BEGINNINGS OF ART: 100,000 – 28,000 BP

A NEURAL APPROACH

Volume 1 of 2

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ABSTRACT

Upper Palaeolithic Europe is known as the time and place when humans first become an art-making species, associated with symbolic thought and language. However, recent discoveries of abstract markings and personal ornamentation from Middle Stone Age Africa may indicate humans are engaged in producing artefacts of a symbolic nature within a language based culture up to 100,000 years ago. If art is a much earlier practice, to what extent can we apply the same complex set of theories and judgements used to evaluate art of Upper Palaeolithic Europe and apply it retrospectively in the evaluation of preceding artistic endeavours.

The aim of this thesis is twofold. Firstly, to examine the development of artistic activity, beginning with incised stone and ochre and perforated marine shells in Middle Stone Age Africa at around 100,000 years ago, and following its course as modern-type humans migrated into India, the Levant, Australia, Papua New Guinea Australia and Europe, ending at 28,000 years ago, with the advent of 2D and 3D representational art. Secondly, to consider the development of the earliest art using current research in neural and visual plasticity and Environmental Enrichment studies as a basis. Understanding the ways in which environmental factors affects neural networks, especially in terms of the visual brain, may contribute to an understanding of the earliest artistic manifestations and why particular artefacts or materials may have acquired symbolic status. In addition, Environmental Enrichment studies may improve our understanding of how physical, social and cultural environments affect neural resources to the extent that it may inform our thinking about the so-called 'Human Revolution' of Upper Palaeolithic Europe. By examining the development of art in relation to the brain, this thesis focuses on the interrelationship between the brain, the environment and cultural production.

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CHAPTER 1

Introduction

Art is a global phenomenon, unique to the human species.[1] Yet, despite its ubiquity it remains a difficult concept to define and evaluate. This dichotomy is made even more problematic when we consider the origins of art. For if art is a worldwide practice, where and when did it first emerge; and similarly, taking into account the complexities of what constitutes art, what are the criteria by which we identify the earliest art objects?

The time and place when humans first demonstrate their abilities as an art-making species is arguable, and has provoked considerable archaeological debate on the subject.[2] In light of recent finds, how we define art within the archaeological record has increasingly raised some issues on what constitutes art. As such, there has been a move towards whether objects possess a symbolic element,[3] which presents its own problems of definition and identification.

The study of the earliest art was, for a long time, the preserve of French archaeologists, in most part, simply because of the wealth of excavation work undertaken in the 19th and early 20th centuries. Steeped in a century and a half of European archaeological excavations and chance discoveries, Upper Palaeolithic Europe became established as the geographical and temporal nexus for the origin of art. The Upper Palaeolithic in Europe broadly dates from around 45,000 – 10,000 BP and is known variously as a “Cultural Explosion”,[4] a “Human Revolution”,[5] and a “Big Bang”,[6] due to the diversity and intensity of material culture.

For some, this so-called ‘Human Revolution’ was the result of a genetic mutation that promoted the fully modern ability to create and innovate,[7] for others it

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[1] Examples of animals demonstrating creative acts are well-documented, indeed paintings made by elephants have been sold at the elite auction houses such as Christie's and shown in museums and galleries around the world. (See Mayell 2002) However, such activity is widely acknowledged as not being the result of symbolic behaviour.
[2] Bataille, 1955; Geidion, 1962; Pfeiffer, 1982; Mithen, 1996; Dunbar et al, 1999; McBrearty and Brooks, 2000; Conard, 2003; D’Errico et al, 2003; Lorblanchet, 2007;
[3] See White, 2003,
[4] Pfeiffer, 1982
[5] Mellars, 1989
[6] Mithen, 2003
[7] Klein, 1999

marked a change in the structure of the brain, allowing an interconnection of intelligences, termed by Mithen ‘cognitive fluidity’,[8] or simply that art was an invention of people who long had the neurological hardware for representational thought.[9]

Notwithstanding the cognitive basis of these objects, their status remains in no doubt. Regarded as an “elite group of artefacts”,[10] they provide evidence for “being part of a symbolic code”.[11] Personal ornamentation, three-dimensional sculptural forms and cave paintings, as well as innovative working techniques in a variety of new materials visibly demonstrate comparable and recognisable characteristics, qualities, and skills in which we currently engage. An important factor in the eminence of Upper Palaeolithic Europe is that the art produced is immediately familiar; there is a reassuring resonance with more recent and current art production. Effectively, we see ourselves in the people of Upper Palaeolithic Europe. This manifestation of artistic activity characterises the emergence of so-called ‘modern human behaviour’, intimately linked with fully syntactical language and symbolic thought. Therefore, Upper Palaeolithic Europe is regarded as the time and place when we first demonstrate fully developed artistic capabilities and become behaviourally modern humans. This capacity for artistic communication is construed as evidence of cultural complexity.

