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The Hidden Meaning of Forms: Methods of Recording Paleolithic Parietal Art

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There are many restrictions placed on researchers studying Paleolithic Cave art due to the constraints of conservation that limit direct contact with the original works. This paper discusses how recent advances in technology have revolutionized the study and interpretation of Paleolithic cave art. The interpretation of Paleolithic symbolic systems is a complex process and hypotheses must be applied to cave art with the greatest of precision. A detailed analysis of the painted or engraved surfaces leads to a greater understanding of both the techniques employed and the actual sequence in which parietal compositions were executed. By unlocking the creative process followed by Upper Paleolithic artists we are able to glimpse the artist's motivations and to understand a portion of the art's hidden meaning.

KEY WORDS: prehistoric art; methodology; meaning; relevés.

INTRODUCTION

The Upper Paleolithic is characterized by the first appearance in human history of artistic expression in the form of images of animals and geometric signs. In this paper we discuss both historical and current methods of recording Paleolithic cave paintings and engravings. We then offer interpretations of Paleolithic art based on a new understanding of the sequence in which figures were produced and on the overall composition of murals. We use the term art in this paper in order to avoid cumbersome phrases such as "graphic expression." In doing so, we are not implying that modern connotations of art should be applied to the prehistoric world. Whether or not cave paintings should be considered "works of art" is a

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debate beyond the scope of this paper as it leads us to question the nature and function of art in our own societies.

Paleolithic art, especially cave art, is often difficult to approach. With some notable exceptions (e.g., Lascaux and Chauvet cave sites, France), the images have suffered from natural and cultural transformation processes that affect the viewer's perception of the art. For example, figures engraved in rock with flint tools are often barely visible after thousands of years of erosion. To be deciphered they require subtle variations in lighting—often low light. This makes it difficult for a camera to perfectly record the engravings. Furthermore, photography in an underground environment is often more difficult than expected and does not always bring the anticipated results.

Problems of viewing the images *in situ* and the difficulty of reproducing them constitute further obstacles. Ever since painted caves were first discovered more than a century ago researchers have had to invent accurate techniques to record the images and to reproduce them for the public. As a result, the specialist technique known as *relevé graphique* (often abbreviated "*relevé*"[3]) was developed. The technique has continued to evolve over time, especially in the last twenty years as the need for precision has increased considerably.

While early scholars recorded an image in isolation of its context, current researchers are careful to take into account factors such as state of preservation, the underlying surface, use of the surface's natural topographic features, and techniques of painting or engraving employed, etc. Developments in recording rock art reflect the fact that apart from the formal analysis of an image researchers are interested in the spatial and thematic relationships *between* images and in the structuring principles in the cave. As a result current methods and interpretations are oriented toward understanding symbolic systems in use among Upper Paleolithic people.

A BRIEF HISTORY OF RECORDING CAVE ART

At the beginning of the 20th century, the reproduction of parietal imagery posed serious practical difficulties. The prehistorian, Henri Breuil (1877–1961), a well known specialist in Paleolithic art, recorded hundreds of sites in France and Spain between 1902 and 1950. His publications and those of his colleagues represent an important body of work that remains very useful today (e.g., Breuil, 1906, 1934, 1952) Breuil's method is well known and it provides us with a good example of the procedures that were used during the first half of the 20th century.

The first step consisted of tracing the drawings directly on the cave walls. In rare cases, such as at the site of Altamira (Spain), where the rock or the

[3]Translator's note: The French word relevé can be translated into the English word "tracing" but it was thought that this term would easily be confused with the kind of direct tracing of the cave walls that Henri Breuil undertook.

paint appeared too fragile to allow any contact, Breuil resorted to drawing from sight, calculating dimensions of the images by triangulation. Then from the notes he took while in the cave he made pastel drawings, which he published as lithographs.

However, at sites with many engravings (e.g., Les Combarelles, Les Trois Frères) he proceeded almost exclusively by direct tracing. Lighting was provided by candles, lanterns and later by acetylene gas lamps that gave off a yellow light that was often insufficient for discerning very fine engravings. The tracing paper he used was not transparent enough and its quality was greatly affected by the cave's humidity. Examples of the first materials he used include paper florists wrap flowers with and cellophane crumpled beforehand to make it more flexible. The drawing implement he used was a graphite pencil or sometimes a thick blue pencil, similar to what is still employed in masonry today.

Starting in the 1950s, tracings were made, first with indelible ink, then with felt-tipped pens, on thin, translucent sheets of polyene plastic held close to the cave wall (Plénier, 1971). In France, a significant change in methodology occurred during the 1970's when tracing was no longer done through contact with the original image but from a photograph of it (Aujoulat, 1987; GRAPP, 1993; Lorblanchet, 1995; Whitley, 2001). Freed from the medium of tracing paper or plastic sheets, with photography prehistoric markings were easier to see and therefore easier to analyze. The tradeoff, however, is the inevitable optical distortion as a three-dimensional structure (the cave wall) is transformed into a two dimensional photograph. Today, we can compensate for some of this distortion, but the issue has not yet been completely resolved.

Historically, the difficulty reproducing the undulating surface of the cave walls has led to criticism of this methodology. While some specialists believe that the analysis of cave walls through photography is indispensable, others condemn this method and argue that the images should be studied directly, and without an intermediary. This is

> "another reason why the composition of Paleolithic art is almost always ignored: unlike all other forms of visual art that we are aware of, rock art is created on a rough, irregular surface, is never (or almost never) made on a vast, flat surface[...] Once you try to reproduce these images on paper, with either a drawing or a photograph, you come up against these insoluble difficulties. Everything is stretched, twisted, distorted in every sense. We are almost always obliged to isolate one image from the group of which it forms part because it occupies a surface that is concave, convex or very irregular. Sometimes the photograph can only show a fragment of an image. Little by little we have become accustomed to thinking of Paleolithic art in fragments and we forget the whole (Laming-Emperaire, 1962)."

A. Leroi-Gourhan would have taken the same position in principle; for him, the visual examination of a figure *in situ* was sufficient. Ironically, he relied heavily on Breuil's drawings for his research, unaware of their short-comings.

CURRENT METHODS OF RECORDING CAVE ART

Over the past 30 years, the process of recording parietal art has been compared to excavation on an archaeological site. It is the process that gives meaning to the uncovered material. Just as with parts of a site that remain unexcavated, images on cave walls that are not recorded are not included in the analysis—their nature and chronology remain unknown (Lorblanchet, 1995).

Our primary objective is the study and recording of anthropogenic modifications of the cave wall while taking into account the impact of other factors related to the context of the cave wall such as surface morphology and concretions. This allows us to establish a visual hierarchy between human and natural factors.

We devise a graphic interpretation that accounts for the observed features of the art while acknowledging that this process already represents a reduction of the data. To avoid a kind of 'visual confusion,' we must collect selectively from the enormous amount of data on the cave wall. For example, information about the condition of the cave wall (calcite, cracks, etc.) should not interfere with one's perception of the art. The selection of the data, therefore, cannot be disassociated from one's research goals and from the importance that we accord them.

In addition to the above considerations, the method of relevé used in the cave is dictated by one major concern: the preservation of the cave walls and floor. The ramifications of this deontological requirement are far reaching as all forms of direct tracing are forbidden. In our opinion, only photographic methods and their computer based manipulation meet the imperatives of conservation as well as the requirements of study. We establish 5 steps in this process:

1. *Surveying the Cave Wall.* In a decorated cave, preliminary research involves the decipherment phase. Few researchers mention this fact in their publications but one has to spend many hours in front of the cave wall, repeatedly deciphering the markings to try to understand the images. The work is sometimes easier in the case of figures that have been executed with pigments but the process becomes more complicated when we are faced with engravings. In addition, in every case the state of preservation is a problem; one has to become accustomed to the nature of the site, and identify the damage done by time, or sometimes by vandalism before isolating Paleolithic markings. This first step is crucial because it is difficult to photograph or draw images we do not understand. Creating a sketch of the images allows for the memorization of these first decipherings before commencing the study that will normally complete or modify them (Fig. 1).
2. *Photographic Recording.* The second step involves photography (film and/or digital). Photographing the entire cave wall is undertaken while respecting the constraints of orthogonality and of distance (Fig. 2). Sometimes, if the context is difficult or if the engravings are very faint, we take

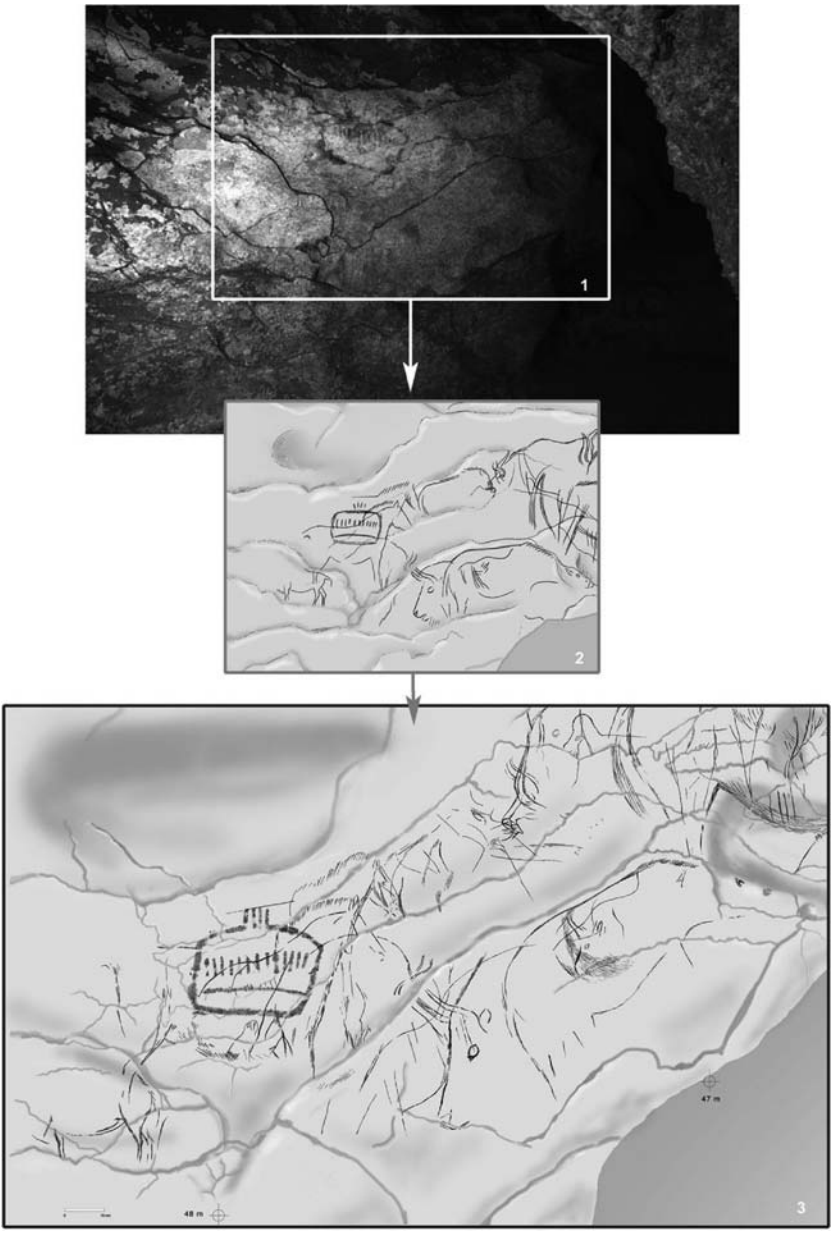

Fig. 1. In the cave of Marsoulas (Haute-Garonne, France), the engravings and paintings, eroded by time, are not very visible (1). The study starts with a thorough examination of the walls; once located, figures are noted in a sketch (2) before being recorded in the relevé which makes it possible to supplement or correct the first readings (3). (C.F.-G.T.).

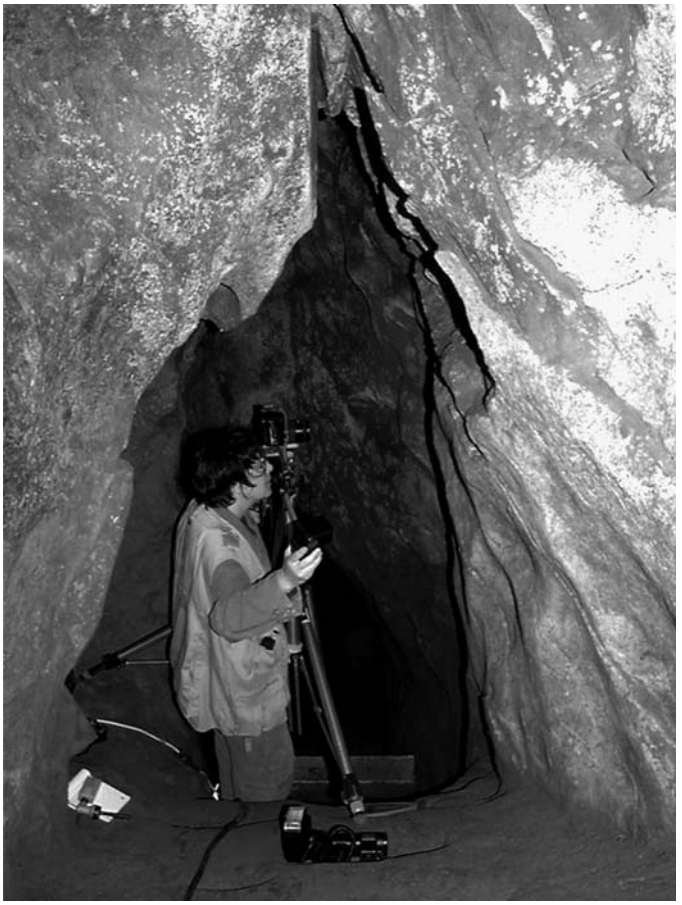

Fig. 2. The photographic mosaic constitutes the basis of Paleolithic parietal art relevés. This photograph illustrates how narrow some parts of a cave. For this reason photos are often taken at close range and then pieced together to reproduce the entire panel. (G.T.).

a number of photographs of the cave wall and piece them together like a mosaic (6 × 6 film format). Currently, we use medium-sized film plates which produce high definition images. However, continual technological advances virtually assure that digital imaging will be more widely used in the future.

Photography also includes the use of emulsions sensitive to infrared (IR) and ultraviolet (UV) rays. Depending on the walls, and more specifically their state of preservation, the results obtained using these methods

can range from spectacular to disappointing. Surfaces that are covered with calcite, clay or that are lightly damaged are generally impervious to these types of rays. At the site of Marsoulas (France), tests of IR were conducted on two panels with red and black paint in various states of preservation. It was found that the images were no more visible than when photographed with normal light. In this case, the poor legibility of the painted images may have been due to the presence of bacteria on the wall as a consequence of the degradation of the rock's surface (mondmilch). Conversely, these emulsions have produced spectacular results in many decorated caves, a notable example being the site of Niaux (France) where the faded traces of a bison seemed to "reappear" in the UV photographs (Fig. 3).

3. *Assembling the Photos.* If a researcher has to record a surface of considerable dimension (or if the engravings are very fine), he/she can create a mosaic of photos from several digitized plates. Again, computer technology offers a large selection of software and tools with which to work on such images. If necessary, the photographs are enhanced in order to increase their visibility or contrast (Fig. 4). For at least a dozen years, researchers have recognized and appreciated the contributions of these techniques to the recording of cave art (David *et al*., 2001).

   Once the mosaic of photographs is considered satisfactory, it is checked against the images in the cave in terms of the dimensions of the original figures, legibility, possible distortions, etc. The scale of the relevé is determined in relation to the dimensions of the original drawings. Indeed, the monumental dimensions of certain figures and panels necessitate working at a reduced scale. This choice has consequences for the precision of the resulting data. Moreover, it is often not physically possible to manipulate large composite photographs while standing in front of the cave wall.
4. *Recording Data in the Cave.* The next stage brings us back into the cave, where we proceed to trace the data from the photographs onto transparent paper; this work takes place facing the original art and constitutes the phase of data analysis and recording. This is the most important step—the graphic transcription of the results of the analysis.
5. *Recopying the Relevés.* The final step involves cleaning up the relevés, which are scanned before being digitally manipulated. A chart of graphic conventions is developed and employed in order to standardize the visual presentation of the relevés. This step leads to a further reduction of the data as a result of constraints imposed by publication (resolution, file size, etc.). Indeed, the major challenge of rock art (not just of the Paleolithic period) is its often monumental size, which is incompatible with standard paper formats (DIN A4 or A3).

   Computer programs also allow us to make virtual repairs to the damage caused by nature or thoughtless vandalism. At Marsoulas, for

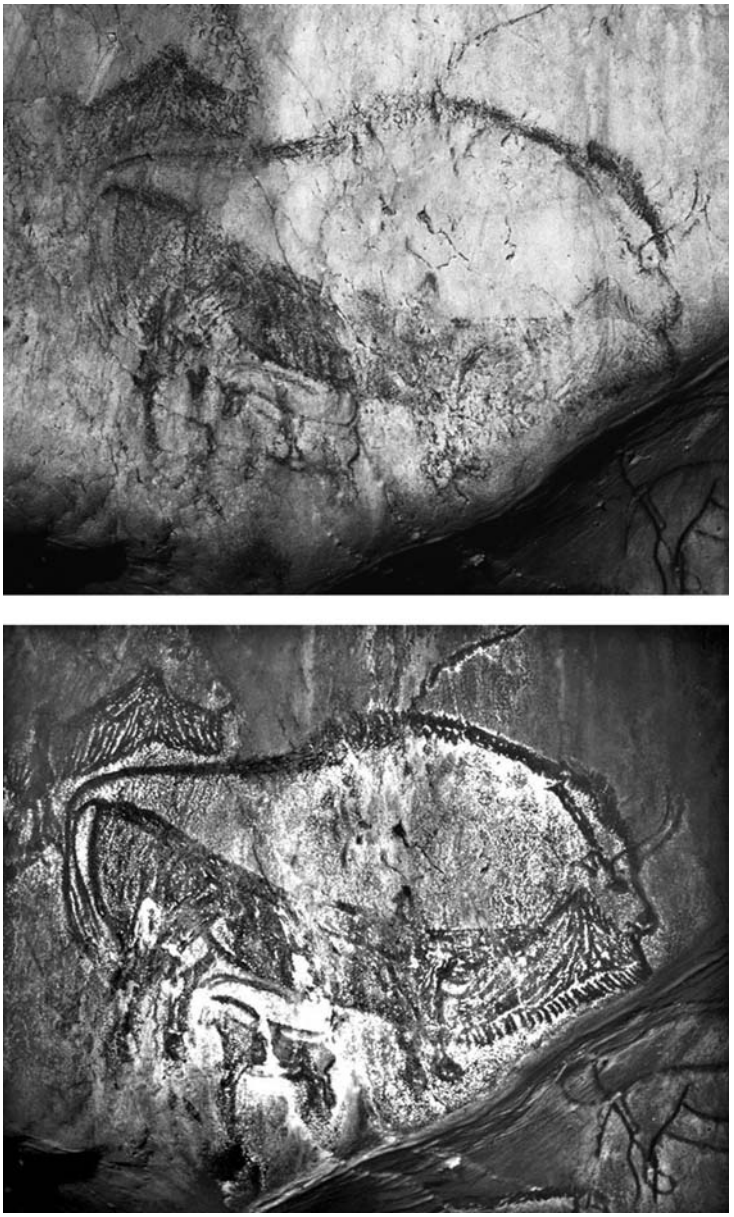

Fig. 3. Niaux cave (Ariège, France). Plates taken in normal light (*top*) and with UV photography (*bottom*) of the same painted bison from the Salon Noire. Damaged by water running along the rock in 1978, the animal is not easily visible today; in UV light, many details are once again perceptible because traces of manganese, preserved on the cave wall absorb the UV rays while the calcite coating reflects them (SESTA).

