# Chapter 23

# Neuroarchaeology and the Origins of Representation in the Grotte de Chauvet

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In the Bible, representation begins with the Creation, when God makes man in his own image, and most modern accounts of the origins of representation are tinged with Creationism in their use of terms like Pfeiffer's 'Creative Explosion' (Pfeiffer 1982)[1] or Mithen's 'Big Bang' (Mithen 1996). Almost all recent accounts of human history look for, and find, in the appearance of representation in the Upper Palaeolithic, decisive evidence of the emergence of human beings fundamentally distinguished from animals by their use of speech and symbolization to construct a social culture. This paper is more cautious. Like Lewis-Williams (2002) and McBrearty & Brooks (2000) it sees the story as more episodic and gradual. Instead of looking optimistically for a fully-fledged modern-type human, adept at most of the behaviours that would later assure the species's dominance, it seeks to understand how such behaviours might have emerged more slowly out of a series of contingencies. It does so by relating new knowledge of Palaeolithic art to new knowledge about the brain. It will discuss representation, not as the attribute of a suddenly manifested and almost divine humanity, but as one of several behaviours that developed when a distinctive neurobiology reacted to a new environment.

This new 'neural' approach to archaeology has features in common with an established tradition, one that leads from Breuil and Lucquet to Lorblanchet and Lewis-Williams, but it is much more radical. Neuroarchaeology, the term I use for the approach adopted here, like neuroanthropology (Onians 2003a) and neuroarthistory (Onians 2003b), acknowledges that humans are different in crucial ways from other animals, but sees that difference as primarily due to the unique ways our distinctive neural apparatus leads us to relate to the material and social environment. It agrees with those like Damasio who criticize thinkers such as Plato and Descartes for seeking to separate the mind from the body, and seeks to reintegrate the neural and the physical. To do so it bypasses terms like 'mind', 'cognition' and 'consciousness', which are tainted by their association with the same tradition, and which prove slippery tools. Instead it treats the operation of the human brain as concretely as possible, in terms of the firing of neurons, the formation and breakdown of neural networks, the operation of neurotransmitters and the distribution of hormones, and it relates this activity to the moods, emotions and thoughts which make up our inner life, and the actions and behaviours to which they give rise.

### Representation without intention

The value of this neurological approach as a way to open up debate becomes apparent as soon as we apply it to a reappraisal of the phenomenon of representation, whose frequency in the Upper Palaeolithic is often taken, uncritically, as clear proof of the currency of conscious symbolic behaviour within a language-based culture. We tend to think that someone who represents something does so because he or she is aware that such a representation has some socially recognized function, but there is no necessity for this to be the case. What we call representation can come about for many reasons. Indeed, in order to distance ourselves from the concept of intention it is safer to think only of one thing visually *resembling* something else. There are many examples in the natural world of one thing resembling another, from the extreme cases of the chrysalis of the blue butterfly, *Spalgis epius*, that resembles the face of a monkey and the Brazilian bug, *Fulgora lucifera*, that resembles an alligator, to the orchid whose flowers resemble bees or the butterfly whose wing markings resemble eyes. There is, of course, no intention behind such resemblances. What does lie behind them is a long process during which one creature's neurally directed proclivities interacted with the other's form and configuration. The reason why these life-forms have acquired these visual attributes is because when seen by another creature,

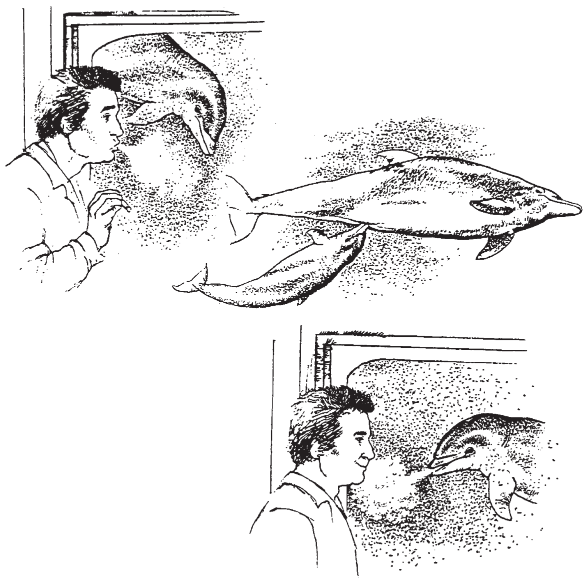

**Figure 23.1**. *Man and dolphin. (From Byrne 1995, 74, ill. 6.4.)*

and carried from its eye to its brain, they cause that life-form to either seek out or avoid them. Because possession of the genetic coding for these resemblances increases the likelihood that the creature or plant will survive it has become part of that creature's or plant's genome. Resemblances are thus frequent in nature and they are the product of neurological activity, but not necessarily of the lofty mental activity we associate with a Leonardo. In most cases they are the passive consequence of genetic selection.

In other cases a resemblance can be the result of an individual animal's autonomous, but unconscious, action. Take for example an event recorded three decades ago. An ethologist was watching dolphins in a tank (Taylor & Saayman 1973). He was smoking, and on one occasion he noticed that when he blew a cloud of smoke into the air, a young female dolphin swam off to its mother, took a suck of milk and coming back to him blew it into the water, so making a cloud just like his (Fig. 23.1). In artistic terms what the dolphin did was to copy the image she had seen made using a different medium on a different support, milk instead of smoke on water instead of air. Seeing the effect the man had produced and remembering that she had seen a similar effect when milk leaked from her mouth, she collected some more milk and copied him. There was no training or external inducement involved. Rather, the image was again the product of the impact of natural selection, only in this case the selection was for a complex neural apparatus that would ensure that a young mammal would imitate its elders and so acquire the skills necessary to survive. The reward system that provoked the behaviour was purely biological. An important aspect of the behaviour is that it goes beyond the simple reflexive imitation of an action. What captures the young dolphin's attention is a particular object with a particular shape, that is the cloud that the man makes, and what her neural apparatus encourages her to do is replicate that shape, in Peircean terms, making an *icon*, that is a representation, of it. Like the art school student copying an object, she can only do this because she remembers how such shapes can be made. The principal difference between her and the art school student is that while the student has been trained in such copying and makes the copy because he or she is responding to a reward system that is external and social, for example the expectation of the approval of teacher and fellow students, for the dolphin the reward is internal and neurochemical. Evidently the act of representation can take place without any of the conscious mental activity, training or social formation with which it has now routinely become associated. Until we have investigated the possibility of the earliest representation in the Palaeolithic arising from similar causes, we are unwise to assume a more conscious origin.