Cultural complexity is not a particularly well-defined concept in prehistory, but in the context of Upper Palaeolithic Europe it has been considered to comprehensively include,

“*the first consistent practice of symbolic behaviour, such as abstract and realistic art and body decoration (e.g. threaded shell beads, teeth, ivory, ostrich egg shells, ochre and tattoo kits) systematically produced microlithic stone tools (especially blades and burins); functional and ritual bone, antler, and ivory artifacts; grinding and pounding stone tools; improved hunting and trapping technology (e.g.,spearthrowers, bows, boomerangs, and nets); an increase in the long-distance transfer of raw materials; and musical instruments, in the form of bone pipes*”.[12]

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[8] Mithen, 1996
[9] White, 2003
[10] Mithen, 2003:176
[11] Mithen, 2003:176
[12] Powell, Shennan and Thomas, 2009:1298

This suite of artefacts and behaviours is, in general, associated with Upper Palaeolithic Europe and the advent of modern human behaviour, although there appears to be strong evidence for many of these markers of cultural complexity at multiple sites in Middle Stone Age Africa up to 100,000 years ago.

Therefore the terms 'cultural complexity' and 'modern human behaviour' are reasonably interchangeable and are used to refer to a list of traits that distinguish anatomically modern humans from behaviourally modern humans. The characteristics of 'modern human behaviour' typically include: increasing artefact diversity; standardisation of artefact types; blade technology; worked bone and other organic materials; personal ornaments and "art" or images; structured living spaces; ritual; economic intensification, reflected in the exploitation of aquatic or other resources that require specialised technology; enlarged geographic range; and expanded exchange networks.[13] Our concern here rests on personal ornaments and 'art' or other non-functional images.

Yet, for some there appeared to be a paradox. Genetic and fossil evidence suggested that anatomically modern humans emerged in east Africa[14] up to 200,000 years ago. We can now say with some assurance that modern-type humans (*Homo sapiens sapiens*) migrated from their African homeland at around 80,000-60,000 BP,[15] probably exiting Africa via the Arabian Peninsula,[16] arriving in Europe at around 45,000 BP. Therefore, there seemed a disparity between the development of modern-type humans physiologically in Africa and the advent of modern human behaviour at around 40,000 years ago in Europe; and this time lag was difficult to account for.

Increasingly, archaeologists have been arguing that elements included in the list of traits were seen in different geographical and archaeological contexts prior to Upper Palaeolithic Europe.[17] Therefore, more recently the definition of 'modern' has shifted to an emphasis on the symbolic nature of 'modern' behaviour,[18] with Conard stating, "The key component of fully modern cultural behaviour is communication

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[13] Taken from McBrearty and Brooks, 2000

[14] The oldest known fossils of modern humans are from the sites of Omo and Herto in Ethiopia dating to 195,000 and 160,000 years ago respectively.

[15] Cann, Stoneking & Wilson, 1987; Stringer & Mckie, 1996; Cameron & Groves, 2004

[16] Rose, 2006

[17] Révillion & Tuffreau, 1994; Marean and Kim, 1998; Bar-Yosef and Kuhn, 1999; Bar-Yosef, 2004; Burke, 2004

[18] Wadley, 2001; Henshilwood and Marean, 2003; Zilhão, 2007

within a symbolically organized world and the ability to manipulate symbols in diverse social contexts”.[19] This emphasis on the symbolic nature of artefacts is an important factor in the modern human behaviour debate, yet how we define and identify whether an artefact is symbolic has the potential to be highly problematic. Evaluating the symbolic importance of an object in which the contextual information is limited or ambiguous makes this a tricky enterprise.

In comparison to Europe, archaeological excavation work undertaken in Africa historically has been on a much less extensive scale; the size of the landmass and the geographic and topographic diversity in Africa makes this endeavour much more complex. Yet increasingly, new discoveries suggest that the origins of ‘modern human behaviour’, including the production of symbolic objects, have their roots in Africa. A landmark paper published in 2000 by McBrearty and Brooks comprehensively argued that virtually all the characteristic traits that comprise so-called ‘modern human behaviour’ were in place in Middle Stone Age Africa, prior to the migration. With regard to artistic activity, evidence of personal ornamentation in the form of perforated shells and abstract markings on stone and ochre were proof that modern-type humans were engaging in symbolic thought within a language-based culture, up to 50,000 years earlier than previously thought.

