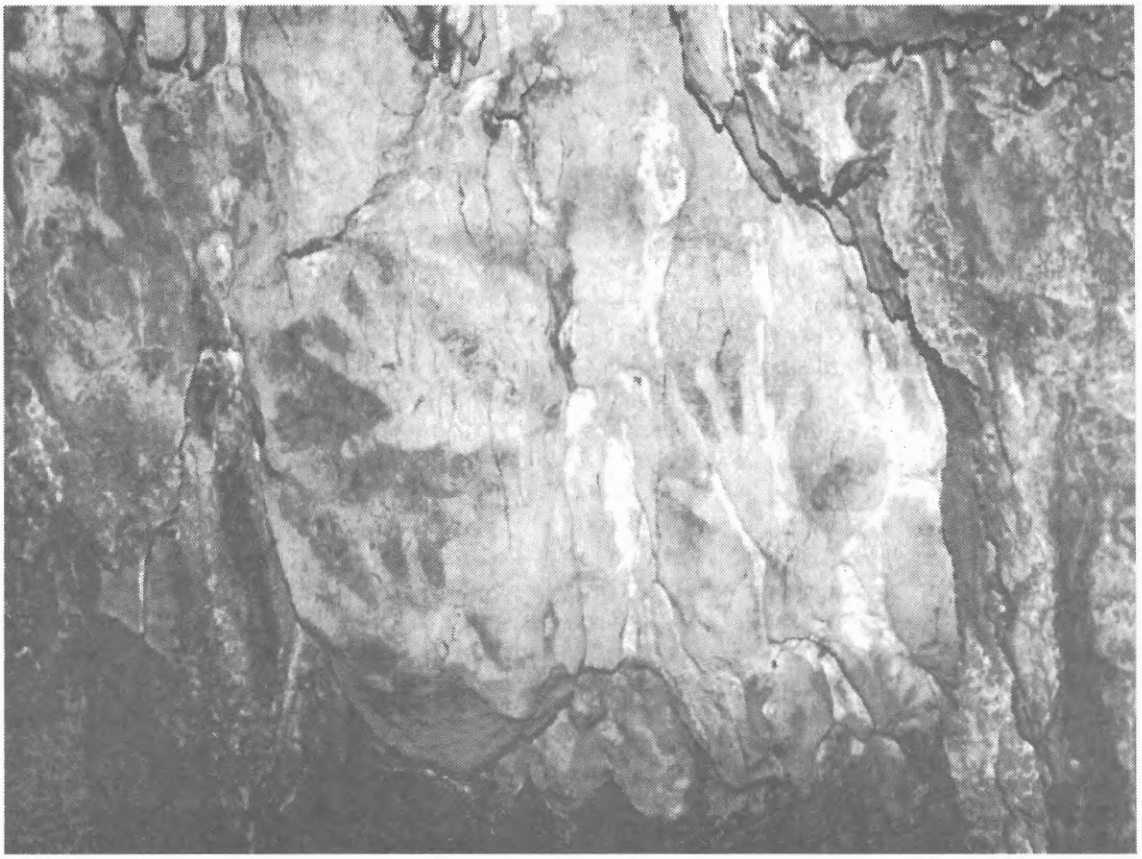
Since 1879 a hundred of decorated caves, of different size and importance, have been discovered here. Though only a few can resist a comparison in aesthetic terms with Altamira, there are very important sites like Peña Candamo, Tito Bustillo and Llonín, in Asturias or El Castillo, La Pasiega and La Garma, in Cantabria. These caves have several hundreds of painted and engraved representations with different styles and conventions which belong to successive human occupations along the Upper Paleolithic. Other many cavities shows works of chronology more concrete. Among those which reach greater showiness should cite La Lluera and Covaciella, in the west, Chufín, Las Monedas, Las Chimeneas and Covalanas, in the center, and Santimamiñe, Altxerri and Ekain, in the Basque Country (González Echegaray and González Sainz, 1994). At the same time, the works of portable art have been multiplied in the archaeological sites of the Upper Paleolithic. The most important sites of portable art mobiliar are the caves of El Pendo, Tito Bustillo, Llonín, El Castillo, Altamira, El Juyo, El Pendo, El Valle, Bolinkoba, Urtiaga and Ekain (Barandiarán, 1995). In these and many more archaeological deposits has been able to study the development of the different phases of the Upper Paleolithic, between 38000 and 11500 years BP, with precision (an updated synthesis in Straus, 1992).