Two other case studies involving our primate relatives bring us closer to identifying such causes. Over 60 years ago, T.H. Huxley observed the young gorilla Meng, apparently tracing his shadow on the white wall of his cage and suggested that such an activity might have been at the origin of painting (Huxley 1942). Whether or not he was right, he certainly presents evidence for the existence of an inclination among primates to trace their own shadow, an inclination which must be rooted not in social formation but in the neural linkages between the eye and the hand. A further insight into those linkages surfaced ten years ago, when I visited Sue Savage-Rumbaugh in Atlanta to discuss her work with the Bonobo chimpanzee, Kanzi (Savage-Rumbaugh & Lewin 1994). In pursuit of my interest in Palaeolithic vulvas, I asked her about Kanzi's interests in female genitalia. In response, she told me that the toy he most enjoyed playing with was a red rubber ball, a preference she explained in terms of an inborn tendency to reach out for things having the visual and tactile properties of female bonobo genitals. Such a tendency must be triggered by the sight of a particular object causing the release of brain hormones, which in turn stimulates manual activity, which probably leads to further hormonal activity. What gives the actions of these two primates their relevance to our enquiry is that Kanzi's might be considered to be proto-sculptural, that of Meng proto-pictorial. Both raise issues of representation and both are the products of unconscious neural activity.

## Some neuroscience: neuroplasticity and mirror neurons

To pursue our enquiry we clearly need to have some knowledge of our neurobiology and neuropsychology and we are lucky that this is now increasingly available to us thanks to improvements in the technology used to investigate the brain. Research has in many areas shed light on artistic activity, as has been demonstrated by the neuroscientists Ramachandran (Ramachandran & Hirstein 1999) and Zeki (1999a & b), but the present paper will concentrate on two discoveries, each of them of great significance for an understanding of our humanity. One is the recognition of the importance of neural plasticity for the formation of the individual's brain. The other is the importance of mirror neurons for the shaping of the individual's behaviour.

Neural plasticity is the key to understanding why we differ from each other at another level than the genetic. The basic principle of neuroplasticity is that our brain changes its configuration in response to changes in the individual's experience and actions. We are all born with 100 billion neurons, each capable of having up to 100,000 connections to other neurons. What makes us different from each other is the way those connections form and fall away in response to our experiences. Thus, if we repeat an experience, such as an action or a sensory exposure, the particular neurons involved in the motor or sensory cortex develop more connections, so improving our success in those actions or perceptions. Hubel and Wiesel showed forty years ago how this happens in the case of the neurons that respond to lines of different orientations (Hubel 1963; Hubel & Weisel 1963; 1973) and Tanaka showed ten years ago how this operates in the case of the perception of a single object (Tanaka 1993; Tanaka & Matsumoto 2004). In terms of vision, the more often we look at something the more connections will form between the neurons involved, so strengthening our preference for looking at that thing.

Such neural plasticity is clearly adaptive, as it means that if, for example, when we are young we see our elders eating a fruit with a particular shape and texture we will acquire a preference for giving that fruit visual attention. The more often we see that fruit the better we will become at detecting it when we are food-gathering ourselves. The same is true of things we learned to avoid. If we see our elders looking at something dangerous, such as a poisonous mushroom or a dangerous animal, the effect will be similar. The more often we look at the poisonous mushroom or dangerous animal the more our neural networks will become adapted to perceiving it and the stronger will be our preference for giving it visual attention, with obvious benefit to us. Neural plasticity in the visual cortex helps us both to find things and to avoid things. This is why such neural plasticity has been selected for. It has helped our ancestors survive, especially when they changed habitat and needed to learn to give new things visual attention.

But this is not why it is important for us. What makes neural plasticity so important for someone studying the history of art is that it holds a critical clue to the understanding of the formation of visual preferences generally. The core principle is that the more someone looks at any configuration the better he or she will get at finding and identifying it, and this means that the more we know what a particular individual or the members of a particular group have been looking at the more we will know about what they will have been inclined to look at and *see*, whether in their environment as a whole or in a particular surface. The predictability of this principle is an extraordinary resource for anyone seeking to understand the history of artistic activity, because it implies that if you know what somebody has been looking at with attention you will know what they will have been inclined to see in the materials around them, with obvious consequences for the character of their art. Of course, in some communities people give more visual attention to things in their environment that have been around for a long time, and if that includes existing art that will encourage the maintenance of tradition, while in others people may look at new things, and that will encouraging innovation. In each case we need to ask ourselves afresh: What are the members of this particular community, or what is this particular individual likely to have been looking at?

While the principle of neuroplasticity sheds light above all on our differences, 'mirror neurons' tell us more about our similarities. Not only are they a type of neuron that we all share, their particular property is that they help us to imitate each other. They were first identified by Rizzolatti and his team at Parma University, who noted that when a monkey observes another primate doing something with its hand, such as reaching out for a peanut, some neurons in the premotor cortex of the observing monkey, that is those which would normally fire before it performed the same action, also fire (Rizzolatti *et al* 1996; Rizzolatti & Craighero 2004). Although no signal is transmitted to the motor cortex and no movement results, the observer monkey learns how to perform the action. Many experiments later it has become clear that this means that the observer monkey understands not only what the other monkey is doing, but why he is doing it, as is shown by the way the same mirror neurons fire at the simple sound of a peanut being cracked, presumably because the observer monkey knows from its own experience that peanuts are obtained by hand movements. Important conclusions can be drawn from these observations. In particular it is now recognized that the existence of many such neurons in the primate brain gives us and our relatives an unconscious understanding of what our fellow primates are doing, an understanding that is akin to empathy. Watching the motor actions of others is enough to give us an understanding of what they are doing and why, and gives us that understanding automatically. The neural connections throughout the brain that sustain such empathy are exceedingly complex, but the core of mirroring is manifest in the way the sight of another's hand prepares us to activate our own. The potential importance of mirror neurons is widely recognized, as by the neuroscientist V.S. Ramachandran, who has predicted that:

> mirror neurons will do for psychology what DNA did for biology: they will provide a unifying framework and help to explain a host of mental abilities that have hitherto remained mysterious and inaccessible to experiments (Ramachandran 2000, 1).

These two fragments of an emerging neuroscience are of immense importance because they allow us to move away from a notion of the brain as a stable organ. Until now archaeologists have typically talked of differences in the brain in terms of genetically determined features, size, complexity etc., that is, the features that distinguish the different species of the genus *Homo*. What the new neuroscience allows us to do is something much more fine-grained, to talk of differences between individuals. To the extent that an individual has been exposed to a different environment he or she will have a differentiated neural apparatus. Depending on what plants or animals they have looked at, what bodily movements etc. they have witnessed, what emotions they have shared and what attention they have given them, their neural apparatus will be different, and to the extent that those differences affect vision and movement their visual and motor preferences will be different. To the extent that all individuals in a group have had a similar exposure they are liable to share those preferences. This allows us to potentially explain any aspect of an individual's or a group's behaviour, from art-making or tool-making to ways of thinking and feeling, in relation to such exposure. The better we can reconstruct that exposure, the more accurate our explanation is likely to be.

**The earliest representational art**

It is particularly appropriate to apply knowledge of the modern human brain to the study of the earliest art, since there is good evidence for its emergence being connected with the arrival of modern-type humans in western Europe between 40,000 and 35,000 years ago. There have been claims made for early art elsewhere, but it is generally less impressive and less well dated (see Bahn this volume). In Europe, on the other hand, as the studies by Bahn, Bosinski, Lorblanchet, White and others have demonstrated, in the period 35,000 to 25,000 BP there are many candidates for early examples of representation, from Russia, across eastern Europe and southern Germany to southern and western France, and in each case the art is associated with the arrival of the new slender-boned, large-brained anatomically modern humans, also known as modern-type humans, who ultimately displaced the heavier-boned Neanderthals. Since improvements in both neural plasticity and mirroring/empathy are critical determinants of adaptability it is virtually certain that improvements in these areas of our neurophysiology were a key to the newcomer's success. These improvements would have been particularly critical for the visual and motor areas that support the activities that are our concern here. In a cold environment at the limits of human survivability, where there were few sources of vegetable food, success in hunting large herbivores and in avoiding or killing large and dangerous rivals was vital and such success would have required unprecedented skills in the fields of both visual attentiveness and the manipulation of tools. The connection between the severity of the environment and the development of new skills is already apparent in the Neanderthal populations who previously occupied the region. They certainly had exceptionally large brains and particularly effective tools, when compared to all other contemporary populations except the modern-type humans who were to emerge from Africa and replace them. However, the rapidity with which they were displaced suggests that there were fundamental constraints associated with their genetic make-up, constraints which were much reduced in the new species. Certainly neural plasticity in the visual cortex and success in mirroring would have been at a particular premium and, given that the relevant areas of the brain would have been under constant stress, any genetically driven enhancement of these attributes in the newcomers would have given them an enormous advantage.

In considering how the new humans' engagement with the new environment might have affected those behaviours we call artistic, we could consider any of the early assemblages, but the most rewarding context for their application is the collection of representations from the Chauvet Cave in the Ardeche valley. Not only is the dating evidence remarkably clear and consistent, suggesting that most of the art was made about 32,000 BP, but the whole site is in an excellent state of preservation. The latest publication documents 420 images, of which 65 are rhinoceroses, 71 felines, 66 mammoths, 40 horses, 31 bovids, 20 ibex, 25 cervids, 15 bear, 2 musk ox and 1 an owl, not to mention a whole group that are unidentified, as well as 4 or 5 female genitalia and many silhouettes and stencils of hands (Clottes 2003). A few images are engraved, but most are painted in charcoal and/or ochre.

Any discussion of the art of Chauvet needs to take account of both the variety of its subject matter and the range of techniques used. It also, above all, needs to acknowledge the astonishingly life-like property of many of the images. Some of the rhinoceroses seem nervously about to charge, menacingly presenting their horns (Fig. 23.2). Lions lower their shoulders, as they would when hunting, and the positioning of the eyes and ears well conveys an appropriate sensory alertness (Fig. 23.3). Four horses' heads are painted next to each other, but each captures a different equine behaviour. On many heads shading suggests the underlying bone structure, and on bodies the mobility and texture of flesh covered by fur. Often there is an extraordinary sense of a moment of viewing recaptured, as in a photograph. One figure may conceal another from the viewer, as would happen in a real encounter, and some animals, such as bears, are shown from on top, in slightly three-quarters view (Fig. 23.4). It is not going too far to say that often the spectator's experience is like that of someone watching a modern wild-life film. The art of no other cave is so natural or vivid. Publications of the cave under the direction of Jean Clottes (e.g. Clottes 2003) scrupulously document these remarkable attributes, but they do not explain them. Indeed, the fact that the publication limits itself almost entirely to description, with the addition of a few unsystematic interpretations based on anthropological analogies which don't seem to convince even their authors, leaves the reader with the impression that those who have studied the cave so far can make little sense of it. There is certainly no suggestion that a solution is near using any available cultural approach.

## Neuroscience and representational art

A neural approach offers more possibilities and its desirability has long been recognized. The psychologist, G.H. Lucquet, observed in 1926 that many prehistoric representations, and especially engraved representations, are superimposed on the marks made by bear claws and Chauvet contains several examples of this, such as the engraved mammoths in the panel of the

**Figure 23.2**. *Rhinoceros, Grotte de Chauvet. (From Clottes 2003, 134, ill. 130.)*

**Figure 23.3**. *Lion, Grotte de Chauvet. (From Clottes 2003, 131, ill. 126.)*

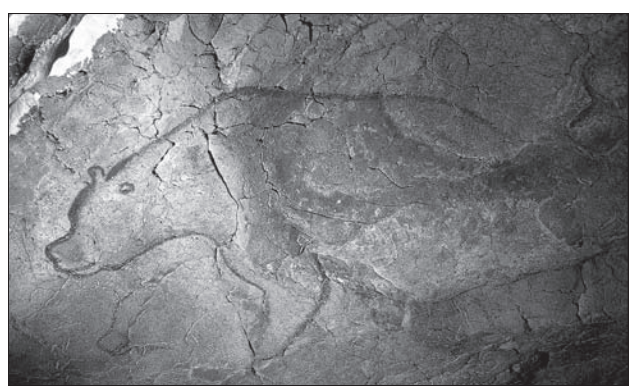

**Figure 23.4.** *Bear, Grotte de Chauvet. (From Clottes 2003, 70, ill. 63.)*

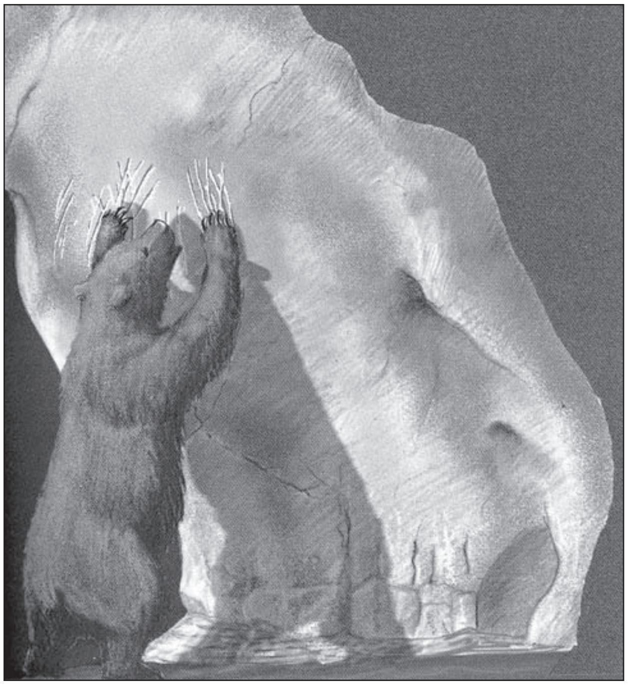

**Figure 23.5.** *Reconstruction of bear activity, Grotte de Chauvet. (From Clottes 2003, 117, ill. 2.)*

**Figure 23.6.** *Reconstruction of superimposed human and bear activity, Grotte de Chauvet. (From Clottes 2003, 117, ill. 3.)*

engraved horse in the Hilaire Chamber (Figs. 23.5 & 23.6). Lucquet suggested that the activity of the bears was the starting point for that of humans and Michel Lorblanchet has recently repeated the claim, pointing out that hand prints are superimposed directly on claw marks on a panel dated to around 25,000 BP in the Galérie de Combel in the cavern at Pech-Merle (Fig. 23.7) (Lorblanchet 1999, 11, 15). Lorblanchet is adamant that the origin of this phenomenon and others such as the popularity of hand silhouettes, which are known throughout time and throughout the world, lies in *le cerveau humain*, 'the human brain', and it is now possible to suggest more precisely what that origin might be (Lorblanchet 1999, 218). If the sight of another hand, or even the sound of a peanut, can activate the mirror neurons in the premotor cortex of a primate it is easy to see how the sight of the marks made by a bear's claw could have activated the premotor cortex of the individuals entering Chauvet and that in some cases this would have led to the firing of the relevant neurons in the motor cortex, leading to the making of a similar mark. The likelihood of this happening would have been greatly increased because the chance touch of a hand on the wall must often have left some sort of mark, whether a groove in the white cheese-like substance known as 'moonmilk', a prototype engraving, or a black mark from a soot-covered palm, a prototype painting. Such actions can only have been encouraged by the natural empathy that human beings would have felt with bears, who, like them, also spent much time in caves, were omnivorous, frequently stood erect on two legs, and whose claws were enviable equivalents to human tools. Given such empathy, the same neural apparatus that led a young dolphin to imitate the art-like action of a human, might have led a human to imitate that of a bear.

If the principles governing the operation of mirror neurons help us to understand why humans made marks on the walls of the cave, and why those marks are of two kinds, one engraved and the other coloured, the principles of neural plasticity help us to understand why the making of coloured marks led to the replication of images of the hand with which the marks were made. Such hand images are of two types, the one, dark, being made by pressing a hand covered with paint against the cave wall, and the other, light, and made by spitting dark paint around it (Fig. 23.8). Visitors to the cave who brought their hands close to the cave wall would have seen the shape of the hand successively in two tonal modes, first as a black shadow cast by the torch, and then, as the hand came between the torch and the wall, as a bright illuminated form. They would have seen this again and again and this would have caused the formation of neural networks that would have strengthened their preference for looking at such configurations, so increasing the pleasure in making them. Huxley's observation of a young gorilla tracing his shadow on the white wall of his cage shows how shadows may elicit manual

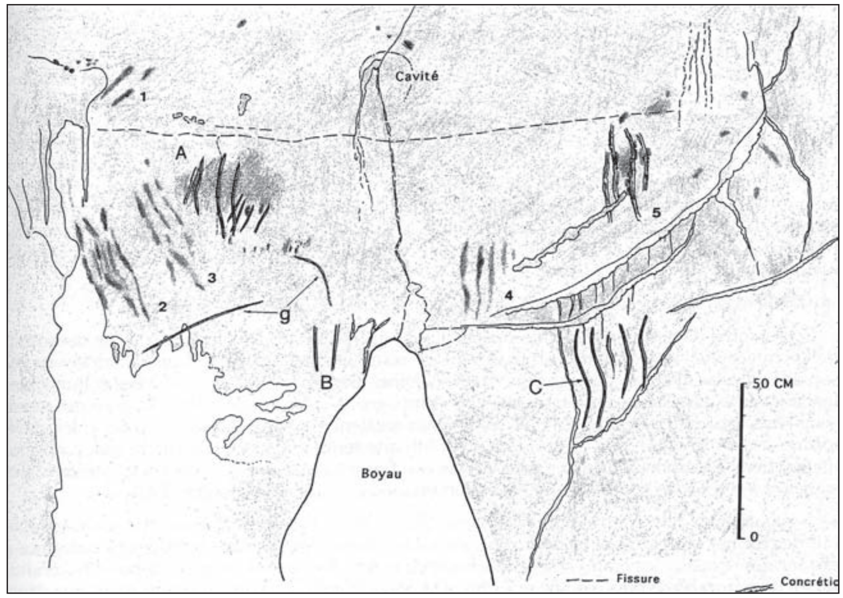


**Figure 23.7.** *Human marking superimposed on bear claw marks, Galerie du Combel, Grotte de Peche-Merle. (From Lorblanchet 1999, 15.)*

activity in a primate, and the notion of a human using blown paint to reproduce a light effect is not far from the young female dolphin's untaught blowing of milk to imitate an effect created by a human blowing smoke. As with the young dolphin, all that was necessary was for the individual involved to remember how a particular chance effect had been produced before. Such a chance effect could have been created either by a random spitting of paint during the sort of play activity indulged in by other great apes in the wild or by a cough or sneeze which might easily have left some silhouette of the hand. Either way the effect could have been striking and surprising enough for the memory of how it was produced to stay in the brain, where it was ready to be called upon when the networks of the pre-motor cortex that stimulate imitation, stimulated the human's hand to find a way of rivalling the imprint of the bear's hand. The making of both positive and negative hand images can be seen as another example of the innovations in both general behaviour and detailed technology that result from *Homo sapiens'* possession of a distinctively powerful and generalized inborn inclination to imitate creatures whose habits or equipment gave them advantages that they particularly desired to share.

If one of the distinguishing features of Chauvet was its popularity with cave bears, another was its inherent visual interest. The limestone caves of southern France come in many forms and Chauvet is among the most splendid, its vast voids filled with all sorts of crystalline concretions and its surfaces stained with many different minerals (Fig. 23.9). It was already filled with forms and colours of great visual appeal long before our ancestors added their paintings and engravings. Those who entered such an environment, their visual neural networks formed by exposure to those things at which they would have looked with most attention, above all the large and powerful animals from whom they were in danger, and to a lesser extent the vulnerable species on which they preyed, would have tended to see those creatures that they either feared or desired in the colours and shapes revealed by the shifting lamp light. In many places at Chauvet, as often in other caves, we can see how a projection or recession, a line or a stain, was the starting point for a representation. We cannot reconstruct the precise sequence of neural events that led

**Figure 23.8.** *Hand stencilled with blown paint, Grotte de Chauvet. (From Clottes 2003, 84, ill. 77.)*

to an individual completing the image, often in life-like detail, but we can imagine that the sight of claw marks will have aroused memories of how similar marks had been made by the visitor's own fingernails or tools, while the sight of brilliant washes of colour created by the seepage of ochre down the cave walls will have reminded visitors of effects they may have already achieved in the application of pigment to their own bodies. The memory of what the hand could

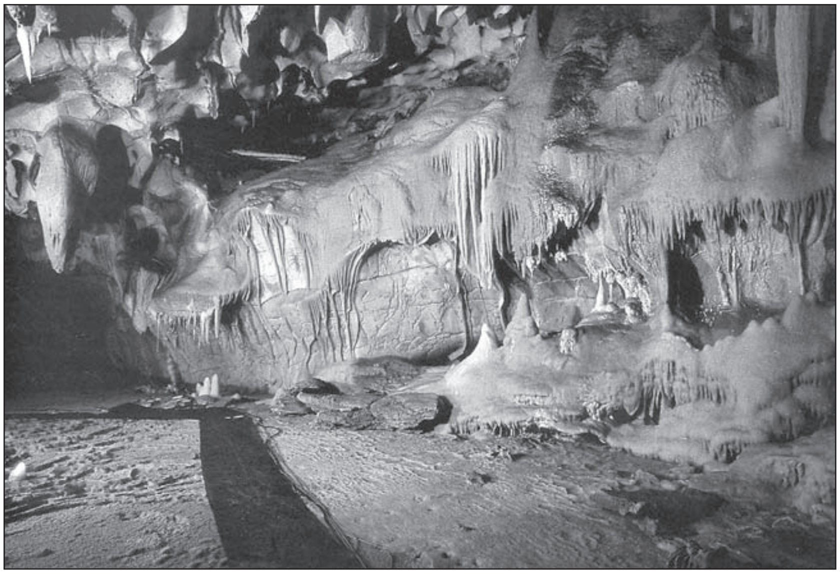

**Figure. 23.9.** *Chamber of the bear hollows, Grotte de Chauvet. (From Clottes 2003, 80, ill. 73.)*

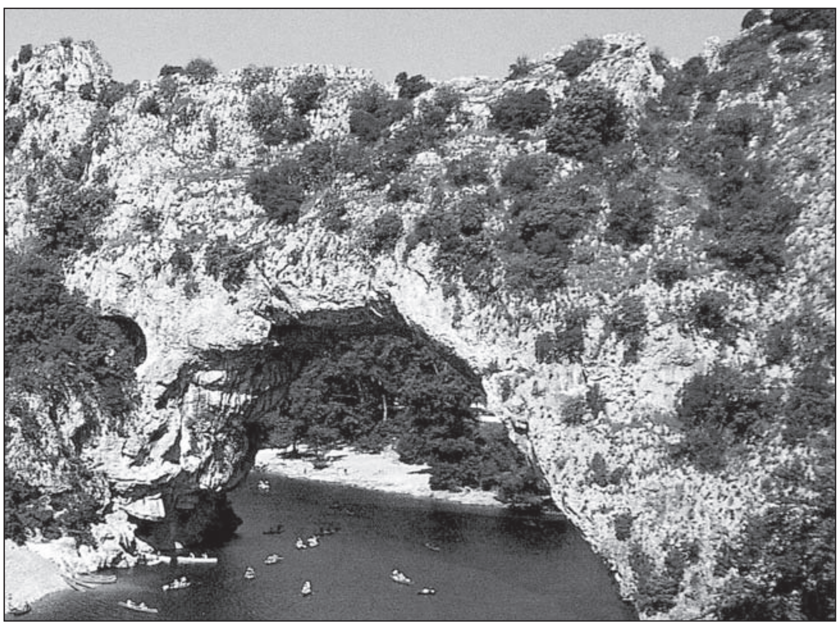

**Figure 23.10.** *Rock arch near Grotte de Chauvet. (From Clottes 2003, 6–7, ill. 2.)*

do is likely then to have primed the motor networks involved, and this in itself could have encouraged people to return to the cave later with their familiar tools, stones and sticks, ochre and charcoal, the neural networks controlling their hands primed to extend or complete an imagined shape.

Once they had begun to add their own marks and colours, their pleasure in the imagined shape would have been increased, prompting further enhancement. In each case the continued activity is likely to have been fuelled by the brain's chemistry, with each enhancement of the correspondence causing the release in the brain of one of the neurotransmitters that drive all the actions that are vital for our survival. The chemicals involved in such different activities as competing with a rival, searching for food or pursuing a sexual object are different, but with each the release is apt to increase until a goal is fulfilled. Sometimes, as when dealing with animals that are either dangerous or are potential food, the release may be an acquired response, while in others, such as the sight of female genitalia, it is inborn, as Kanzi's fondness for a red rubber ball illustrates. In all cases, however, the release would have prompted the repetition of the activity, so eliciting a further release and this process of continuous positive chemical feedback from the manual interaction would have been liable to continue as long as the constant increase in the resemblance intensified the chemical reaction. The process might thus only stop when the chemical reaction could not be strengthened further. In each case the point where the process would stop might be different, but when the engagement established by the artist's neural networks was particularly intense the point might be some notional one of maximum correspondence to the object represented. An unconscious feedback process could thus lead to the production of a highly naturalistic representation or artwork, without any teaching, guiding or other social stimulation. A naturalistic image might be produced completely spontaneously, due to nothing more than the normal operation of the human neural make-up.

But why should all this happen in this particular cave? As we have seen, the improved neural apparatus of the new light-boned big-brained human type would have made all members of the new species who lived in the novel environment more likely to manifest art-making behaviour than their predecessors, while at Chauvet the combination of cave-bear activity and a visually stimulating environment would have further enhanced this likelihood; but this combination was found in several environments in southwest France. Was there anything special about Chauvet that would account for the unique response it elicited? Neuroscience would lead us to look for a reason why individuals in the area might have spent more time looking at animals than their contemporaries elsewhere, and one unique feature of the cave's environs is likely to have had precisely that effect. The natural rock arch, after which the present town of Vallon Pont d'Arc is named, is one of only a few in the world that bridges a fast flowing river and its situation close to the point where the Ardeche river enters the Rhone would have made it a tempting crossing point for the animals forced to migrate north or south in search of food in the then severe climate (Fig. 23.10). The bridge's presence would not only have made the site particularly suitable for human habitation, it would also twice a year have presented those in the vicinity with the sight of an exceptional procession of animals. Those who witnessed that sight would indeed have had neural networks exceptionally attuned to seeing large mammals.

This explanation for the emergence of representational activity in the cave also sheds light on some of its most remarkable features. One of these is the way animals are in two cases grouped in tripartite panels around arches, one around the Alcove of the Lions in the Horse Sector and the other around a niche containing a horse in the End Chamber (Fig. 23.11). The latter, which is the richest collection of animals in the cave, is striking not only for its composition around the arch-like niche, but for the way the mammoths and bison at the right and the rhinoceros at the left seem to be climbing up, as if negotiating a mountainous landscape, while another mammoth stands at the top (Fig. 23.12). The suggestion that the scene recalls one of migration is reinforced by the way it is framed on both sides by a dense and dynamic procession of animals without parallel in prehistoric art. Yet another feature of both panoramas is the way animals are often shown superimposed on each other, but moving in opposed directions. This happens, for example, both in the case of the rhinoceroses to the left of the horse niche and the reindeer to the right of the Alcove of the Lions (Fig. 23.13). Seeing an animal moving in one direction might have brought back the memory of a similar movement in the other. All these features, which are without parallel in other caves, are easily understood if those who made the images did so because of the way their neural networks had been configured by repeated exposure to a varied procession of animals migrating over the arch. They are difficult to explain in any other way. Perhaps the most decisive contingency at Chauvet leading to the occurrence of representation there was the distinctiveness of the surrounding landscape.

**Figure 23.11.** *Animals painted around rock niche in End Chamber, Grotte de Chauvet. (From Clottes 2003, 130–31, ill. 126.)*

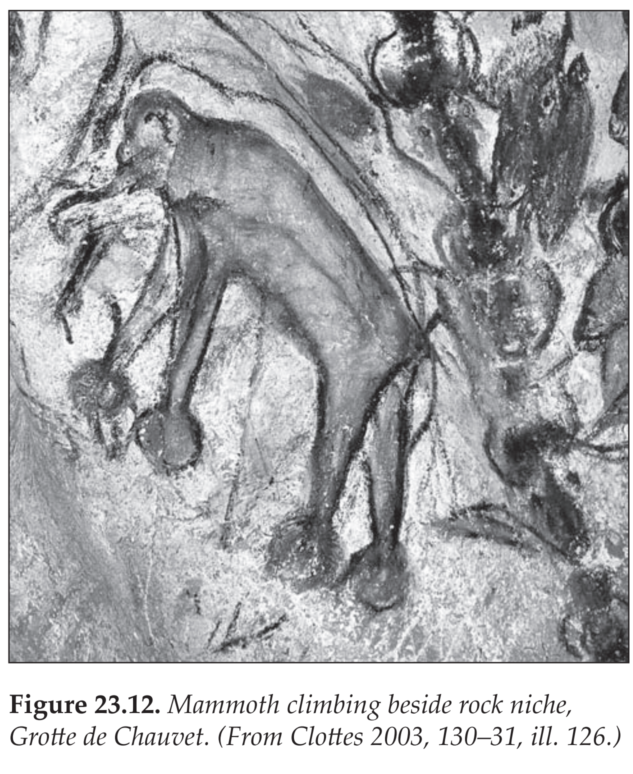

**Figure 23.12.** *Mammoth climbing beside rock niche, Grotte de Chauvet. (From Clottes 2003, 130–31, ill. 126.)*

**Figure 23.13.** *Reindeer moving in opposite directions, Grotte de Chauvet. (From Clottes 2003, 108, ill. 104.)*

**Some conclusions: on art**

If the argument presented here is accepted, it leads to some conclusions that many will find surprising. One is that Chauvet is not only an early example of cave painting, it may even be the earliest, the product of a unique set of contingencies. The members of the new species, having settled into an inhospitable environment far more challenging than those they had occupied before, with their visual networks dramatically reshaped by the sight of animals migrating over the rock arch and their mirror neurons activated by the sight of the marks of bear claws, were provoked into adding to the extraordinary visual richness of the cave by their memory of how similar linear and colouristic effects had been achieved by their own hands. This argument explains why Chauvet may be the earliest painted cave, but it doesn't require it to be, since a similar conjunction might have had the same consequences anywhere. Indeed, it follows from this argument that, since other powerful, though different, conjunctions may have happened at any time, with similar consequences for art production, artistic activity is likely to have emerged in any number of places at different periods, wherever *Homo sapiens* lived, which is exactly what seems to have happened, with representational art being found in Australia, South America and Africa at different times in the Upper Palaeolithic, without any evidence that the habits involved were transmitted by diffusion. However, the likelihood of other sites producing evidence that controverts the present argument is not great. The situation with Chauvet is very different from that with Altamira and Lascaux. In their case it would have been rash for anybody to claim that they constituted the earliest art, since it has long been known that the human type that made them had lived in the area for over 15,000 years. The art at Chauvet, on the other hand, was made so soon after the new species' arrival that the chance of comparable early art being discovered is drastically reduced.

Indeed, it is interesting that the body of small statuettes from the Swabian Jura, of which the material from the Vogelherd cave is the most significant, appears to represent a precise parallel to Chauvet. Conard now dates this art to about 33,000 BP, that is shortly before the French cave, and sees it as an early product of the new groups of modern-type humans, as they entered the area from the east, before some moved on to the west. Since the limestone outcrops and caves of the Swabian Alps have much in common with those of the Ardeche and the Dordogne, it is easy to see both outbursts of creativity being the result of a similar conjunction of neural resources and environment. Though it is important to recognize that the Swabian caves are much smaller and less colourful than those in France and would certainly have been less likely to provoke the act of painting, which could well explain why the art with which they are associated is almost exclusively sculptural.

Another conclusion that emerges from the study of Chauvet is that, applying the same neurobiological principles, we would expect later representations to be less naturalistic. This last point, that the later art is in many ways less effective in capturing the vitality of its subjects, will puzzle those who are used to the history of art as a story of progressive improvement as a result of social criticism and conscious effort. To someone writing a history of art based on the principles of neuroscience it is not just comprehensible, it is predictable. If it was a particularly intense visual exposure to real animals that created the neural networks that guided the hands of the first artists at Chauvet, then the progressive increase in the number of painted images that followed would have resulted in the formation of neural networks shaped by very different experiences. The networks of later artists would have been shaped less by the sight of fur over skin over muscle and bone, and more by that of outlines filled in with ochre and carbon and engraved silhouettes. We would expect a hand guided by such networks to produce less naturalistic and more schematic results, and we can see this happening already at Chauvet. Those who made the paintings frequently repeat themselves, making one image after another in a similar way, and, as a consequence, we often find particular representational devices, such as the way a rhinoceros' horn or a lion's

**Figure 23.14.** *Repeated lions and rhinoceros, Grotte de Chauvet. (From Clottes 2003, 130–31, ill. 126.)*

brow is drawn, recurring again and again (Fig. 23.14). Often traits become exaggerated, as in the lengthening of the rhinoceros horn, as might be expected from the operation of the neurally based 'peak shift' phenomenon discussed by Ramachandran & Hirstein (1999). Obviously those who painted the first images and who necessarily spent some time looking at them would have been the first to have had their networks reconfigured by the exposure. For those who came after them the process can only have accelerated, although there must always have been a range of neural networks involved, with some artists having looked more at real animals and some more at painted representations. The more time someone had spent looking at art and the less at live animals, the more their work would have become stilted and formulaic, the more they looked at animals, the more it would have been naturalistic. Often individuals with the two types of networks might contribute images to the same cave, as already seems to happen at Chauvet, which is why both here and in later caves there is a great variety in the way representations are made. The stylistic variety of Palaeolithic art and the absence within it of a simple stylistic progression, which have become increasingly clear over the years, have puzzled, even annoyed, scholars, though not Lorblanchet who has a more open-minded approach than many. To the scholar who follows the principles of neuroscience, both properties of the art are no more than one would expect.

**Some conclusions: on language**

The argument advanced here proposes that the first phase of representation, including the time and place of its emergence and the character of its development, is congruent with the principles of the neuroscience of the human visual and motor systems. We have not needed to invoke the role of language, but we should at least reflect on its possible influence. After all, as David Lewis-Williams says: 'There is no doubt in any researcher's mind that Upper Palaeolithic people had fully modern language … ' (Lewis-Williams 2002, 88) and if that view is correct we should need to at least consider what role it might have played in our account. In evaluating this common view we can begin by disposing of one of the main assumptions on which it is based, that it is unthinkable that representation should emerge without it. As we have seen there is good evidence that, far from being unthinkable, it is predictable.

A more reliable approach is to look for evidence of its role in the content of the representations. What do they suggest? After all a visual representation has something in common with a verbal description; so we should be able to learn something about Palaeolithic verbal descriptions from visual representations from the same period. If we ask ourselves what language we would need in order to produce a verbal equivalent of Palaeolithic art, an immediate answer would be, we would need nouns, e.g. 'bison'; adjectives, e.g. 'big'; and intransitive verbs, e.g. 'runs'. What is missing, not just in the earliest art, but in all the tens of thousands of specimens of all types of Palaeolithic art, is any clear example of a representation that would require a transitive verb, that is, a verb that takes an object, for its description. There is not a single indubitable representation of a noun–verb–object relation, such as a human or an animal doing something to another human or animal. There are no scenes of something attacking, killing or eating something else or a woman giving birth to a baby. Nor is there any scene which suggests that because this happened that happened, for example, because this animal or human appeared this other animal or human ran away. There is no scene of cause and effect, none in which one thing has 'power' over another, none even of basic narrative, e.g. this happened after that. One of the few possible exceptions to this rule is the scene in the shaft at Lascaux showing what might be a disembowelled bison in threatening proximity to a recumbent man, but, although this may suggest that something has been done to a man or an animal, it certainly doesn't represent that action. In other words the art provides lots of evidence for description, none, or virtually none, for narrative.

Of course, it would be possible to argue that this doesn't prove that narrative did not exist. Visual art and verbal language could be two separate domains, and a single image could act as a cue for a narrative. However, we should remember that since the common argument is that the clearest proof of the importance of language is the wealth of representational art, we should expect there to be some correspondence between these two media. More particularly, since the common view is that the representational art demonstrates the existence of such phenomena as shamanism, religion, and cosmology, we would expect to see in the art some evidence of the type of linguistic formulations on which such systems always rely. Now, all currently known versions of those systems rely precisely on narrative, on stories of causation, on tales of differentials of power. They all depend on what we call myth. Again, it could be argued that perhaps we are not adept at reading the imagery. Perhaps when animals are shown running one behind the other or standing beside each other a narrative or tale of power differential is alluded to but not represented. This certainly happens in later art, that produced after 10,000 BP, and would have been possible in the Palaeolithic.

It is, however, most improbable. What makes it improbable is precisely the character of that later art. One of the principal new features of that art is its frequent representation of scenes of men and animals doing things to each other, that is narrative scenes, scenes that would have required a subject–transitive verb–object sentence for their description. It also represents differentials of power, with large and small figures contrasted and organs such as eyes, mouths and hands enlarged, in expression of the basis of such power differentials. At European sites such as Çatalhöyük in Turkey, Addaura in Sicily or Morella la Vieja, Spain, and at many sites in Africa and Australia, such representations of narrative and of power differentials become commonplace in the millennia associated with the Neolithic and other later cultures. Of course, there were also many other images which were not either narrative or expressive of power differentials, as there are today. That is what one would expect. Many phenomena that are important to humans are independent of narrative and power differentials. The point is that, while narrative is increasingly omnipresent after 10,000 BP, and especially after 5000 BP, before that it is totally absent. Palaeolithic art has been assumed to be the evidence that such narratives existed, but it suggests the reverse. It would surely be quite extraordinary if Palaeolithic art, with its tens of thousands of images, depended on myth but never illustrated it directly.

What Palaeolithic art suggests is that not only was there no narrative but that the role of speech was very reduced, and independent support for such a claim comes from recent psychological research. Nicholas Humphrey (1999) used the similarity between the art of Chauvet and that of the autistic and virtually languageless Nadia to argue that the inhabitants of Chauvet might also have been deficient in speech use, and some of his observations apply to Palaeolithic art in general.

## Some conclusions: on new material and social technologies

Besides the presence of art, the other features that are seen as inconceivable without the elaborate use of language are the rapid advances in tool technology and the social exploitation of the environment. A neural archaeology has to explain the emergence of these features, just as it has to explain the emergence of art, and such an explanation is available. The explanation of the emergence of artistic activity proposed earlier saw it as the product of the interaction of the complex and flexible neural networks of *Homo sapiens* and a particularly rich, but particularly stressful, environment, and it is possible to extend that explanation to deal with the new problem. One of the most important discoveries of neuroscience is that the operation of mirror neurons is correlative with complex empathy, that is, the stimulation of the pre-motor cortex in the viewer of a movement is associated with an understanding of what it means to the other, its purpose and value (Rizzolatti & Craighero 2004), and this finding is a particular help to us as we try to understand the emergence of new material and social technologies.

Once arrived in northern and western Europe, faced with the need to maximize their exploitation of food resources and to protect themselves from the cold, the members of the new species would have looked with a new attention at the life-forms with which they were surrounded. As they observed how mammoth used their tusks, rhinoceros their horns, lions and bears their claws and teeth, bison their horns and reindeer their antlers, they would have empathized intensely with their value as instruments for piercing, tearing and scraping. With their pre-motor cortices activated in this way they would have been more inclined to adapt the stones and sticks which they had long used as tools to better mimic the different functions they observed in the animal world, creating complex instruments, such as harpoons and spear throwers. Similarly, seeing how spiders spun webs to trap their food and birds wove fibres into nests to protect their young they would have found their hands doing what birds did with their beaks or arachnids with abdominal extruders; in other words they would have been liable to spontaneously develop textiles, baskets, traps and nets. Seeing how other mammals were protected by warm coats they would have wanted their own, which they often took from the creatures they envied. Humans had, of course, always been surrounded by such phenomena, and the Neanderthals, whose neural resources were only proportionately rather than absolutely less rich than those of modern-type humans, had already been affected by them, which is why they were as adept as they were in the use of tools and the making of clothes. Of course, too, the new lighter larger-brained species had also already been exposed to these and analogous phenomena. That exposure had begun tens of thousands of years earlier in Africa and southwest Asia and helps to explain many of the technological advances they achieved in those regions. It had continued during their expansion into Europe and westwards across that continent, but at the beginning of that migration the conditions would not have been harsh enough to force them to look with such envy on other species and later on their journey up the Danube the environment probably became so ecologically poor that there was much less to observe. It was only when they arrived in the west where the climate was severe, but the proximity of the ocean and the Mediterranean assured a richer flora and fauna, that they were drawn to look at the rest of nature so intently. Finding themselves in an environment where they could not opportunistically vary their diets, but were forced to maximize their consumption of their fellow mammals, and where fire alone could not keep them warm, their visual attention was inevitably drawn more than before to the many rival life-forms and their different resources for dealing with similar problems. Material technologies that we think of as the product of reflection and analysis, need only have been the fruit of an unconscious process by which intense observation led to imitation.

The same would have been true of social technologies. As they observed the behaviours on which other species depended for survival, whether they were prey animals or predators, whether their expertise was in defence or aggression, they would have heightened their own already strong sense of the advantages of co-operation, team work, the division of labour and leadership. They would have empathized with their mental as well as their physical resources and begun the process that would eventually lead to notions of spirit transfer and the appearance of shamanism and totemism. All this would have happened simply as a consequence of the neural networks of the new species being confronted with a new environment. There would have been no need for language-based reflection, or analysis or instruction.

### Final conclusion: the 'big bang', the eye and the brain

In his article on mirror neurons Ramachandran has envisaged that

> the so-called 'big bang' only occurred because environmental triggers acted on a brain that had already become big for some other reason and was therefore pre-adapted for those cultural innovations that make us human (Ramachandran 2000, 4).

He does not speculate about what those triggers may have been, but the scenario presented here is consistent with his hypothesis. Implicit in his celebration of the role of mirror neurons is a recognition of the importance of the act of looking that most typically activated them. In this sense it was not language but looking that led to the dramatic changes in behaviours that characterize the Upper Palaeolithic. It was a new intense looking that lay behind the appearance of new physical and mental resources. It also lay behind the appearance of representational art. Indeed, the two types of looking were intimately connected. It was empathy that led our ancestors to look at the life-forms with which they were surrounded with such intensity that their neural apparatus was transformed and it was this transformation of the neural apparatus that led to them seeing and representing animals on the walls of caves and in pieces of ivory and bone. This is why it is not surprising that the range of the fauna represented at Chauvet — or for that matter at Vogelherd — precisely matches that of the animals with which their empathy would have been greatest.

Many were the attributes of their fellow creatures with which they empathized, but perhaps one attribute engaged them above all, the animals' own capacity for visual attention. They looked intently at animals that were themselves looking intently. They may have desired their horns and claws, their thick skins and warm furs, but most of all they will have found themselves valuing their visual alertness and hunting intelligence, as particularly exemplified in the highly focused lions and bears (Figs. 23.3 & 23.4). The tools they envied most in the animals they lived with were the neural linkages between their eyes and their brains. It was watching the animals that activated their mirror neurons, so teaching them too to look intently, and it was this intense looking that affected the plasticity of their neural networks in such ways that they projected life-like images on the cave walls.

Neuroarchaeology thus suggests an explanation for most of the remarkable properties of these remarkable images. It helps us to understand why these subjects were painted in this way at this time and at this place, and nowhere else on the planet. It may thus provide us with the key to the origins of representation. As a theoretical framework it may also help to solve many other problems that archaeologists have found intractable using existing methods.

Neuroarchaeology makes no claim to replace those methods. Traditional cultural approaches have been and always will be the principal framework for the study of archaeological material. Indeed, they will surely eventually yield alternative and better explanations for some aspects of Chauvet. For the time being, though, it seems that there are no coherent cultural explanations for this extraordinary art to match the neural explanations offered here.

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