For some, however, the evidence of art and symbolically mediated behaviour prior to the Upper Palaeolithic is not convincing; as White asserts, “it is difficult to see in this African record any evidence of a burst of symbolic activity coinciding with the biological transition from archaic to modern anatomy”.[20] In fact, he goes further to state that prior to Upper Palaeolithic Europe, “our species produced little or nothing that could be called symbolic”.[21] White further argues that occasional marked objects prior to 50,000 years ago, isolated from each other by enormous spans of time and space, suggest the presence of such a capacity, but an absence of a culturally widespread system of representation.[22] Nevertheless, for some the recent finds of perforated shells and incised stone and ochre from South Africa means, there is now no question that explicitly symbolic behaviour was taking place by 100,000 years ago.

Thus, the current situation presents two opposing viewpoints; put simply, either, art and symbolic thought emerged in Upper Palaeolithic Europe from around

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[19] Conard, 2006b:296
[20] White, 2003:156
[21] White, 2003:156
[22] White, 2003:156

40,000 BP, or that it first appeared in Middle Stone Age Africa up to 100,000 years ago. The important point to make is that 'modern human behaviour', of which art is a significant characteristic, is fully equated with symbolic and abstract thought and by necessity requires fully syntactical language to convey its meaning to others. Essentially, this has resulted in a situation where the same complex set of theories used to explain Upper Palaeolithic art are being applied to Middle Stone Age Africa. Upper Palaeolithic Europe is the benchmark by which antecedents are judged.

It is not my intention to re-define the category of art, despite the term being problematic in many contexts. For the purposes here I will continue to use the terms art, art-like and artistic activity, depending on the extent to which the term is applicable in the particular context. In some ways art is a useful categorisation because in one way or another, the term refers to objects that are regarded in the archaeological literature as symbolic. These are the objects that form the basis of this enquiry. One of the most important things to keep in mind when thinking about Palaeolithic art is the issue of presence over absence. These objects are only under scrutiny because archaeologists had occasion to find them and the materials used were durable. Therefore the 'representativeness' of how art emerges and develops is a matter of bias and must underpin any discussions.

What is of concern here is the nature of symbolic behaviour, especially in relation to Middle Stone Age Africa. Symbolic thought is easier to identify in Upper Palaeolithic Europe because of the greater diversity and quantity of material culture, and often better preserved contextual information. But at the beginnings of artistic activity, why something should be symbolic may be more difficult to ascertain. The current situation, with its focus on attributing symbolic behaviour to objects in the archaeological record in order to identify modern human behaviour, has diverted attention away from observing in what forms art may have first emerged and developed.

The endeavour of this thesis is twofold. Firstly, it will examine the objects classed as evidence of symbolic thought in the archaeological literature, and to see when and where these objects emerge. The aim is to follow the developmental trajectory of these objects in Africa but also as modern-type humans migrate out into other environments. By doing so, we can trace to what extent these objects change and develop, taking into account any similarities and differences. This provides a more interconnected perspective of artistic activities. Instead of using Upper

Palaeolithic as the measure by which other objects are judged, the task is to follow the emergence and development of objects spatially and temporally. The start date of 100,000 BP is defined by the earliest known examples and the end-date of 28,000 BP includes the earlier part of the Upper Palaeolithic period in Europe, but excludes the best-known period of Palaeolithic cave art of the European later Upper Palaeolithic. The end-date coincides with the end of the Aurignacian period, a term defining the first European culture in the early Upper Palaeolithic, but includes a period when humans first begin to make two-and three-dimensional representations, something very different from the earliest art-like activities. Further, the data used in this dissertation may be defined as artefacts that are products of 'art-like' activity, but evidence of behaviours such as the use of red ochre are excluded. In other words, the dissertation confines the discussion to a certain selection of objects.

Secondly, it will consider that these objects produced by modern-type humans have a compelling relationship to the organ that is most critical for their production, namely the brain. References to the relationship between brain and behaviour and the 'Human Revolution' of Upper Palaeolithic Europe are evident in the archaeological literature,[23] but more tangible research between the brain sciences and archaeology is now starting to emerge.[24] Until recently an enquiry such as this was unlikely, simply because of a lack of working knowledge about the functional processes of the brain, especially in relation to artistic production. This situation changed when U.S. Congress designated the 1990s, the 'Decade of the Brain'.[25] This decade marked an explosion of neuroscientific research providing new insights into brain function, from which new debates concerning art and the brain emerged.[26] