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Résumé : Les problèmes de conservation qui affectent la grotte d’Altamira et ses peintures offrent une étiologie variée. Manuel Hoyos (1994) a regroupé ces problèmes en trois catégories, toutes trois fondamentales et fortement corréllées. Il s’agit des caractéristiques géologiques et karstiques de la grotte, de l’état d’altération des peintures et des dégradations anthropiques produites tant à l’extérieur qu’à l’intérieur de la cavité. Historiquement, ces facteurs se sont finalement développés en plusieurs étapes, de manière telle que l’intérêt premier pour le réseau géologique de la cavité a entraîné une série d’interventions, à tel point qu’ils ont fini par affecter l’état de conservation des peintures. L’afflux massif du public a contribué à aggraver la situation. Dans cette communication, nous résumerons les problèmes ayant affecté la grotte d’Altamira et ses représentations artistiques, depuis sa découverte jusqu’à aujourd’hui, les différentes étapes qu’elle a traversées, ainsi que le point de vue actuel et futur après l’établissement d’un programme muséologique ambitieux et un contrôle environnemental strict de la grotte d’Altamira qui a permis de concilier conservation de l’héritage culturel d’une part et satisfaction du public de l’autre.

Abstract: The problems of preservation which affect the Cave of Altamira and its paintings are of varied aetiology. Manuel Hoyos (1994) summarised these problems in three categories, all of them basic and closely related among them. The geological and karst characteristics of the cave, the altered state of the paintings and the anthropic alterations produced both outside and inside the cavity. Historically, these factors have eventually been developed in a series of steps, in such a way that the initial concern with the geological structure of the cavity resulted in a series of interventions over it, of such magnitude, that they ended up affecting the preservation state of the paintings. The massive influx of public helps to aggravate the situation. We will sum up in this paper the problems which have affected the Cave of Altamira and its art, from its discovery until now, the different stages through which it has undergone and the current and future scene after the setting about of an ambitious museological program and a strict environmental control of the Cave of Altamira which succeed in achieving the harmonisation of the preservation of the cultural heritage along with its public enjoyment.

INTRODUCTION

The Cave of Altamira is located in the upper part of an ancient karst tending to disappear because of collapses and falls, owing to the tabular structure of the limestone and the steep slope of the fracture planes. As Hoyos (1993) pointed out the geologic evolution of Altamira is marked more by a series of gravitational collapses of the limestone rock layers, rather than by the water flow. These collapses began in Prehistory and, of them, the oldest could have buried Mousterian occupations or maybe Aurignacian. During the Solutrean period there might have occurred another cataclysm and a new one along the Magdalenian.

A great collapse which took place some 13,000 years ago bringing about the fall of the initial part of the cave, leaving it sealed until the very moment of its discovery, right in the 20th century.

The discoverer of the paintings, Marcelino Sanz de Sautuola, visited the cavern around the years 1875 or 1876 and later in 1879. Sautuola (1880) reports how in the course of these visits, new collapses had taken place at the entrance area. In fact, the whole interior of the cave was strewn with sharp detached blocks, many of them, before the artistic works were performed. Rodriguez Ferrer (1880) made the comment that the route inside the cave was made going up and down crevices and debris which block the way all the time. Similar depictions are repeated in subsequent years and the tone of alarm becomes patently clear in the reports sent to the Academia de Bellas Artes seeking the support of the institution to solve the serious problems of stability of the cave.

We have to say that, in spite of the cave looking pitiful and the –real– chance that the collapses would affect the paintings hall, the problem was not tackled by the authorities concerned, still unaware of its value and, in general, of the importance of the historic heritage. J. Carballo – regional archaeologist- informed King Alfonso XIII of such an alarming situation, and then the king took the initiative personally and he gave the Duke of Alba the job of taking the appropriate steps to solve the problem. Under his auspices, they set in motion a series of actions aimed at the legal protection of the monument, its better scientific knowledge and the solution of the geological stability problems of the cavity.

In 1921 Alberto Corral was commissioned to plan the drainage and consolidation of the cave of Altamira. His interventions in the exterior and the interior of the cavern were as well meant and in compliance with the technical knowledge at that time, as aggressive for the natural environment of the cavern and its setting. In the outside an access road was built, the ground above the ceiling of the paintings was waterproofed with concrete and the bushy vegetation was replaced with meadows. In the inside, the most important cracks were filled in with hydraulic cement, the electric light was installed and the level of the ground was lowered to make the visitors passage easier. The collapses which occurred in the site area during Obermaier's excavations (1924-25) forced the building of great walls to prop the ceiling, varying Corral's original project in which only some passage paths were proposed (Fig. 1 a 3). The walls were put up halfway the excavated zone of the site and the paintings hall in such a way that
The new people in charge considered that the problem of the rock instability was not solved and new actions should be made on this matter. They decided to prop the ceiling of the paintings hall and the galleries III and IV with timber beams. It was a really unfortunate measure, since irrespective of its void usefulness and constituting an aesthetic aggressiveness of the first order, it became a focus of microorganisms in direct contact with the rock art. This propping system remained in the inside of the hall no less than fifteen years. A detailed report from Alfredo Garcia Lorenzo was necessary for its removal, proposing its replacement by new wallworks, this time placed at the entrance area of the hall and from there into the inside beneath the big crack which grooves the ceiling and a large part of the perimeter of the Hall. All these walls were deftly camouflaged so that the visitors just cannot notice its artificiality, even some prehistorians, from the 40’s onwards and judging from their published works seemed not to have been aware neither of their existence nor of the actual and full size of the painted and engraved surface on the ceiling and, therefore, of all its figures.

The evolution followed by the inner space of Altamira and the gradual changes, which occurred in it, are clearly shown in our figure 3. There can be seen how the original space originally inhabited by men and women during the Upper Palaeolithic was completely modified and these alterations brought about serious consequences for the preservation of the Polychromes Hall, encapsulated between concrete walls. The structural changes particularly affected the environmental parameters and the airflow (Hoyos, 1994), altering their natural conditions and that situation being aggravated by the massive presence of visitors in the Polychrome Hall. So, although at first the geological stability of the cavern was the main concern, from the fifties the preservation balance would tip more weight towards the damages caused by an excessive presence of public in the Paintings Hall.

Altamira has always exerted a great fascination on the public and as such focus of attraction, it has been visited just since its discovery following an increasing pace until becoming a place of cultural pilgrimage, as emblematic as the Alhambra in Granada or The Museum of El Prado. The Cantillana del Mar Town Council, as early as the beginning of the 20th century, ordered that the visits were guided and issued some rules in order to avoid excesses in the cave. Some years later, in 1926, The Junta de Administración y Exploración de la Cueva de Altamira laid down that the groups should be made up of a maximum of ten people accompanied by a guide. Two years later, The people in charge, asked for the presence of the Guardia Civil in order to avoid the excesses which took place among the large number of public which wanted to gain access to the cavity. All this happened at dates in which we cannot talk about a developed tourism industry but the existence of a holidaymaker group, with a high purchasing power, and being also a demographic minority. The inflection point towards a mass tourism took place in the fifties reaching 50,000 visitors yearly, and they would come to be 177,000 in 1973.

The first to raise the alarm about the conservation state of the paintings coincide with the increase in the number of
tourists recorded in the 50's. In 1955, the engineer García Lorenzo informed the Patronato de las Cueva Prehistóricas de la Provincia de Santander about the appearance of calcite concretions in the Hall of the Paintings. This concern has leaked out to the public opinion, as it is shown by the leading articles of newspapers such as ABC (16th July 1955) and YA (25th July 1957) recounting the alarming situation. From the outset, the relationship between the increase of the number of visitors and the damages shown by the paintings was clearly seen, consequently the technicians in charge of the preservation of the cave, proposed a reduction in the
number of the people who gained access inside the paintings area, as an effective method to fight against the deterioration. Nevertheless, it is essential to accept that Altamira had become an indispensable source of income for the development of a region that struggled for making its way and no politician in charge could assume to take on the course of one of the jewels of the growing regional tourism. But rather, there was an increasing tourism promotion of the Cave of Altamira and from its takings, great sums of money were invested in arranging another Cantabrian Caves containing rock art paintings for tourism.

We owe to the engineer Alfredo Garcia Lorenzo, man in charge of the conservation of the caves in the Patronato, the huge efforts to achieve a reduction in the number of visitors, to control the environmental parameters and the harmful effects of the electric light. He raised the issue of the conservation problem of the Altamira paintings for the first time in the international scientific for from the 70’s. The fact that the Symposium Internacional de Arte Rupestre of the Union Internationale des Sciences Préhistoriques et Protohistoriques was held in Spain served as the pretext for the presentation of a report in which there was a thorough approach to he problems affecting Altamira and an enumeration and description of all the environmental parameters whose in-depth study should be dealt without the slightest delay through the creation of a multidisciplinary team (Garcia Lorenzo and Enderiz, 1972). At this moment, The issue had gone through the public opinion due to the continuous references in the media, and the damages seemed to be visible on every figure, especially on the great hind. In spite of all what had happened, the situation remained in the same terms until 1976 when, after the political regime change in Spain, the new people in charge of the recently created Ministry of Culture took steps, precautionary at first, to a reduction of visitors and later the total closure of the cave. A Comisión Investigadora made a series of studies on the colour evolution of the paintings, pigment analysis, rock support composition, among many others, whose results were published in the proceedings of the International Symposium of Rock-Art held in commemoration of the centenary of the discovery of Altamira Cave (Altamira Symposium 1979).

In 1979 The National Museum and Research Centre of Altamira – shortly Museum of Altamira was created in which the cave itself was included, becoming state property, high technology scientific material was purchased in order to be applied to the conservation of the paintings and an study was commissioned to a team directed by a physics professor of the University of Cantabria. This team started from a series of basic assumptions, such as the ignorance of the extent of the damages suffered by the paintings, the danger rate of the factors intervening in it, as well as the environmental conditions which could have existed inside the cave before its discovery. It was intended to find a balance state of the ecosystem which might keep the Paintings Hall within some parameters as much stable as possible keeping the natural ventilation of the cave, abandoning the idea of artificial systems of air conditioning. This team worked until 1983, issuing then a series of technical reports and analysis results which were recorded in tree volumes of the series Monografias del Centro de Investigación de Altamira (numbers 5, 9 and 11). In 1982 the opening of the cave to the public was recommended within a restricted visits regime, with the purpose of analysing the behaviour of the environmental variables under that public access regime. A daily maximum for visitors was established depending on the month of the year and the time of stay inside the Paintings hall, all of this according to a mathematical model which related the exterior climate to its seasonal variables, the cave climate itself and the heat brought by every visitor. This access regime to visit the Cave of Altamira is still in force.

During the closure period of the cave – from 1977 until 1982-, the aspect of the paintings seemed to improve and the intensity of colour was recovered, then gradually disappearing the existing fading on the hind’s neck. In 1985, Altamira had been included by the UNESCO in the List of Human Heritage confirming its exceptional nature and the efforts made by the Ministry of Culture for its preservation. This situation, the recovery of the tourism figures in Santillana del Mar and the scarce visits allowed into the cave, as well as the appeasement of the political authorities either local or regional made the old idea of building a replica of Altamira to be taken up again strongly by the people in charge of the public affairs (and also by curators, museologists and prehistorians involved); It was borne in mind the precedents of the model of the German Museum of Science and Technology of Munich made in 1960 and the ongoing project of Lascaux II. Having a facsimile of the original was for many the panacea for the preservation of Altamira as it might reduce the pressure for visiting the cave and at the same time it would provide Santillana del Mar with renewed tourism attractions again. So, since 1983 until 1991, it was opened a period in which the priority was defining the replica project which was wanted to be achieved and the drawing up of a viable project which could allow it. As for the model, the facsimile of the Cave of Lascaux was taken as a reference, even regarding to its location, since the future replica of Altamira was also seen too close to the original. In the different projects submitted, it was clear that there was not an effective approach to the problems springing from the management of thousands of visitors who, again and in a swollen number, would come back to Altamira, if the problems of the old and obsolete museum exhibition (inadequate for the visitors expectancies and to reflect the wealth of the Palaeolithic in Cantabria), apart from the fact that there remained pending environmental risks in the surrounding exterior environment of the cave, the experience accumulated in Lascaux/Lascaux II should be used, in its successes and in what was liable to be improved.

In this situation, it seemed essential starting a new plan which would deal with the conservation and spreading requirements Altamira needed. What at first had been proposed as a specific intervention, the building of the replica, became an extensive museological program which proposed a comprehensive solution to the multiple matters which affected directly to the preservation of the monument and its environment as well as to its adequate management and spread.
It was understood that the reproduction of Altamira, the research and conservation of the original should be part of the same project, for which a series of essential actions should be tackled. In 1992 The Museological Plan was submitted to the Museum's Patronage, which was promptly accepted, where the pending problems as well as the most advisable solutions were stated.

THE CONSERVATION OF THE CAVE AND ITS PAINTINGS

Within this plan of action, one of the first steps taken was that of purchasing, in 1993, the private land which still existed over the cave and its surroundings. Thus the perimeter of direct protection of the cave and its paintings was enlarged preventing any new activity in this pieces of land to be carried out, until now used as meadowland for cattle.

The direct action inside the cavern also started in 1993, when the electrical and lighting installations were totally renovated. The new technologies allowed the perfect view of the paintings with fewer than 60% of lamps and less than 90% of power installed. It was thus ensured the elimination of the risks which for the preservation of the artistic representations involved an excessive and inadequate lighting.

Another pending question was that of the definite diagnostic study on the geological status of the cave itself and the conservation state of the paintings since the works undertook in 1982 by the University of Cantabria needed verification after several years of limited opening of the cave to the public. The preservation of the rock-art paintings located in caves from the moment that they were made until their discovery, it is due basically to the lack of aggressiveness of the natural karstic and climatic conditions. Nonetheless, once the paintings are discovered, we can observe in most of them a relatively quick degradation in a short period of time, which if it had come from the past, it would not have allowed its preservation until the present time. In the Cave of Altamira the high degree of conservation noticed at the moment of its discovery occurred due to two favourable conditions, basically (Villar et al., 1986, Hoyos, 1993): (1) the low rate of infiltration water through the calcareous layer which separated the Polychromes Hall and the exterior surface. (2) The maintenance of stable microclimatic conditions since the natural closure of the cave until its discovery.

The caves are natural systems whose balance is affected by any activity carried out both in its external area of influence and in the interior:

Exterior: The CO₂ (gas) produce by the biologic activity of the exterior soil is dissolved by the rain water carried along with the atmospheric CO₂ through the rock up to the interior of the cave. Likewise pollutants can be carried (e.g.: fertilisers). Any modification caused in the recharge area of the cavity (e.g.: quarrying of rock, change of the soil use) can influence negatively the conservation of the rock-art housed in it.

Interior: When the water with high values of the CO₂ pressure springs into the cavity there is an out-gassing and the atmosphere of the cave is filled with this gas. The temperature and relative humidity of the air suffer natural fluctuations of a very low rank throughout the year. The entrance of visitors brings about some increases in temperature, relative humidity and CO₂ modifying the microenvironment of the cave.

The external climatic conditions and the geological characteristics of the area, including its seismic activity, are natural factors which cannot be kept under control and condition the natural karstic evolution of the cave. The anthropic actions should be aimed at delaying as far as possible, the effect of those natural processes of decay. Unfortunately the destabilising factor which favours the progress of the deterioration processes and its support rock is related either directly or indirectly with these anthropic activities.

The many factors which have an influence in the delicate balance of the caves which house rock-art imply the need to carry out multidisciplinary studies. By means of the implementation of a complex study methodology, it can be achieved a detailed knowledge of the problems of the karstic systems and the chance of incorporating the results in an integrated model. The multidisciplinary teams which had carried out the studies for the preservation of the Cave of Altamira were directed and co-ordinated by Manuel Hoyos Gómez until April 1999. This teams had been made up of members of the Geology Department of the National Museum of Natural Science (Madrid), Natural Product and Agrobiology Institute (Tenerife) and Natural Resources and Agrobiology Institute (Seville) all of them members of the CSIC. For some detailed aspects of the microbiological studies and aerosol particles there has been a collaboration with the Universities of Antwerp (Belgium) and Vienna (Austria). The research works carried out had been focused on the aspects which are stated below.

A. - Geologic study and analysis of the structural characteristics which control the morphology of the cave

By means of these studies a delimitation of a total protection area of the cavity has been achieved where there is a chance that the infiltrational waters would reach the cave interior. Likewise, a context for the hydrology of the karstic system and a geo-structural analysis of the cavities could have been established. By means of these studies a delimitation of a total protection area of the cavity has been achieved.

Facing a geological-karstic structure such as the one of Altamira, the precautions which should be taken with regard to the activities that produce vibrations must be the maximum. Irrespective of their origin, the vibrations borne by the host rock of the cavity favour the mechanical instability, bringing about the formation of the new fissures, and widening of the previous ones, rock-block fall and spalling of rocks some millimetres thick. A significant example is the influence which had the limestone quarrying made directly within the protection area of the
cave before its discovery. It has been estimated that the rock quarrying brought about a reduction of the thickness of the cover in approximately 17%. The direct impact over the cave was the mechanic destabilisation of the ceiling of the cave, contributing to the rock falls, changes in the via and infiltration rates of the water. Possibly brought about the opening of the cave previous to its discovery.

In any work which it is made the natural vibration level to which the cave is subjected must not be exceeded. This limitation has been noted in the recent works of building of the new museum, as it will be seen below.

Another basic aspect for the research of the alteration processed suffered by the paintings, is the detailed study of the petrological characteristics and the chemical and mineralogical composition of the host rock of the rock-art paintings, the karstic deposits and the outer edaphic cover. With the integration of these data along with the hydrogeochemical, microbiological and microclimatic, we have been enabled to distinguish in each case the inorganic origin of the decay phenomenon. Thus, it can be established a quantitative and approximate assessment of the alteration processes and of the possible measures to take in order to optimise the preservation conditions.

B. - Hydrogeochemical characterisation of the infiltrational waters. Analysis of the hydrological characteristics of the cavity and study of the water circulation through fissures and cracks

Infiltrational water is one of the main factors in the physico-chemical equilibrium of the karstic system. It is the main transport agent of CO₂ into the karstic system, having an influence as well as on the rest of the microclimatic parameters of the cavity. Its compositional characteristics define its capacity to precipitate or dissolve carbonate minerals. Any modification in its infiltration via and rates or in its composition can alter this equilibrium contributing to the accentuation of the deterioration processes.

As it has been commented above, there has been a farm within the total protection area of the cave of Altamira. This activity has given rise to the creation of an organic mud and high rates of CO₂ in the outer edaphic cover. From the national follow of the geochemical characteristics of the infiltration water, in 1996 it was detected the presence of nitrogenous compounds (NO₃⁻, NH₄⁺) High contents of dissolved CO₂, and dissolved organic matter an in suspension in the analysis of the dripping waters of the interior of the cave (Hoyos et al., 1998). This phenomenon in direct connection with the farming activities brings about a series of problems with regard to the conservation of the paintings.

- An increase of the rock dissolution rate in infiltration areas due to acidification and the formation of new precipitates in emergence areas.

- An increase of the organic matter available for the chemoautotrophic biological communities.

- High rates of CO₂ in the air of the cave which favours micro-corrosion processes.

C. - Characterisation of the microbiological populations which develop over the walls and ceilings of the cavity

A basic aspect for the conservation studies is the identification and quantification of the microbiological populations present in the cave, as well as the assessment of their interaction with the support (paintings, speleothems, etc.) and with the infiltration waters. For that reason it is basic distinguishing the nature and origin of the nutrients, determinant in the growth and development of the communities of microorganisms. By means of the studies carried out, it has been proved that the metabolic activity of the colonies of microorganisms present in the cavity generates chemical precipitates, sometimes placed directly over the paintings. Their growth and development is generated and/or favoured by the contribution of the organic material dissolved in the infiltration waters as well as because of its introduction into the system as a result of the visits (Cañaveras et al., 1998, 1999, 2001).

A clear example of the action of micro-organisms lies in the development of the alteration crust made up by hydromagnetic crystals over the horse in the Polycromes Hall (figure 4). The accumulation of organic matter in the external soil because of the farming activities contributes to the heterotrophic bacteria (actinomycetes) growth inside the cavity. These organisms use the organic carbon springing from the dissolved organic matter in the infiltration water and contribute to the mineral precipitation (hydromagnesite) over the paintings disintegrating the pigments. The circulation and condensation of water over this on that area can cause the later break-up of the minerals that compose the coating, dragging the disintegrated pigment easily.

D. - Characterisation of the micro-environmental conditions of the cave through high resolution and continual monitoring of the most significant environmental parameters

The microclimate of the cavity is determined by the interaction of a large number of internal external factors. The alteration of the natural microenvironmental conditions of the cavities results in the breakage of the natural dynamic balance of the karstic system. The different anthropogenic modifications introduced both for the activities performed in the exterior and the ones introduced in the karstic environment cause the development and increase of the alteration processes of the paintings and their host rock.

For all of this, it is essential to characterise the micro-environmental conditions of the cave (in short and long terms) and their relationship with the external climatic variations, as well as assessing the anthropic influence (visits) in the micro-climate of the cavity.

With this aim, it was carried out the design, installation and maintenance of a high resolution automated system for
measuring environmental parameters (figure 5). The system consists of the combination of sensing instruments, and a hardware software package allowing the recording and logging the data. The environmental monitored parameters have been the following. Atmospheric pressure, temperature (atmosphere of the cave, exterior, rock, water), humidity (relative and total), 222Rn in the interior air and exterior soil, CO2 in the interior air and exterior, infiltration water rate, thermal flux, velocity of the currents of air inside the cave and exposure time to artificial lighting. Likewise, one thermal air flux sensor was installed in the Stalactites Cave with the object of obtaining a record of the natural evolution of this parameter in a cavity where disturbances are produced due to the entrance of visits. As a whole, the aim was to establish a study model and assessment of the alteration degree and the anthropogenic influence in the deterioration processes.

In this study, a monitoring of the micro-environmental parameters of the cave has been completed, particularly, a detailed one of the Polychromes Hall, during a two year period (1997-1998). Throughout the annual cycle of 1997 a complete record of all the parameters studied was obtained, immediately stating the need to incorporate new parameters to the recording system since the system performance is not as simple as the one of the previous model with which the current visits regime was established. Nonetheless, the development during the subsequent years of the necessary works for the building of a replica leading to a strong disturbance of the present microclimatic cycle, at the same time they have affected physically some sensing elements of the measuring equipment of microenvironmental parameters. Thus, the results awaited in principle could not have been achieved, based on the contrast, of at least two complete annual cycles. Nevertheless, from the study carried out some interesting results have been obtained among which stand out the following:

- The impact of the continual daily visits over the micro-environmental parameters is bigger than the one which had been stated in previous studies, modulating and modifying the climatic characteristics of the cave.

- It has been observed the important role played by the external vegetation layer which covers the upper part of the cave ceiling in the deterioration phenomena progression, both in the air content of CO2 and the infiltration water, and the natural ventilation of the system.

- Precise characterisation of the amplitude and gap of the annual thermal cycle of the Polychromes and the Stalactites cave.

- It has been established a first integrated quantitative model of the inorganic corrosion processes of the host rock of the paintings induced by the daily entrance and permanence of visitors in the cave (Sanchez-Moral et al., 1999). Besides the exchange of matter with the exterior, the entrance of visitors produces a series of variations in the microenvironment of the cavity: emission of heat through radiation via the skin, production of CO2 and vapour, and consumption of O2 through respiration. The global effect is translated into a destabilisation of the micro-environmental equilibrium and an alteration of the geo-chemical conditions of the System CO2-H2O-CO2Ca which causes a significant increase of the host rock of the paintings corrosion. The results obtained show that the current conditions and the present regime of visits, the entrance of visitors inside the cave of Altamira brings about an increase of the corrosion processes 78 times higher to the ones which would happen in normal conditions (Table 1).

Nowadays, starting from all the data obtained through this multidisciplinary study, a proposal to minimise the deterioration phenomena and optimising the protection of the paintings. The first correction measures should convey: (1) the change of the current edaphic cover due to its high content of organic matter, nitrogenous compounds and CO2; (2) modification of the visits regime, redefining the
The new museum site has gone from comprising 60,000 square meters before to the current 160,000. This has been useful for incorporating most of the impluvium area of the cave and suppressing the road traffic above the cave itself for what a new path along the exterior has been built; the farms which were on the impluvium area and whose wastes affected the cavity have been purchased and eliminated, and of great significance, a Special protection Plan as an effective legal instrument environmental planning and prevention. In short, Altamira is now in better preservation conditions than before carrying out this museological project.

In order to avoid any risk derived from the construction work of the new building and of its accesses (roads and parking places), the use of explosives or pneumatic percussion was banned excavating the rock by means of the exclusive use of expansive mortars. The monitoring by precision seismographs, let us know that the works did not increase the level of vibrations above the "natural noise" level that is to say, the opening and closing of the gate for the visits produce more vibrations than the construction work. This seismographic control, permanently monitors, was entrusted to the Engineering School of the University of Cantabria.

The reproduction of the Cave of Altamira was the longest awaited element of the whole museological project, and the one which aroused more previous expectations and the one which was more extended within the media but, why naming it neocave?

The Cave of Altamira, as it has been already said, has suffered, since its last prehistoric occupation, notable and radical changes. Shortly after the last bison were painted on its ceiling a great natural collapse took place at the entrance area which left it totally sealed and inaccessible, until, through a little crack, it could be discovered in the 19th century. Some other collapses happened shortly after its discovery in 1875, and others in 1924 and in 1930. In order to avoid that they would affect the painted ceiling, several walls and pillars were built - skilfully camouflaged, the visitors do not notice them - besides, paths and stairs were created to render the cave suitable for visits. To sum up: the modern Altamira is much different to the Palaeolithic One. The project assumed a real tridimensional reproduction and we proposed "remaking" The Cave of Altamira restoring the cavern space such as we knew it was, and thanks to the archaeological and geological data, and not as it has reached the present time. This new cave -The Neocave- actually is the end of a research process whose result is at the disposal of visitors to the museum. And this has been possible thanks to the previous research and the application of the most modern topographic and carving techniques controlled by digital processes.


The construction of a new building to house the museographical premises as well as the replica, named from now on Neocave of Altamira, brought about important consequences for the Cave of Altamira both from the point of view of its conservation – since it allowed important preventive measures to be taken-, and the best scientific knowledge of the original one – inasmuch an important cartographic and photographic documentation was generated.
For this reason the National Geographic Institute of Spain made a digital model of the whole cave. The Polychromes Ceiling was recorded with a grid in an exact point every 5 mm (an irregular triangular grid of 5,600,000 points); at the entrance area 500,000 points were nearly recorded (one point every 10 cm) and, in the rest of the cave the record is practically one point every 35 cm. This allowed the automated carving of the painted ceiling – a milling machine directed by a computerised procedure – reproduced accurately the natural relief and the crack system over which the Palaeolithic artists made their work. Nothing, however, has been able to take the place of the hands of those who applied the artistic techniques to reproduce on an exact support and with the same pigments than in Prehistory this original art. The digital check elements guaranteed, in any case, the accuracy in the making of every painting and engraving.

Two are the main restitutions that the Neocave has allowed us to make in order to get closer to the Palaeolithic Cave: (1) the recovery of the great mouth of the cave and (2) the removal of the modern walls which artificially separate the everyday life activities area, along with the exterior light, the ritual area, of the magic, of the sacred... which is located in the darkness.

This Neocave enables us to understand easily that in the original some aspects of Prehistory: “cave man” did not exist, nobody lived in the darkness of a cave as rabbits live inside a warren; the leading characters of the prehistory symbolised by Altamira were physical persons and neurobiologically like us, their mental abilities and their appearance were like the ours; their quality of living was remarkable, they planned their activities having self-control, and their life expectancy was not surpassed until the end of the Middle Ages, their art was exactly that: creation, symbolic plastic; somebody who to his condition of hunter linked the position of artist, made the figures – and the rites associated with them? – which the group needed and understood; somebody aware of the surrounding natural environment and deft in the use of plastic expression techniques who played an outstanding role within his hunter-gatherer band and who bequeathed us an eternal present.

Before getting into The Neocave, a short documentary film shows us the prehistory and history of Altamira; once inside we Will witness – holography? virtual reality? - an instant in the every day live of its primitive dwellers, we will see the encampment of an Magdalenian human group; we will pass by an archaeological excavation in progress (Although, to be honest, nobody has still seen the archaeologists working over there), we will see the remains of a cavern bear which died while being in hibernation, some millennia ago and, finally: the great painted ceiling, and no only the famous bison but the animal and anthropomorphic engravings and, the signs and the printed hands, the most ancient figures of red horses...

There has been an accurate reproduction of the physics – the shape- and the chemistry- an 80% of natural limestone, ochre carbon and water pigments – and instead the alchemy, the halo about which W. Benjamin speaks, and the emotion, the Neocave offers scientific information in a synthetic, kind and pleasant manner. It is like an open book, without hardly having any word, with a rigorous content, which can be read carefully or subtly assimilated by many people. The surprise which rediscovering provokes in the visitor, the obvious quality of the reproduction and certain virtual reality museographical elements produce an stimulating and moving experience on its own when getting to know this master work of the universal Art.

The Neocave is not an isolated element, although its visit has an entity of its own, it is really another hall of the museum. The entire museum is devoted to the time of Altamira, the art, its culture, the live and the hunter-gatherer bands techniques during the Upper Palaeolithic inhabited the old Europe. The exhibition is based upon the...
best collection of original Palaeolithic objects of Spain, they are 400 exceptional pieces which finish off the museum’s collection and they come from other state museums (National Archaeological, Anthropology, Natural Science Museums, of America) or of other ownerships such as the Prehistory Museum of Cantabria, Fine Arts museum of Santander, The Archaeological Museum of Valencia and Asturias. In the exhibition there is a coherent integration of the original objects found during the archaeological excavations of the main sites, the recreated objects so as to understand their production or use, some reproduced exceptional objects, and the ancillary information which is presented in the way of short documentary films, texts, graphics, photographs, interactive databases and also cartoons – for the first time in a museum – aimed to the youngest visitors and the unprejudiced adults.

The visitors satisfaction as one of the quality parameters and their number – more than 200,000 from the 19th July until the 30th December 2001 – allow us to assess the project in a favourable manner. The replica is no substitute of the original, whose contemplation cannot be substituted in any way, is not the aim given. Pleasure and knowledge go frequently along: this is the purpose and aim for the Neocave and the Museum of Altamira.

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Bibliography


RODRÍGUEZ-FERRER, M., 1880, Apuntes de un diario, la cueva de Altamira. La Ilustración Española y Americana, n° XXXVII.


SANZ DE SAUTOULA, M., 1880, Breves apuntes sobre algunos objetos prehistóricos de la Provincia de Santander. Santander: Imprenta de Telesforo Martinez.