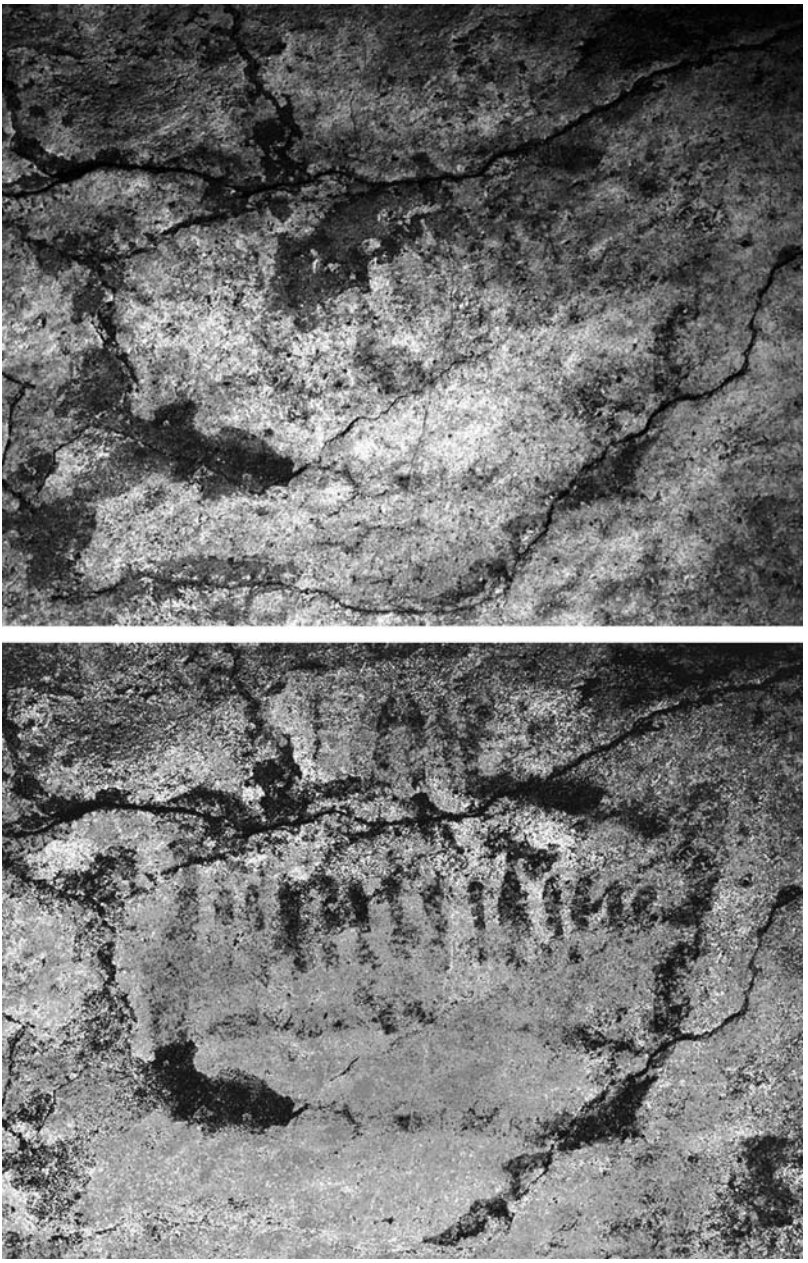

Fig. 4. Above: quadrilateral sign painted in red in the cave of Marsoulas. Below: the same plate after the use of image enhancing computer software. Varying certain parameters, one can make the contours of the sign significantly more visible (C.F-G.T.).

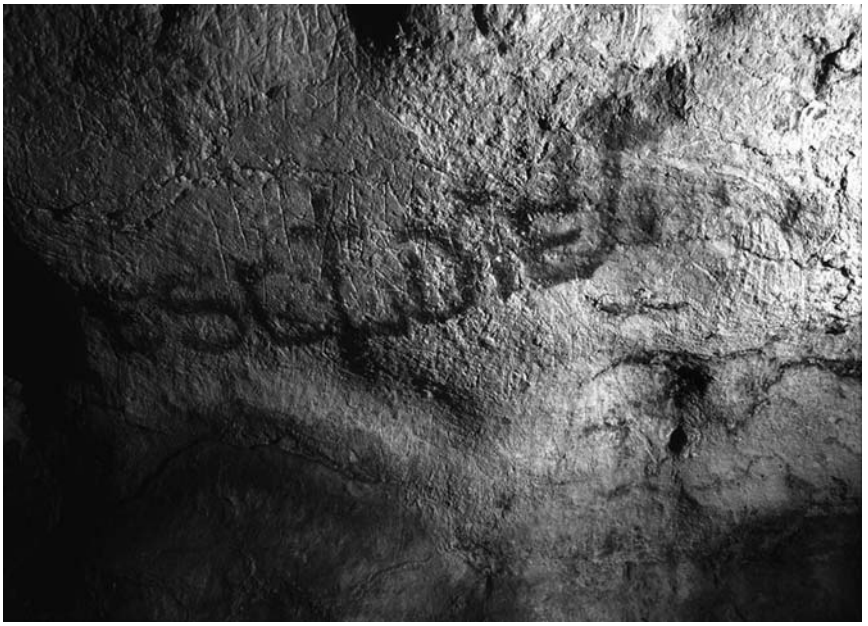

Fig. 5. Cave of Marsoulas (Haute-Garonne, France). Panel of Paleolithic engravings, mostly destroyed by graffiti (approximate length is 2 m) (C.F.).

example, we were able to isolate different episodes of graffiti that were incised or traced in lampblack, and by progressively 'fading them out' on the screen, separate them from the Paleolithic markings. In this way, the contours and the details of a large incised bison gradually became discernible. On the relevé (known as "selective recording") the bison is more readily discernible than in the cave. In the cave, the perception of the figure is obstructed by modern inscriptions that are visually more salient than the Magdalenian engravings (Figs. 5–7).

THREE DIMENSIONAL RECORDING OF CAVE ART

As in many areas of scientific imaging, 3D technology has, for the most part, been integrated into the study of prehistoric art—offering new perspectives on the relevés, and responding to the main criticisms concerning the "flattening" of parietal art. As at a number of rock art sites of all periods, a 3D program has been in place at Marsoulas since 2003. We are working closely with a surveying company to test the potential of this technology.

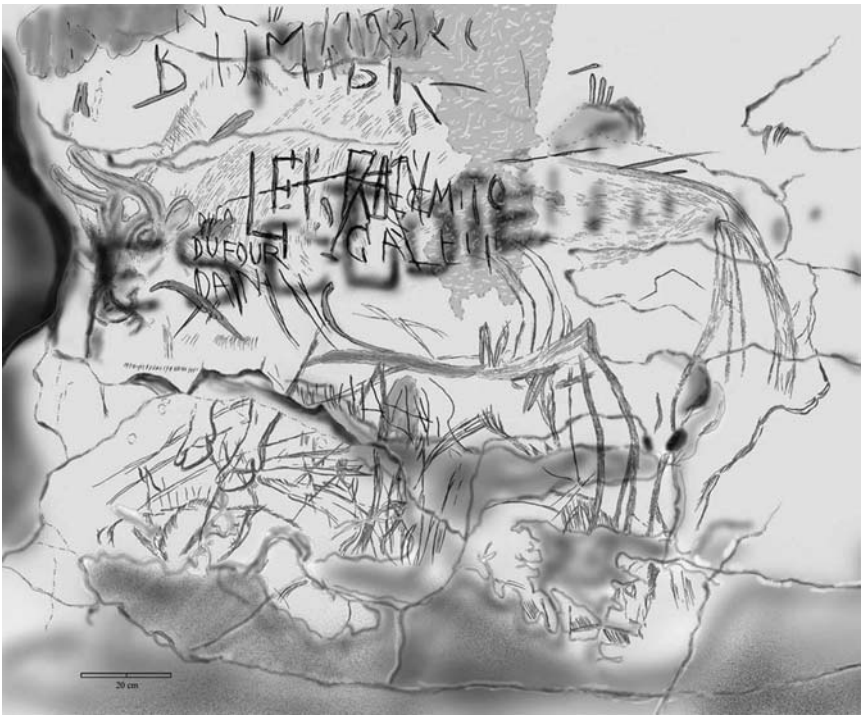

Fig. 6. Marsoulas. Relevé of the markings (modern and prehistoric) of the panel shown in Fig. 5 (G.T.-C.F.).

Using a 3D scanner, decorated cave walls can be precisely recorded to within a millimeter. Presently, recording engraved lines finer than the dimension of the laser beam projected at the cave wall (<1 m) is not possible. It will likely be several years before this limitation is overcome, and before it is possible to directly record images in 3D without using photographs as an intermediary. 3D digitization is conducted following a protocol that resituates data acquisition according to the topography of the cave. Each cloud of data points is precisely located in three dimensional space in relation to an established datum or zero point.

This precise recording of the wall's surface allows for mapping (also known as "matching") the (ortho)photographs with a precision that is far superior to the "mosaic" technique described above. The positive contribution of this first phase of research should not be underestimated. In narrow parts of a cave it is often impossible to move back far enough to record an entire image or panel. In these cases it is now possible to develop a three dimensional mesh and then "match" highly deformed digital photographs seamlessly (the deformation is corrected in

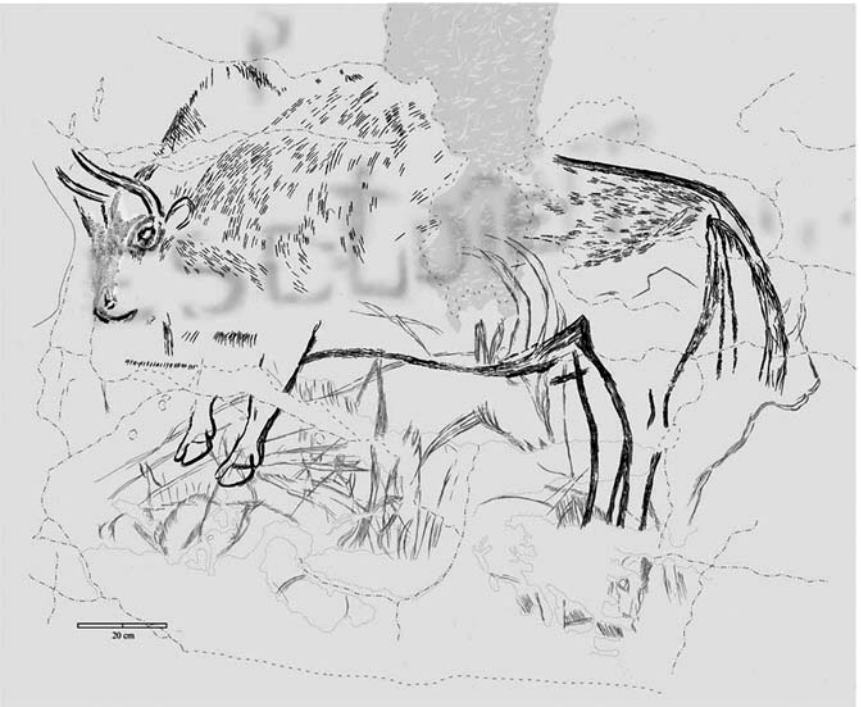

Fig. 7. Marsoulas. Panel of engravings shown in Figs. 5 and 6. Through the use of computer software modern graffiti and other damage are eliminated and features belonging to the bison are selected (length 1.70 m) (G.T.-C.F.).

a subsequent step). This process forms the basis of future relevés of the cave's walls, while solving earlier technical problems.

The next step consists of mapping the relevé itself which was constructed following traditional techniques (Fig. 8). This work poses several problems. Essentially, one "maps" the graphic relevé on a digital screen; it is thus necessary to create an artificial digital framework for the relevés. This process, which we believe we are the first to test, makes it possible to visualize the art and the wall in a way that is at once precise, informative and aesthetic. It proves particularly useful for fine engravings that are almost invisible on plates of the images.

From the point of view of conservation, 3D recording of cave walls provides a high-quality, long-term solution to archival problems. For example, the 8 m long Large Painted Panel from Marsoulas is steadily deteriorating, and while its future is uncertain, we now have a precise digital model (± 2 mm) of it that is continually modified in light of new data. Perhaps one day a "virtual" replica of the cave may be constructed to allow future generations to contemplate this masterpiece.

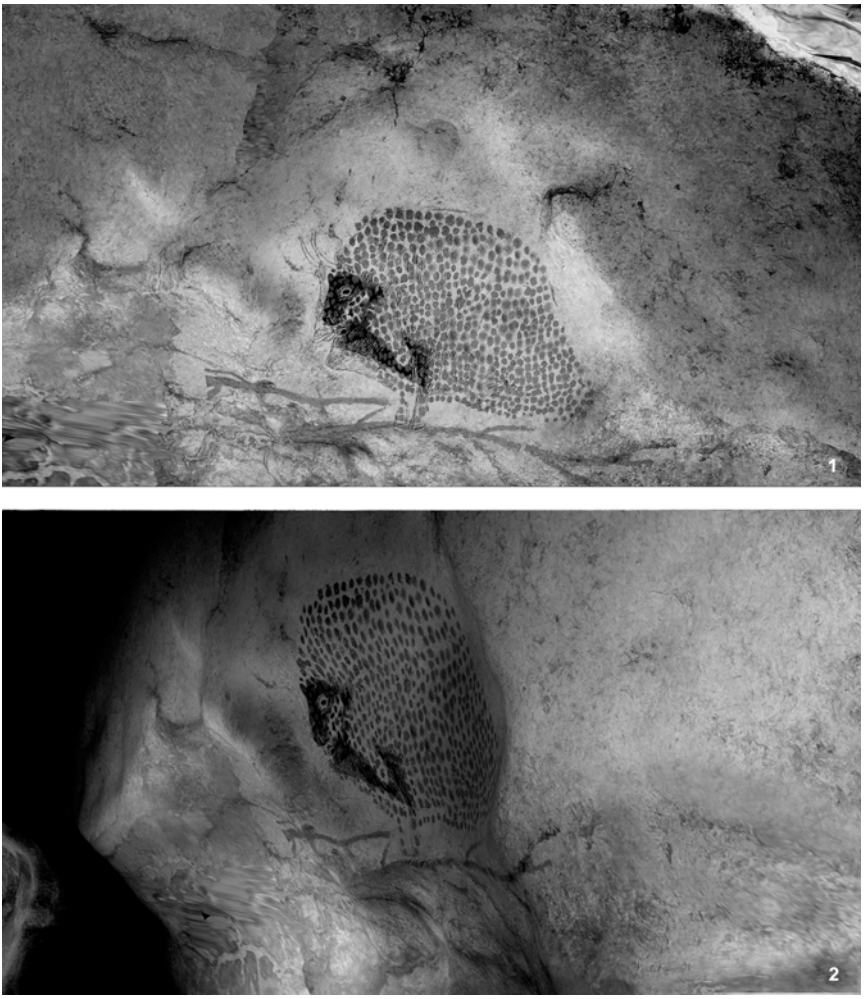

Fig. 8. Marsoulas. Contributions of 3D technology to the relevé of parietal art; example of a engraved bison covered with red dots (length 1.05 m). 1: the relevé of the bison is replaced on the digital 3D model of the cave: unlike a simple photograph, all the details are then visible. 2: an oblique view makes it possible to easily reconstruct the complexity of the rock's surface and the framing of the bison in a niche of the wall (relevé G.T.-C.F.; images Preterit productions).

The digital models also make it possible to work "in the lab" while on site. The relevés will continue to be made on site but with the aid of 3D reconstructions, we will be able to work out simulations of lighting and circulation, etc. Crucial questions at Marsoulas, such as the degree to which the cave walls were covered by sediment when the cave was first discovered or the initial state of the archaeological

surfaces (floors), will be approached with a new eye, for example, by reconstructing the various archaeological levels uncovered by excavators at the beginning of the century (according to bibliographic data and old photographs). By observing the relationship between episodes of decoration in the cave and excavated cultural levels, one will likely be able to propose various interpretations and to test the hypotheses through computer modeling. Lastly, it is certain that 3D technology can facilitate the implementation of a Geographic Information System (GIS) at the site of Marsoulas. This new tool will enable us to centralize all the data on the cave, to organize them hierarchically and to facilitate the cross-referencing of data.

USING RELEVÉS TO UNDERSTAND THE ARTIST'S INTENT

The methodological stages described above result in the creation of a document which reproduces the abstract or figurative representations and the various traces (human or animal) observed on the rock. The relevé is thus a digest of information; it also embodies a personal analysis of the wall.

Often complex and abundant, information may be developed over several documents, which relate to various aspects of the creation of the drawings. It becomes essential to hierarchically arrange levels of analysis and interpretation. We make a distinction between what we refer to as a "reading" ("*lecture*") relevé and what we call a "technical" ("*technique*") relevé and these detail all the phases of the design of the drawings. Generally, the relevés are a source of information which, in turn, lead to more questions.

FROM THE INDIVIDUAL STROKE TO THE RESULTING FIGURE

When we begin to decipher engraved or painted walls, we are first drawn to the most basic visual element: the individual stroke. Successions of strokes comprise lines, which in their turn generate form and contour and organize graphic elements to create the figure and to detach it from the background (Guillaume, 1979). The stroke is thus the guiding principle of formal contour and for this reason, it intrinsically carries useful information that is necessary to understand and interpret. In this section, drawing on well known examples from Chauvet, through the analysis of individual strokes we examine the artistic process at the level of both the image and the mural.

The precise examination of each line is undertaken by locating where the mark of a tool (e.g., flint, pigment "crayon," brush, finger) begins and ends on the surface of the cave wall. This indicates the direction of the execution of the layout, and thus the movements of the artist's hand. If one combines these observations

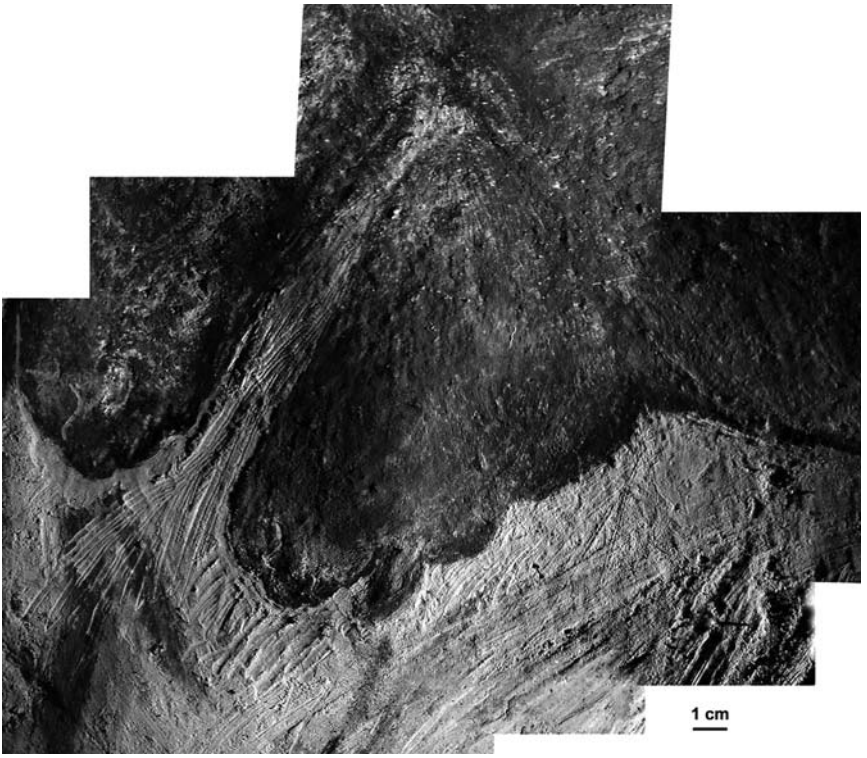

Fig. 9. Chauvet Cave (Ardèche, France). Assembly of macrophotographs of a horse's head drawn with charcoal and engraved (plate C. F.). The superposition of the fine engravings on stumping (smudging or blending of marks made with charcoal) shows that engravings were made after the charcoal drawing.

with overlays of a relevé of the images, one can identify whole sequences of the artist's movements or gestures (Figs. 9 and 10). The reconstruction of these dynamics is based on an examination of the final movements of the tool. On the basis of technical marks (accidental skidding, corrections, or, conversely, confident strokes), one arrives at a certain qualitative appreciation of the work. These gestural reconstructions are studied within the context of research into the methods of execution.

Indeed, contours of an animal figure can be divided into graphic elements (the head [forehead, muzzle, mandible], horns or antlers, chest, limbs, etc.) whose order of execution is not random. Without going into the details of an analysis of the layout, breaking down the graphic elements into chronological sequences (based on an examination of the superpositions of tool marks) reveals consistencies in gestures which tell us about the cognitive processes underlying the construction of form (Fritz, 1999).

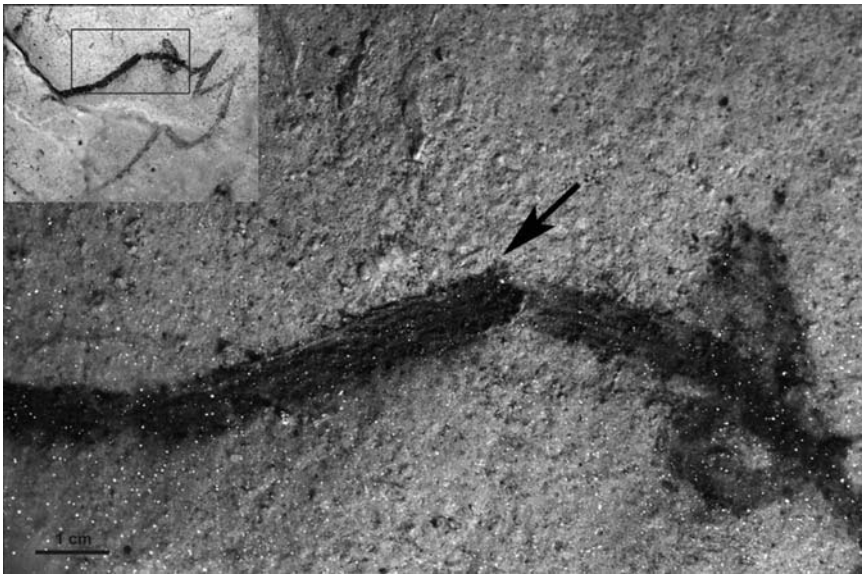

Fig. 10. Chauvet Cave (Ardèche, France). Macrophotography of the dorsal line of a rhinoceros painted in red, undoubtedly using a brush as indicated by fine striations that are parallel with the edges of the feature (plate C.F.). The thick pigment in the center of the plate (*arrow*) indicates the direction of execution, from the right side towards the left.

Research into cognitive processes leads one to question the significant gestural consistencies in the development of geometric or figurative drawings within a culture group (D'errico, 1994; Renfrew, 1994; Van Der Leeuw, 1994). Does the existence of consistent approaches to creating the art help us identify a specific culture group or are they indicative of universals of thought common to all *Homo sapiens sapiens*? If cultural, this recurrence suggests a particular social organization within the groups. How were traditions of rendering forms transmitted? How did they maintain their signifying role within Upper Paleolithic societies (Fortea Perez et al., 2004)?

Our studies of Magdalenian mobiliary (portable) art revealed that production schemes were stable during the Magdalenian but changed notably during the Azilien (12,000 BP–10,000 BP) (Fritz, 1999; Tosello, 2003). On the basis of these observations, it is tempting to extend this type of investigation to parietal art. Can one find identical mental constructs on surfaces as different as bone fragments and rock? Does the perception of form vary according to the space available and the surface used? These questions guide our methodological and theoretical processes.

In Chauvet cave (Vallon-Pont-d'Arc, France), the excellent state of preservation of the walls, especially the Panel of the Horses, inspired us to begin to research how figures are developed (Clottes, 2001; Geneste, 2005). At this site, artists executed the images through a combination of charcoal drawing (modified

using their fingers to blur or smudge the lines) and fine engraving. The latter was sometimes reserved for expressive details such as horns or mouths.

Our study at Chauvet began with two rhinoceroses that are facing each other at the base of the Panel of the Horses (Fig. 11). A comparison of these two figures is all the more interesting as they form a scene illustrating ethologic behavior. Indeed, the two animals seem locked in combat, demonstrating aggressive behavior characteristics of male rhinoceroses during the rutting season. It should be noted that narrative representations are very rare in Paleolithic art.

With the rhinoceros on the left (Fig. 12), the artist first draws the horns on the forehead and snout, then the muzzle and chest (phases 1–2). The mandible is drawn later but it is impossible to indicate its place in the sequence more precisely. The forelimbs are drawn after the chest following a sequence from left to right. The left forelimb is the result of complex gestural sequences. It takes several attempts to draw the contour and then the final rounding of the limb. The right forelimb is the result of 4 or 5 strokes producing a relatively simple contour (phase 3). The line of the belly, the result of multiple strokes, completes the animal. This line is finished by two short strokes: the first stroke marks the fold of the groin and the second stroke outlines the start of the hind limb (phase 4). The curving cervical-dorsal line is drawn with one stroke from right to left with a controlled gesture—a firm and effective action. Next, the rear limb as well as the tail are put into place (phases 5–6). With the contour of the animal represented, the artist turns to the internal features (contour of the interior features that are visually less salient): ears; eye, nostril and the line along the stomach (phases 7–8).

The rhinoceros on the right exhibits more complex gestural sequences primarily due to the number of corrections expressed by the artist (Fig. 13). As with the rhinoceros on the left, the nasal and frontal horns are drawn first but with a significant correction made to the nasal horn (phase 1). The initial rectangular shape of the horn is transformed into a curved appendage approaching anatomical reality. With the horns in place, the artist draws the mouth and a first phase of the mandible/chest with a certain hesitation. The chest is redrawn with a firm, broad stroke then a second version of the mandible is drawn slightly higher than the first. The artist then erases the original line of the mandible and using his or her fingers modifies the contour of the redrawn mandible (phase 2) (Fig. 14).

Now the forelimbs are drawn starting with the right side: first the outlines then a rounding of the extremities. The forelimbs are the result of ten individual gestures. The left forelimb was simpler and was carried out in three phases: shoulder and left exterior line, then right stroke and finally filling in (phase 3). On this forelimb rests the line of belly that is constructed of three strokes, interpretable as a correction in the absence of a better explanation; in fact, the order of these strokes shows an evolution from top to bottom, as if the artist had sought to accentuate the deformation that characterizes the belly of the animal rather than to correct it (phase 4).

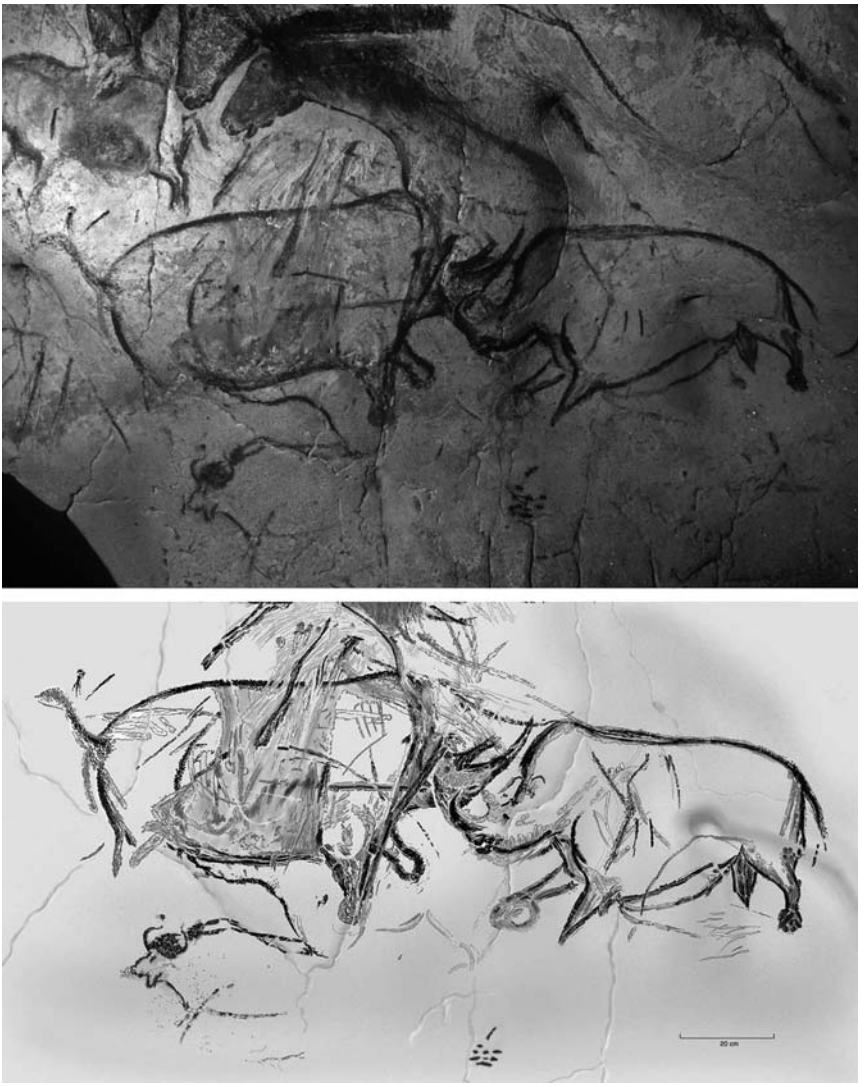

Fig. 11. Chauvet Cave (Ardèche, France), The Panel of the Horses. Rhinoceroses facing each other (CF-GT). *Top*: Rhinoceroses as they appear in the cave. *Bottom*: Cleaned up relevé.

The hind limbs are drawn next. The artist starts with the left leg that ends with a rounded foot and then draws the right leg that has a pointed foot. They are the result of multiple strokes. First the contour is drawn and then using short strokes the artist filled in the contours (phase 5).

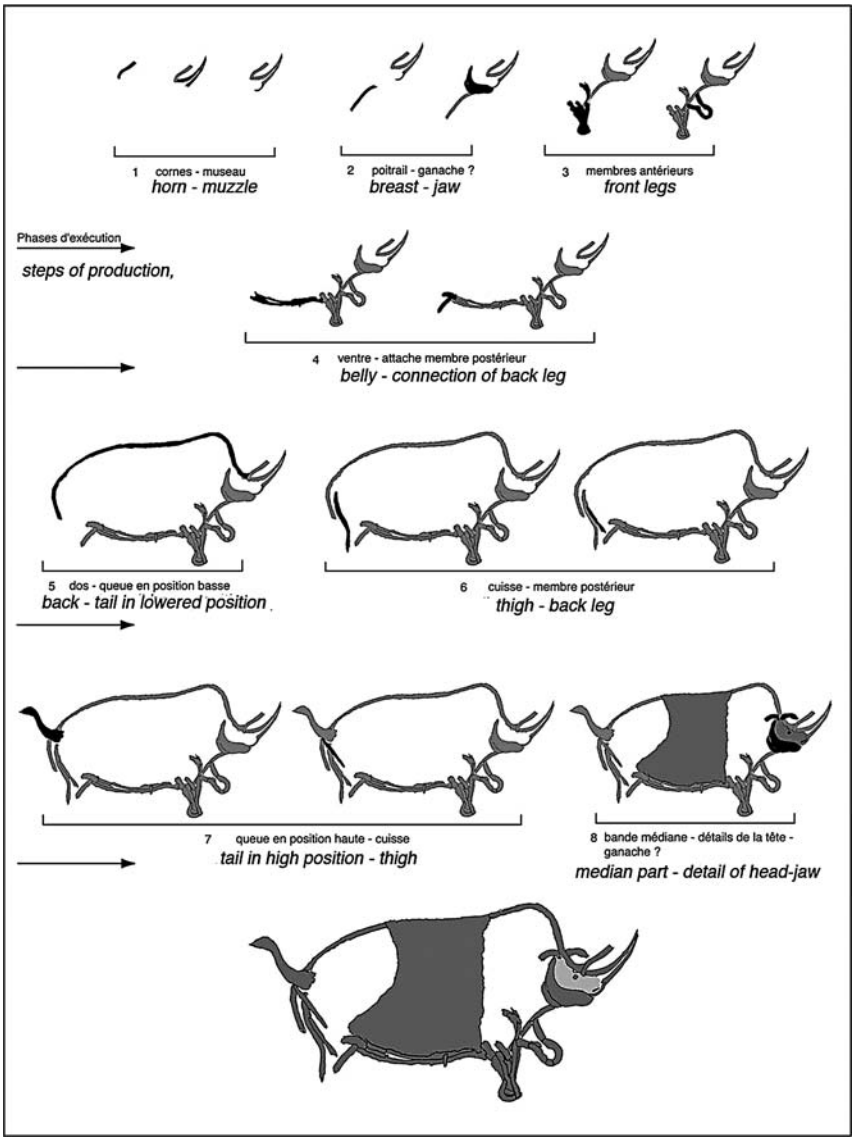

Fig. 12. Chauvet Cave (Ardèche, France), The Panel of the Horses. Diagram of formal construction of the rhinoceros on the left (CF-GT).

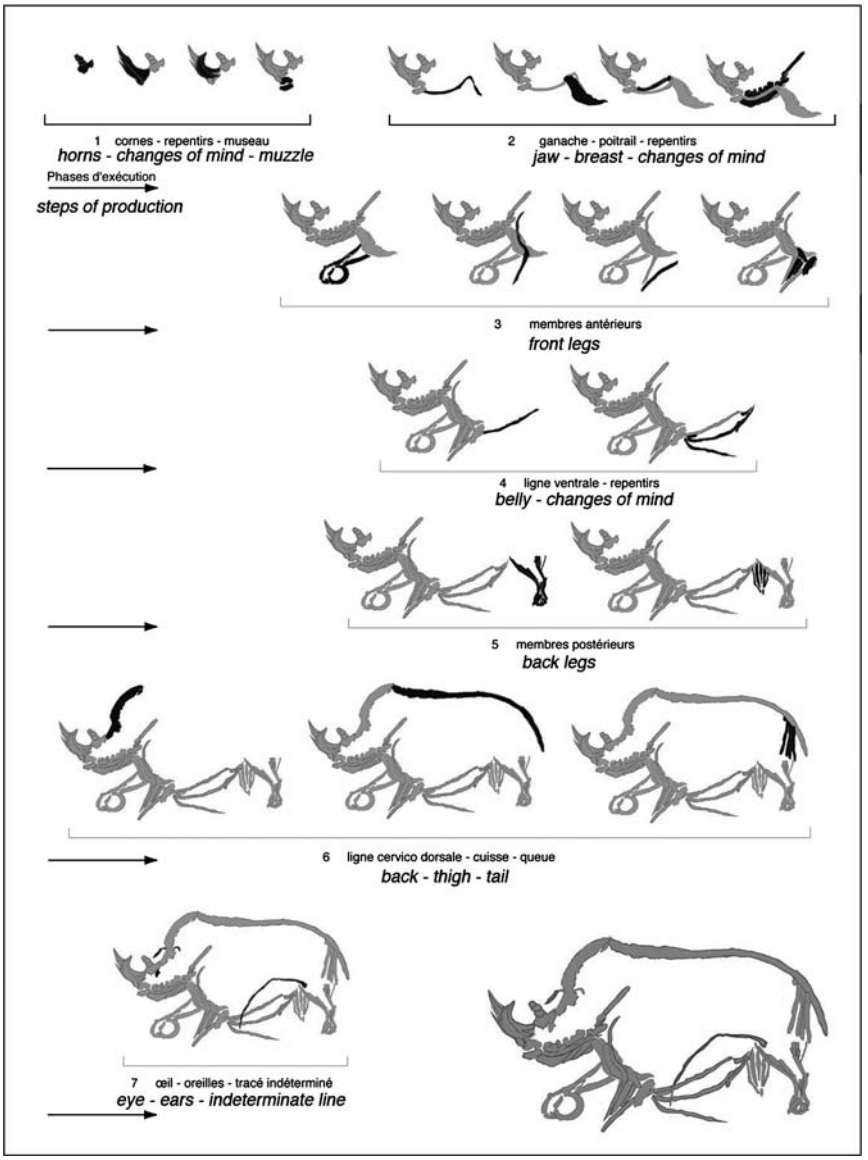

Fig. 13. Chauvet Cave (Ardèche, France), Panel of the Horses. Diagram of formal construction of the rhinoceros on the right (CF-GT).

Fig. 14. Chauvet Cave (Ardèche, France), The Panel of the Horses. The rhinoceros on the right side shows corrections to the horn (1–2) and the lower part of the head and the chest; in that case, the initial line, partially erased by the artist, remains visible (3) (CF-GT).

The cervical-dorsal line is executed in two successive movements: rise of the nape of the neck then the dorsal line, the stroke is broken at the top of the nape of the neck. On the animal's rump, the artist joins the lower part of the dorsal line with the rear limb creating a contour of both the thigh and a tail which were hitherto non-existent (phase 6).

The broad outline of the animal now in place, the artist indicates the internal attributes: ears, the eye and a curvilinear line on the belly which remains enigmatic (phase 7).

The two rhinoceroses of the Panel of the Horses are the result of very similar sequences. This result is hardly surprising (it is even rather reassuring) insofar as the two actors of this scene are undoubtedly drawn by the same hand. We described a production scheme that starts with the head, specifically the horns, anatomical elements that are characteristic of the animal. In the execution, one also observes a separation between the upper portions of the body (cervical-dorsal) and lower one ones (belly/limbs).

The right rhinoceros shows a large number of corrections. This phenomenon should be seen in relation to the morphology of the rock's surface. In this area, close to the ground, the wall has a concavity which inhibited the artist and one encounters the same problem today when photographing this panel. The line corrections are essentially to correct the proportions (nasal horn, mandible); then

there is the case of the line of the belly which is difficult to interpret, unless we imagine that the author changed his/her angle of view and then tried to correct the effects of anamorphosis, before giving up.

These examples demonstrate the value of a detailed analysis which allows us to study various facets of the artist's behavior, e.g., his/her gestures, perception of space within which to create images, the angles from which he or she was working, the induced difficulties, the solutions discovered, etc.

The sequence of these two drawings of Aurignacian rhinoceroses is identical to those encountered on engravings of Magdalenian portable art (see Fritz, 1999 for a detailed discussion). These preliminary results suggest there has been no significant modification in drawing throughout the Upper Paleolithic in nearly thirty thousand years; such a stability suggests that these diagrams are best explained as universals of thought common to all *Homo sapiens* rather than specific attributes of a particular group or culture. But if this is the case, why does one observe a radical change at the end of Magdalenian, around 10,000 BP? It is essential to continue our analyses before reaching a conclusion about this point. The principal obstacle is the scarcity of figurative drawings dating to the Epipaleolithic and Mesolithic periods.

FROM THE FIGURE TO THE INTERPRETATION

Over the past century, there have been many hypotheses to explain Paleolithic art. One of the most important approaches drew heavily on structuralism. Right from the start, this approach derived from linguistics (de Saussure, 2001) describes a system in which each element is definable only by the relations of equivalence or opposition that it maintains with the others. The totality of these relations form the structuring principles in the cave. Thus we seek to explain a phenomenon starting from the place which it occupies within a system following immutable laws of association and dissociation.

> "If the activity of the mind consists in imposing structure on contents, and if these structures are basically the same ones for all minds, ancient and modern, primitive and civilized, like the study of the role of symbols, it is necessary and it is sufficient to reach the unconscious structure, underlying each institution and each custom, to obtain a principle of interpretation that is valid for other institutions and other customs" (Levi-Strauss, 1949, 1979).

While the application of structuralism to the study of Paleolithic art has been the subject of severe and sometimes justified criticisms (Lorblanchet, 1995), we believe it remains a powerful analytical tool. Indeed, for the majority of researchers (including detractors), any study of decorated caves involves a number of fundamental stages: to observe the distribution of the figures and the signs in the underground space, their location relative to each other, their visibility, and to try to reveal associations between species, and to define thematic relationships.

These stages of research appear to be completely compatible with a structuralist approach.

It is based on these principles that several theories and interpretations of Paleolithic image systems were proposed (Laming-Emperaire, 1962; Leroi-Gourhan, 1958, 1966, 1971; Raphaël, 1945, 1986; Sauvet, 1995; Sauvet and Wlodarczyk, 2000–2001). Paleolithic drawings can be regarded as the equivalent of "linguistic signs," in association with other signs and following precise rules. The mind associates the signifier (figurative or abstract image) and the signified (concept). It is therefore necessary to identify assemblages of images, to analyze them, and to index them in order to distinguish possible patterns that are likely to be carrying meaning (even if, as we suspect, *specific* prehistoric meanings will remain inaccessible).

Consequently, the next phase of study relates to the connections between the images that form part of a composition on a panel. The figures are organized on the wall in relation to the wall's natural limits and characteristics. Those are imposed but are often used by the artist, and perfectly integrated into the composition. A area from the Panel of the Horses from Chauvet will once more serve to illustrate our point (Tosello and Fritz, 2005). Well defined in a recess of the wall, the left panel of the 'Alcove of the Lions' (Fig. 15) extends 2.50 m along the wall and 2 m high with 13 animals drawn in black, enhanced with engravings and stump work (smudging or blending marks made with charcoal). The panel is easily divided into two subsets, one dominated by an aurochs and the other by two lions that are facing each other.

The chronology of the first part can be reconstructed. The oldest animal is the megaceros (Irish Elk). It is crosscut by the lion; two horses obliterate this lion and finally, an aurochs finishes this sequence of large figures that are at eye level. In the lower part of the panel, the head of a feline that is off to the side cannot be inserted into this chronology. A small mammoth cuts across the tail of a large lion that is part of the composition on the right half of this wall; thus the lion underlies the mammoth. An uncertainty remains as to the succession between the lion and the horse because their zone is masked by an opaque calcite crust. However, it seems that the lines forming the legs of the lion are interrupted by the horse's mane meaning that the horse is superimposed on the feline.

On this panel, the superpositions of figures are not random. The anterior edge of the aurochs' thigh follows the contour of the lion's mandible; similarly, a horse's head is placed top to bottom with the lion. In the process of creating this palimpsest, the contours of the underlying figures are modified to increase their visibility, without destroying them irrevocably (e.g., back and legs of the megaceros, back of the lion) (Fig. 16). When in one's mind one tries to isolate a particular figure by following its contour, one inevitably slides towards another. The aurochs "leads" to the lion which is situated within the megaceros and the horse; the horse then brings us back towards aurochs, etc. An organic link seems to unite these four animals.

Fig. 15. Chauvet Cave (Ardèche, France), Alcove of the Lions. Overall picture of the panel of the left wall (length approximately 2.50 m) (CF-GT).

In contrast to the preceding tangle of figures, the right portion of this panel of the 'Alcove of the Lions' presents figures that are immediately distinguishable However, taking into account their location and awkwardness of the space their correct perception, (i.e. a perception free of optical deformations) depends on the relevé (Fig. 17). The chronology of this subset of lions can be partially reconstructed. The first animals set up are the four horses, on both sides of a vertical crack, with one horse facing the other three. The last of the three is a stallion. In a second phase, the felines were created, first the lioness then the lion.

This succession corresponds well with what we observe on the wall—first, the superposition of the lion's belly on the face of the mare, then the interruption of the contour of the lion to leave room for the horses. However, two reversed superpositions disturb this sequence; the shoulder of the large lion (supposedly the last figure) was drawn *before* the rump of the stallion and the tail of the lion is cut into by the chest of the horse and the mammoth. This last superposition makes it possible to connect the two subsets of the left wall of the Alcove.

These details show us that this is indeed a composition in the artistic sense of the term. Gradually incorporating the various animals into the design, the artist

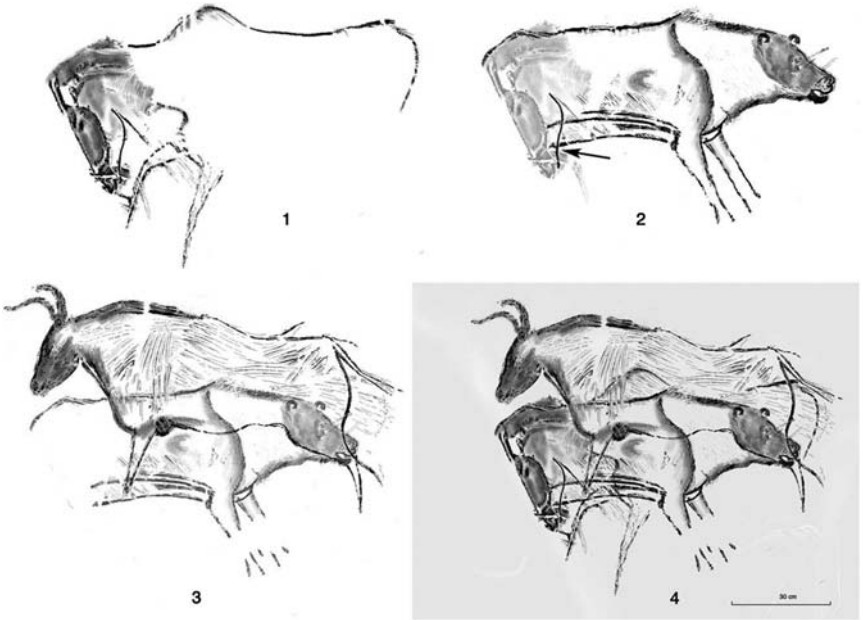

Fig. 16. Chauvet Cave (Ardèche, France), Alcove of the Lions. On the first part of the panel, the animals were superimposed with a desire to preserve certain contours, thus creating a bond between the figures (CF-GT). Numbers 1–4 indicate the sequence in which the images were executed.

according to his/her preferences plans the intersection of images to enhance or reinforce the legibility of each of the subjects. If one assembles the data collected on the two subsets of the left wall of the 'Alcove of the Lions,' one can propose a general chronology of the composition (Fig. 18). For the most part, the great figures were drawn starting in the entry of the cave progressing towards the bottom of the Alcove (megaceros, lion, horses and couple of lions). One exception is perhaps the aurochs which could have been added in at the end; it is difficult to prove but its close connection with the subjacent animals of the left half suggests that this bovine belongs to this initial phase of the decoration.

The chronology enables us to reconstruct the kinematics of the artist as he or she penetrated an increasingly cramped space. Indeed, at the level of the heads of lions at the bottom of the panel, the distance between the two walls is no more than 70 cm: this space constraint leads to a narrow face-to-face discussion between the work of art and its creator. This intimacy is noticeable in the very careful rendering of head of the large lion (Fig. 19), through the use of small, light strokes. Here we see the bond between the underground topography and graphic expression.

We have just seen that different groupings of figures reveal a diversity of behavior: a deceptive tangle of animals or planned superpositions, these

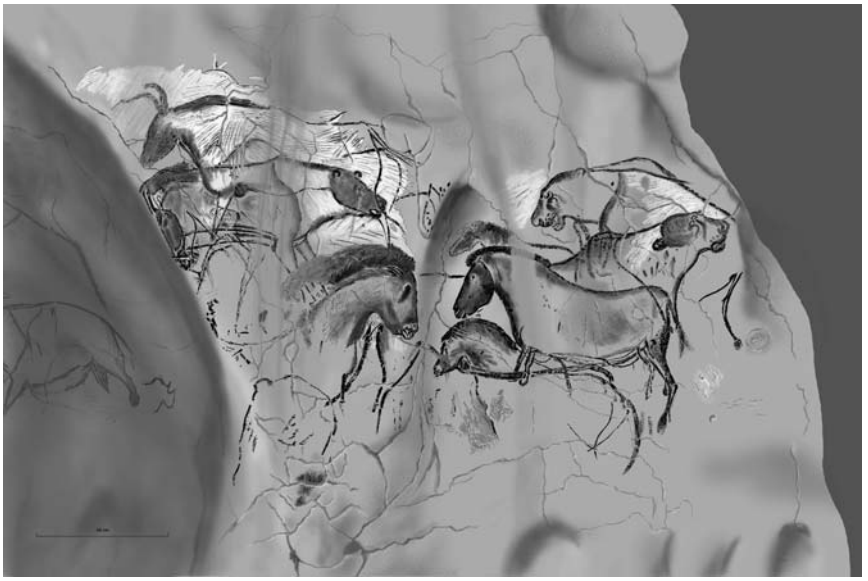

Fig. 17. Chauvet Cave (Ardèche, France), Alcove of the Lions. Relevé of the entire panel of the left wall (CF-GT).

differences can be considered in relation to the meaning of the representations. A final illustration chosen in the immediate vicinity of the preceding example will allow us to explore this important point.

The Panel of the Horses, from which we already described in detail the face-to-face rhinoceroses, is one of most famous panels of Chauvet cave. On this panel are 19 figures belonging to 6 species but 9 figures (4 horses, 3 aurochs and 2 rhinoceroses) clearly dominate the unit which extends approximately 6 m^2. In spite of the immediate legibility of the figures and their expressive force, the graphic analysis was particularly difficult because the events which took place throughout its phase of creation are very complex.

One could propose a diagram of the general structure of the panel which is centered on a diagonal, marked by an alignment of the muzzles of the horses. This group, which is the most spectacular, was executed last, after the rhinoceroses that are facing each other and the aurochs (Fig. 20); the bovines are closely related to the horses and they continue this movement towards the left. If the horses were the last figures executed, then it is as if space was reserved for them in the overall design of the composition. Some earlier animals, in our opinion very few, were erased (e.g., a mammoth and a cervide). One thus observes a development of the decoration starting from the margins towards the center of the panel, culminating in the most expressive horse. Moreover, the movement of the heads, the harmonious curve of the necks, inevitably directs/draws the viewer's gaze towards this horse.

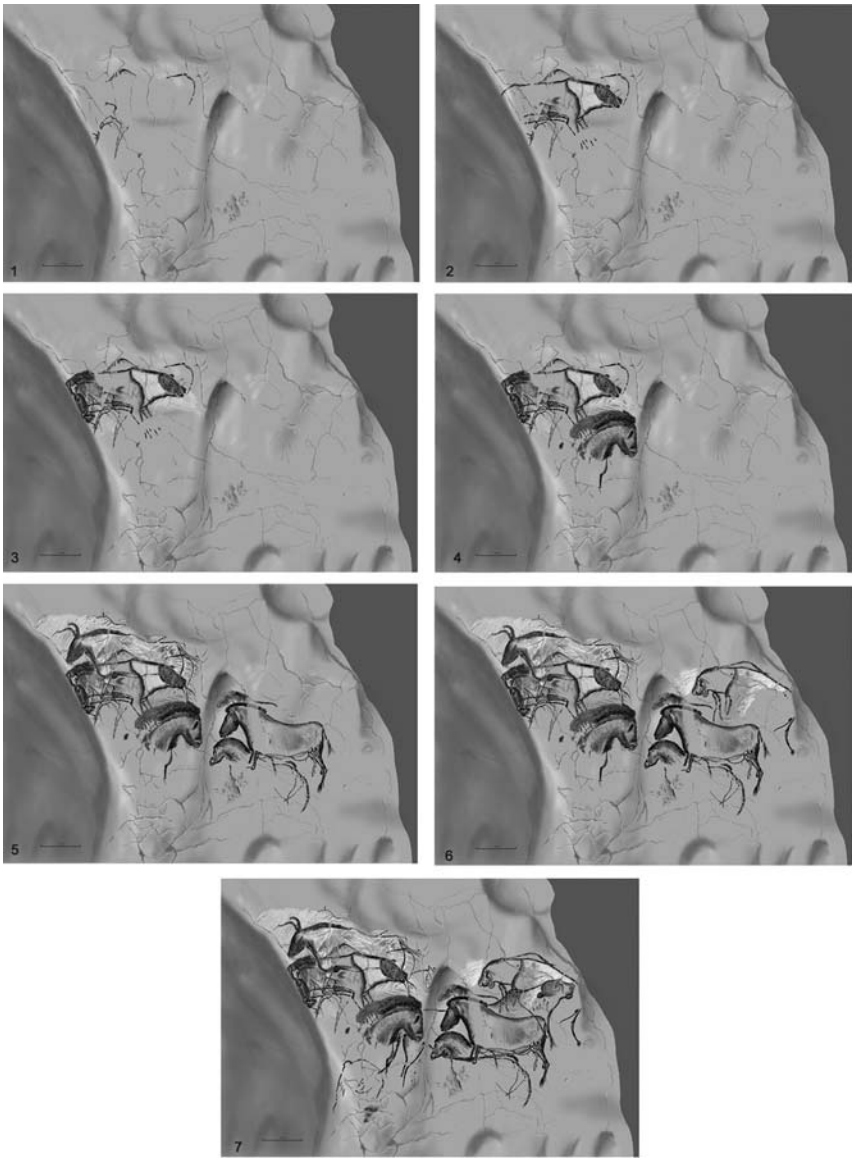

Fig. 18. Chauvet Cave (Ardèche, France), Alcove of the Lions. Numbers 1–7 indicate the principal stages of the chronology of the left wall (CF-GT).

Fig. 19. Chauvet Cave (Ardèche, France), Alcove of the Lions. Head of a large lion located at the furthest point of this narrow space. The relevé (*bottom*) highlights the very light stump work, done with the artist's fingers. This stump work is barley visible on a photograph of the lion (*top*). (CF-GT).

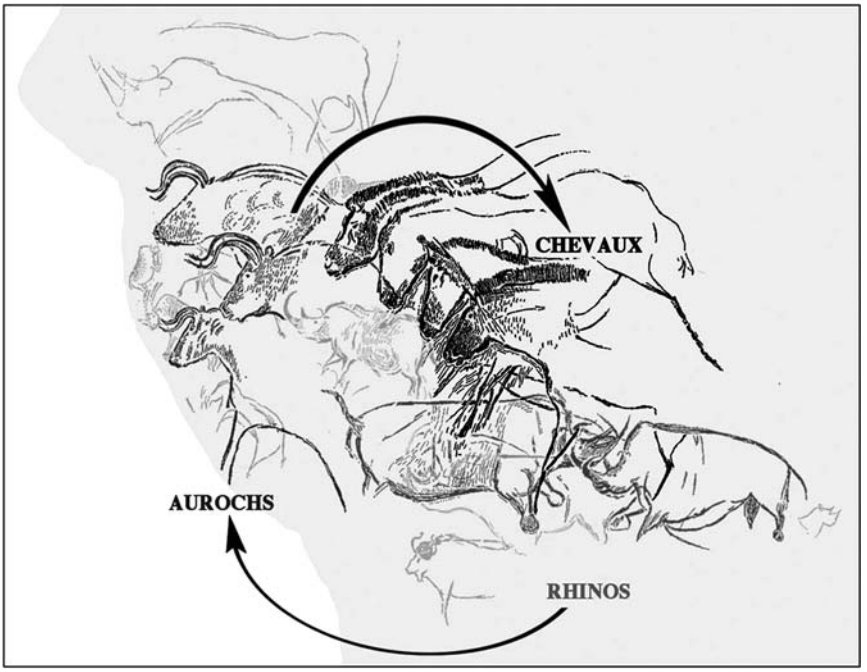

Fig. 20. Chauvet Cave (Ardèche, France), The Panel of the Horses. An analysis of the superposition of images shows an installation of the major figures grouped by animal species: first the face-to-face rhinoceroses, then the aurochs and finally the horses. One thus observes that throughout the work the artists moved from the margins of the panel towards the center (CF-GT).

In the process of working, the artist travels across the entire panel: initially squatting close to the ground towards the right for the rhinos, he/she rises to draw the aurochs above them to the left and then goes back down to eye level to place the horses in the center. In a formal analysis, the horses, which are undoubtedly created by one person (Tosello and Fritz, 2004) suggest they are members of one family. At the same time each can be distinguished from the other by many details, specifically, the proportions of the head and the neck, the drawing of the eyes and the ears, and their attitudes personalize them (Fig. 21). For the aurochs, the general structure of each figure remains the same but the mouth is opened or closed, the eye is sometimes almond shaped, or sometimes V shaped. By comparison, the rhinoceroses appear more stereotyped, less expressive; in their case, diversity is limited to the variations of the form and dimensions of the gray or black band which divides the body.

As we have just seen from the two examples from Chauvet (The Panel of the Horses and Alcove of the Lions), the assembly of the figures is not random, even if the chosen solutions occaisionally surprise us. In the Alcove, the "fusion" of the

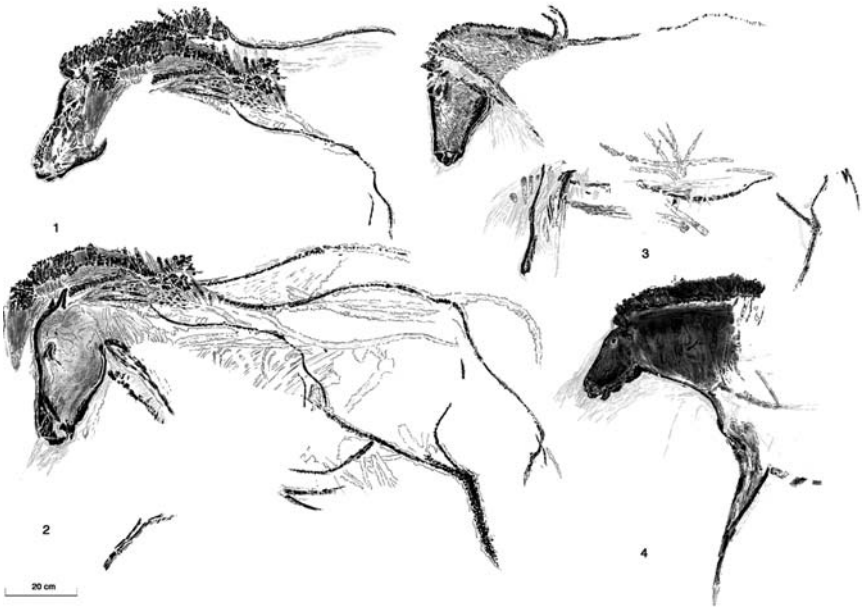

Fig. 21. Chauvet Cave (Ardèche, France), The Panel of the Horses. The relevé of the 4 horses makes it possible to isolate each individual; one then notes the diversity of expression for this species. Numbers 1–4 indicate the sequence in which the animals were created (CF-GT).

contours of one animal with another generates a hybrid creature; a little further, a large lion seems to have "swallowed" the horses, with one of the horses sticking its nose out of the lion's belly.

On the Panel of the Horses, the major figures are assembled by species, something which is seldom seen in cave art and which is reminiscent of Lascaux (Aujoulat, 2004). In the three compositions of Chauvet, the intentions of the Aurignacian people remain enigmatic but it is difficult not to consider symbolic meanings. The order of appearance of the figures on the wall was perhaps imbued with meaning, like characters entering a scene in a narrative. One then imagines sacred stories, in which the spoken word came to comment, even to clarify, narration in images. The cave may have been similar to a mythical universe (Leroi-Gourhan, 1982: 64–65).

CONCLUSION

It is impossible to give life once again to societies that have long since disappeared, it is impossible to revive artists from the past. On the other hand

one can rebuild, through thought, the technical system in which the prehistoric drawings were carried out.

The methodology that we apply to the study of prehistoric graphic expressions is broken into stages that are closely linked. Among the first stages is the recording of the data, and in particular the relevés, whose quality in large part determines our subsequent prospects for research. This phase of analysis brings into play important techniques which are undergoing constant development, especially now However, the essential role that contemporary technology plays should never be an end unto itself but rather be in the service of theoretical reflection and interpretation. Our goal is not simply to rigorously document graphic expressions of the Upper Paleolithic but in the long term to understand the role the art played in these societies.

The scientific path that we have chosen is certainly not the fastest and it is ironic that in an era when speed is greatly valued, knowledge of Paleolithic art requires an increasing amount of time and effort. Frequently the study of a site lasts ten, even fifteen years and five additional years are necessary to secure funding and to wait for a monograph to be published. But how do you collect important qualitative and quantitative information without taking time? Today the state of documentation on the decorated caves, whether French or Spanish, is not helpful in furthering our research. The data available on major sites such as Font-de-Gaume (the Dordogne, France) or El Castillo (Cantabria, Spain) rest primarily on publications (certainly of excellent quality for the time) of 1910 and 1912 (Alcalde Del Rio *et al*., 1912; Capitan *et al*., 1910). Which scientific discipline could be satisfied with such a state of documentation? Marsoulas and Tuc d' Audoubert (Fritz and Tosello, 1999, 2005) prove that a reanalysis of caves that have been known for decades is necessary and results in tremendous amounts of new data. With time and new discoveries, the complexity of Paleolithic symbolic systems will be increasingly confirmed. The hypotheses we formulate must be based on highly accurate documentation which we can achieve using our current means of recording. The detailed analysis of the process of artistic creation in conjunction with a reconstruction of the techniques and chronology of parietal compositions clarify the cognitive behaviors which underlie the art. Studying the gestures of the artists, to visualize the phases of their work and their choices—isn't this one the of privileged ways by which to get a sense of their motivations?

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