Within the unit that the paleolithic art presents in good part of Europe, the cantabrian region shows some distinctive features. Among them an relatively peculiar iconographic distribution, with many representations of the ungulates here more common: deers and specially hinds, horses, goats, auroch and bisons... and scarce of reindeers, mammoths and animals of especially cold environment, though they are present in different sites. The cantabrian caves show also a certain variety of abstract representations (square-shape signs, claviforms and others) specific of this region and different of the used in other areas of the SW of Europe.

The technical procedures are very similar to those of other European regions, though with some absences (bas-reliefs). Some techniques as like the dotted red outline, or the multiple line engravings, have an important role in the region during some periods. During the Upper Paleolithic was especially characteristic, in a first moment, the outside ensembles based on deep engravings (La Viña, La Lluera and Chufín), or with very simple painted motives (hands in negative of El Castillo, La Garma, Fuente del Salín). Afterwards, the sets of paintings in red with lines sometimes dotted in the Solutrean - 21.000 to 16.500 BP — (caves of Llonín and La Pasiega, Covalanas, Arco and Arenaza, etc.), in many cases with abstract square-shape signs . In Magdalenian (c. 16.500 to 11.500 BP) there is a great variety of expressive and technical resources, and this allows to the artist to make more realistic pictures. So, we find black paintings (caves of Candamo, Cullalvera, Las Monedas, Santimami ñe), or red paintings (specially in abstract signs called "claviform"), engravings (Tito Bustillo, Llonín, Venta de la Perra, Altxerri...), some so characteristic as the inner multiple line engraving used to reproduce hinds' heads, or the addition of several technical procedures, like polychromatic paintings (Tito Bustillo, Altamira, La Pasiega, El Castillo, Ekain...).

3. Recent trends in the investigation of the paleolithic art.

The investigation of the paleolithic cave art has been leaded along the 20th century, by the work of two french researchers: H. Breuil (1954) and A. Leroi-Gourhan (1965, 1983), whose works defined the guidelines of the research. After them, in the last twenty years, research is affected by two



[**Negative hands , Garma Cave**]

amazing phenomena:

1. The discovery of many decorated caves, especially in some regions of the Iberian Peninsula (in the North and also in Andalusia, in the interior Plateau and in Portugal), and in the classic french regions.

2. The application of the technological and data processing revolution to the documentation and research process of the paleolithic art.

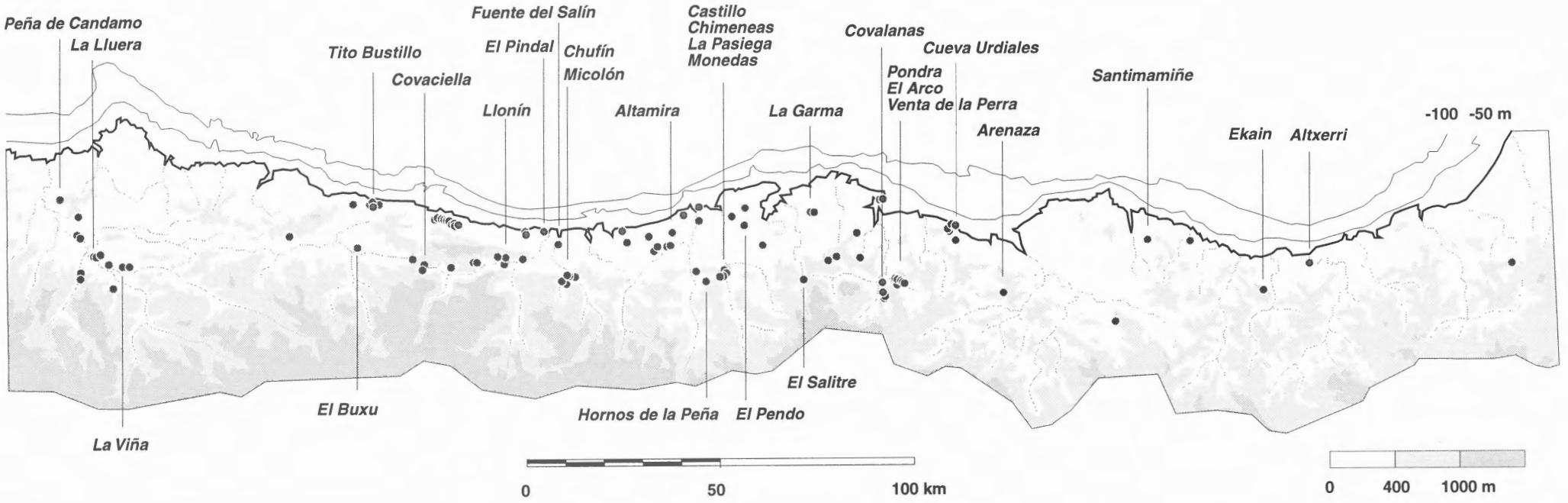
In the Spanish case, the first of those factors is linked with the strong increases of the number of students in the Spanish university during the decade of 1970's. This permitted a multiplication of research centers as well as research and educational staff. At the same time, Spain has experimented social, political and cultural changes that has been accelerated from the last 1970s, in order to get the modernization and democratization of the country. In such context, the economic development of the last decades is supposing a strong impact on the territory (highways, dammings, buildings...) and, consequently, an important number of locations of new decorated caves. These are of different type:

a) Is of great transcendence, among the recent novelties in western Europe, the documentation of paleolithic cave art ensembles located in the open air. They are stony outcrops in the riversides of some rivers, especially the Duero and its affluents, with very similar parietal compositions to those of the caves (sites of Mazouco, Domingo García, Siega Verde and the ensemble of Foz Côa, in Spain and Portugal) (Balbín et alii 1996, Zilhao et alii. 1997). Other sites on the open air are Piedras Blancas (Andalusia) and Fornols Haut (Eastern Pyrenees, France). These new ensembles have changed the way of understanding this first European art, before linked to the inner areas of the caves, dark and mysterious, and to magic/religious interpretations, that today are very restricted.

b) Among the discoveries of new cave ensembles there are two different situations:

* Ensembles discovered several decades ago, where, a modern lighting, and a most adequate exploration permits to discover artistic evidences, often difficulty visible and not spectacular, or bad

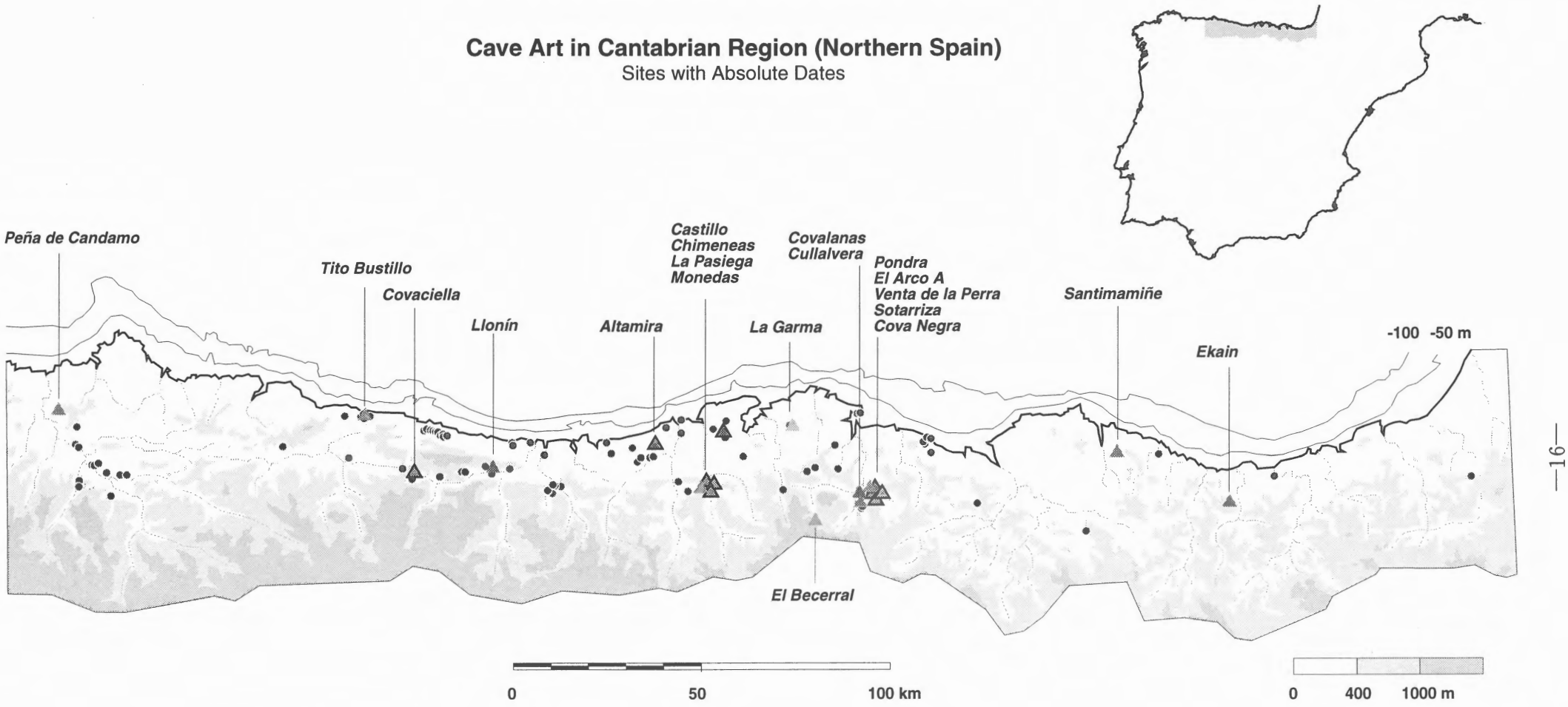
Paleolithic Cave Art in Cantabrian Region



UC UNIVERSIDAD DE CANTABRIA

Cave Art in Cantabrian Region (Northern Spain)

Sites with Absolute Dates

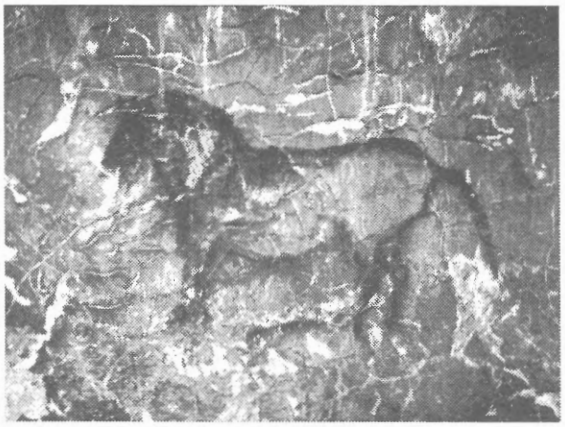


▲▲ Charcoal Samples and Published Dates (^{14}C - AMS)

▲▲ Stalagmite Samples and Published Dates (TL)

• Other Caves With Paleolithic Art

[**Red hinds in the ceiling ,Garma Cave**]



[A **black horse , Garma Cave**]

preserved (caves of El Otero, Sovilla, Grande, Arco, Pondra, El Pendo, all in Cantabria, as well as other caves in other parts of the cantabrian region, Andalusia, France, etc.). These sites, generally small and with a few representations, are however very interesting to get a most real vision about the dimension and extent of the artistic phenomenon, in each region, during the Upper Paleolithic.

It is of special relevancy, in the cantabrian region, the wide series of outside ensembles located in rockshelters and caves of the basin of the Nalón river, in Asturias. These sites (La Viña, La Lluera and others) are subject of an important research project of the University of Oviedo, that includes the archaeological excavation of several deposits (Fortea, 1994).

* closed caves by natural processes, and discovered during the public works accomplishment (Covaciella, in Asturias), with sophisticated equipment of speleology (Chauvet, in L´Ardèche, France and La Garma, in Cantabria-) or of diving (cave Cosquer, partially sunken in the Mediterranean sea, near Marseilles, France) (Cosquer et al., 1995). In this case they are very well preserved sites, sometimes with wonderful pictures.

We are implied in the research of one of these sites, La Garma (Arias et al. 1999). The lower Gallery of this mountain is a cave whose entrance was closed by a cave-in at the end of Upper Paleolithic, so now this cave is accessible descending several abyss that join several caves to different height on the mountain. Throughout the 300 m. long of the lower Gallery, it can be found multiple remains of the last human occupations (between 14.000 and 13.600 BP according to the available C14 dates), consistent in fauna remains, shell of mollusks, tools, charcoals, etc. Furthermore, there are an important number of residence structures in the same surface, including enclosures of stones – which marked the rooms limit and supported skin screens, or foliage - and different entity holes, piles of garbage, some fire... These occupation remains are distributed along a wide surface in the area close to the natural entry to the cave, and also in deeper places. Throughout the walls and ceilings of this gallery there are also a great number of representations of painted or engraved animals (bisons, horses, deers, megaceros, auroch, goats, carnivores...), abstract signs, hands drawn in negative, and multitude of spots of red color of random contours, or series of not- figurative engravings. Such representations correspond, according to the stylistic conventions, technical and other criteria, to different periods of the Upper Paleolithic, at least from the **Gravetiense** (26.000-21.500 ++BP) until central phases of the **Magdaleniense**, when that the cave was closed.

The main interest of the lower Gallery of La Garma –and something similar happens with other intact sites preserved until today - is the exceptional conservation of very assorted classes of remains of the human activity on the floor, and the link among these, or the residence structures well preserved in its perimeter, with the wall paintings. Thus for example, the distribution or rock art and other human remains in La Garma indicates that the engravings and paintings of some low ceilings were accomplished from inside the huts used by the paleolithic. The analysis of these evidences, yet in initial phase, seems to speak about some visits to the deepest regions of the cave more frequent that is traditionally considerated, and about more complex and changing motivations of the parietal art along

the Upper Paleolithic.

Until here the main objects of our investigation at present. But, how it is being investigating, and with which ideas? Close to perspectives much more eclectic about interpretation, currently the effects of the technological revolution underway in the study of the paleolithic art are very important (Lorblanchet, 1995). The modern lighting procedures, instant photograph, photogrammetry, topography and informatic record of the spatial dispersion of remains, digital databases, digitizing and treatment of images with computer, chemical analysis of the pigments, experimental analysis of the technical work procedures etc., are changing each phase of the research process. Among the novelties has reached great importance the possibility of dating by C14, through the Acelerator Mass Spectometer (AMS) some pictures painted with organic material, normally charcoal. At present we have several tens of dates in cavities of France and the cantabrian region (Valladas et al., 1992; Moure et al., 1997). Some of those results are making more precise the chronology traditionally considered, especially for the most ancient phases of the Upper Paleolithic, or pre-magdalenian, and specially, to calibrate the procedures of traditional dating and to decide what continues being valid. In the last two years, it has been begun to test, furthermore, the dating of travertine crusts associated with parietal compositions –superposed or underlayed to the representations—, through Thermoluminescence and other procedures as the Uranium/Thorium (U/Th). Many of the results of these new procedures, and of the research of the last decade, are exposed in a way short in different contributions to International Newsletter on Rock Art, edited in France by the Committee International d´Art Rupestre –CAR-ICOMOS- and other institutions.

The projects guided to interpret the meaning of the paleolithic art have tended to reflect, unfailingly, the changes of mentality and of way of thinking and focusing the past that have been in our society (and that continue being produced at present). Today the prehistorian tend to doubt of global or simple explanations, valid for all the widest period in the different European regions (like the theories that link the representation with the magic of the hunt, with the expression of essential mythologies, or with rituals guided to the maintenance of the social cohesion, or to the transmission of information about the hunt), since these theories are not, necessarily, mutually excluding. At present time is tended to an analysis

[A **panel with several red paintings: auroch, irish elk and caprids, Garma Cave**]

based on the comparison of the different affected regions, and of the different epochs of the Upper Paleolithic, as procedure to try of understanding something of the role played by the art, or its meaning. In the last analysis, it is considered to understand the artistic phenomenon inside the cultural system where it's generated –and it have sense -, or in relationship to other aspects of the system, archeologicaly registered and more easily interpretable (analysis of the spatial distribution in different levels, of the subsistence strategies and of the formulations of organization and mobility of the human groups).

4. Multimedia PhotoVR Database on the cantabrian paleolithic art

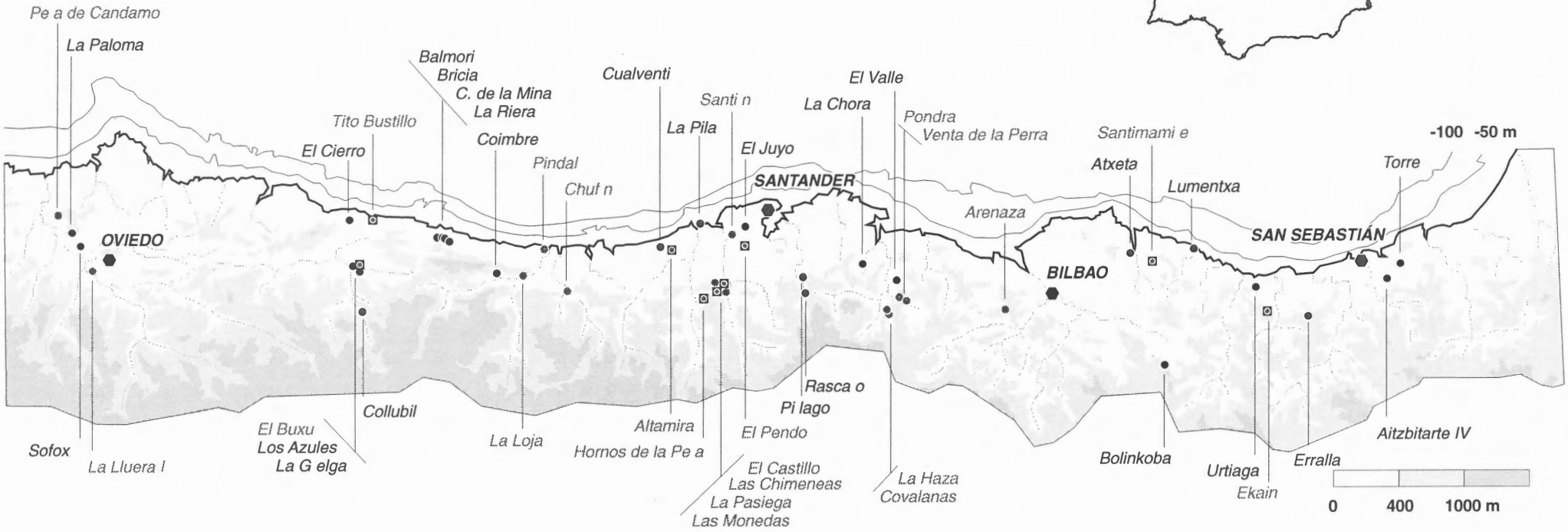
In this context of the research the databases with digitized images have a great interest, because it permits a knowledge extraordinarily more immediate and, in many cases, accurate, for example, of the paleolithic art. And indeed it permits a diffusion all over the world of something before reserved to a few researchers of the implied countries (France, Spain and Italy mainly).

4.1. **Accomplishment.**

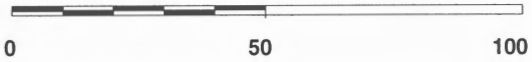
The multimedia database that we present now was accomplished by Texnai, Inc., of Tokyo, and directed by Takeo Fukazawa, cooperatively with the authors of this article, both researchers of the Department of Historical Sciences of the University of Cantabria (Spain). The accomplishment of this database had financial support of the Information Technology Promotion Association Association (IPA), an agency of the Ministry of International Trades and Industries of Japan. This database, will be available in several museums and research

Multimedia PhotoVR Database

Paleolithic Art in Cantabrian Region (Northern Spain)



Cantabrian Region: Upper Paleolithic Sites Included in the Database



- Portable Art
- Cave Art
- Portable + Cave Art

UC UNIVERSIDAD DE CANTABRIA

TEXNAI
http:// www.muse.or.jp / texnai

centers of Japan (University of Tokyo, National Museum of Ethnology, in Osaka, and the International Reserch Center for Japanese Studies, in Kyoto). The spanish version is already available in the University of Cantabria, Museum of Archaeology and Ethnography of Oviedo, Regional Museum of Prehistory of Santander, Service of Historical Heritage of Biscay (Bilbao) and Sciences Society Aranzadi, of San Sebastián.

This work was organized and planned around the end of 1997. For the accomplishment, two teams of photographers and engineers of Texnai were working in the caves and museums of the north of Spain during the spring of 1998. They were accompanied and advised by a scientific team of research students of the Department of Historical Sciences, integrated in the project as scholarship holders. At that time, the main researchers defined the structure of three related databases: cave art, portable art and landscapes, giving content to a wide number of information normalized on each stony canvas or parietal representation, decorated object and landscape sights. Since June, 1998, and until February of 1999, we have been drafting the descriptions of each image, complimenting those fields in the University of Cantabria (Spain), and, at the same time, the graphic works were elaborated in Tokyo, where finally everything has been mounted and integrated in the database. The spanish version was ready in March of this same year.

4.2. **Objectives**.

We have attempted to make a multimedia product that facilitate a wide and updated introduction to the art of the hunters of the Cantabrian Upper Paleolithic, by using modern technics of virtual reproduction through an integrative and plural approach. In this way, the Cantabrian Region is shown as a geographical, natural and cultural unit during the Upper Paleolithic, with some inner changes that we have treated to specify and emphasize. On the other side, we intended to surpass the image of the regional paleolithic art reduced to Altamira and some other caves. Thus, besides Altamira, we include other 21 parietal ensembles, trying to offer a complete image of the artistic phenomenon, including large ensembles (Peña Candamo, Tito Bustillo, El Castillo, La Pasiega, Ekain...) and other little ones like La Loja, Pondra or Venta de la Perra. These little ensembles are very important to understand the real dimension of the paleolithic cave art.

Furthermore, more than one hundred decorated objects are included in the database. These images were shooted in several museums of the region and it allows to get an integrated vision of portable and cave art. Finally, it is offered also an image of the landscape environment where the caves are located. In this way the database integrates several hundreds of landscapes pictures throughout the cantabrian region, from the north of Navarra to the middle basin of the Nalón river (including panoramic images of 360°, for example, from the top of Peña de Candamo, the Macizo de Ardines, in Ribadesella, the Castillo mountain, in Puente Viesgo, Ekain mount, etc.).

4.3. **The virtual reproduction**.

Concerning the multimedia, the database includes conventional images (still picture and video) and other virtual reality files such as IPIX (spherical photographs) that allows to visualize a three-dimensional space in all directions and the sensation of being inside the cave, looking around and watching details of the decorated walls of the cave. Other kind of digital files are the QTVR objects, that allows to manipulate the paleolithic objects in the screen, and to examine its decoration or the techniques of manufacture with a great detail. The third kind of VR images is the QTVR panorama, which offers panoramic photos of 360° horizontally, that has been used for some landscapes. In round numbers this database includes about 200 IPIX files, 300 QTVR objects, 200 QTVR panorama and more than 1000 still pictures.

4.4. **Possibilities of use**.

The advantages of these techniques for the researchers and studious are not reduced to allow the access to caves - or to parts of caves —closed to the public, or very difficult to walk inside. Furthermore, it shows us the cave art in its ambient inside the cave. This is very important, since cave art don't use standard supports (like canvas or flat wall), but panels of different dimensions and directions in walls with irregularities and different conditions of dampness, hardness, etc. Sometimes these techniques of photographic virtual reality permit to appreciate and to understand the fitting of the paleolithic rock art to those conditions. Regarding portable art, usually people can see only one face of the object, through the crystal of a showcase in a museum. The QTVR objects of the database permit to manipulate in the screen the virtual object, and it

allows a very detailed analysis of the decoration in the better conditions (without quiver the hand and the magnifier, and choosing the better direction of the light in each moment...).

The organization of the material - different types of images and texts - in a database, permits to search and filter the information through several defined fields (including texts and logic fields), or combinations of these (representations, techniques, supports, museum, cave, , chronology, location, etc., for example: magdalenian black bison, in all the region or in a selected cave). Furthermore, different maps of the region, of each cave, stratigraphies, etc., are connected to the images, explanatory texts, traces of portable art, and available bibliography on each piece or each art ensemble. The ready texts are not limited to comment each image, but are included updated articles about each cave, the cantabrian region and other artistic areas of the European west, and more general approximations to the paleolithic artistic phenomenon. All this converts this database in an excellent support for teaching –that we are already using for teaching in the University of Cantabria- as well as for researching.

5. The role of the art of the paleolithic hunters in our civilization.

The works of cave art distributed along many caves of the north of Spain and other European regions, or the wonderful miniatures worked on great number of objects, offer today to our society a double permanent lesson:

- they are the live testimony of some beliefs and some forms of already disappeared life, primitive and, at the same time, very respectful with the territory and the environment, from where they got a wide diversity of wild resources, through the hunting, fishing and gathering.

- the spectacularity and artistic and technical mastery of many of the paleolithic representations, constitutes a moderation or regulatory factor, of our technified, complex and superb current civilization, that indicates us the way that the human nature procures to reach very high levels of artistic expressivity and wisdom even in such simple and little developed cultural systems.

The decisive increase of the human action on the territory in the last decades makes increasingly necessary the vast documentation, and the development of a more active conservationist conscience. The diffusion of the knowledge that facilitate the multimedia databases can help also, as we believe, to promote such conscience and to sensitize to the authorities, and to the people, on the convenience of an adequate conservation and research of these manifestations.

Gratefulness.

We want to thanks to all the people who have worked in this project. Firstly, we thank to Mr. Takeo Fukazawa, president of Texnai, Inc. During more than one year we were in a permanent communication Spain-Japan through e-mail, trying to define the main lines of this project, beginning with an idea that, firstly, we saw as a *dreamt*. After defining the project we begun a hard bureaucracy works in Japan and Spain in order to get financial support and permissions for shooting inside the spanish caves and museums. Without the support of the IPA, of the Ministry of International Trade and Industries of Japan, and the administration of Asturias, Cantabria, Vizcaya and Guipuzcoa, in North Spain, we could not accomplish this project.

Afterwards, we could join a great japanese-spanish team of photographers, engineers and archaeologist who were working together in Spain during more than two month. They have a great responsibility in this project and we need to give thanks to everybody of them: Yuji Seki (Museum of Ethnology, Osaka), Norie Hiraide, Hiroaki Seki, Yuki Fukazawa, Shin Hamazaki, Peter Sun, Yoshinori Matsumoto (Texnai, Inc.), Koji Nagasaka (Nagasaka Video Service), and Nerea Gálvez, Ignacio Castanedo, María José Samperio and Gustavo Trueba (University of Cantabria). Finally, we want to thanks to Luis Teira the making of the ilustrations included in this article.

BIBLIOGRAPHY

Arias, P.; González Sainz, C.; Moure, A.; Ontañón, R. 1999. *La Garma. Un descenso al pasado.* Catál ogo de la exposición. Gobierno de Cantabria y Universidad de Cantabria. Santander.

Balbín, R. de; Alcolea, J.J.; Santonja, M. 1996. *Arte Rupestre Paleolítico al aire libre de la cuenca del Duero: Siega Verde y Foz Côa.* Fundación Rei Afonso Henriques, Zamora.

Barandiarán, I. 1994. "Arte mueble del paleolítico cantábrico: una visión de síntesis en 1994". *Complutum* 5, pp.45-79.

Breuil, H. 1952. *Quatre cents siècles d'art pariétal. Les cavernes ornées de l'age du renne.* Centre d'etudes de de documentation préhistoriques, Montignac. (Reimpresión, Max Fourny, Paris 1974).

Cacho Toca, R., Gálvez Lavín, N. (1999): Some applications of digital photography in the enhancement and reproduction of paleolithic rock paintings. En: BARCELÓ, J. A., BRIZ, I., VILA, A.: *New Techniques for Old Times CAA 98.* Proceeding of the 26th Conference, Barcelona, March 1998. BAR International Series, 757: 73-76

Chauvet, J.M.; Brunel, E.; Hillaire, C.; Clottes, J. 1995. *La Grotte Chauvet à Vallon-Pont-d'Arc.* Editions du Seuil, Paris.

Fortea Pérez, J. 1994. "Los "santuarios" exteriores en el Paleolítico cantábrico". *Complutum* 5 pp.203-220

González Echegaray, J.; González Sainz, C. 1994. "Conjuntos rupestres paleolíticos de la cornisa cantabrica". *Complutum* 5, pp.21-43.

González Sainz, C., Cacho Toca, R. y T. Fukazawa. "PhotoVR Multimedia Database: Paleolithic Art in North Spain". *International News on Rock Art,* en prensa.

Leroi-Gourhan, A. 1965 (2ª ed: 1971). *Préhistoire de l'art occidental.* Lucien Mazenod, Paris

Leroi-Gourhan, A. 1983. *Los primeros artistas de Europa. Introducción al arte parietal paleolítico.* Encuentro, Madrid.

Moure, A.; González Sainz, C.; Bernaldo de Quirós, F.; Cabrera, V.; Valladas, H. 1997. Nouvelles dates absolues de pigments dans les cavernes cantabriques. *International News on Rock Art* 18, pp.26-29

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

Straus, L.G. 1992. *Iberia before the Iberians.. The Stone Age Prehistory of Cantabrian Spain.* University of New Mexico Press, Albuquerque.

Valladas, H.; Cachier, H.; Maurice, P.; Bernaldo de Quirós, F.; Cabrera Valdés, V.; Uzquiano, P.; Arnold, M. 1992. "Direct radiocarbon dates for prehistoric paintings at the Altamira, El Castillo and Niaux caves". *Nature* 357, pp.68-70.

Zilhao, J. (coord.) 1997. *Arte Rupestre e Pré-Historia do Vale do Côa. Trabalhos de 1995-1996.* Ministério da Cultura. Lisboa.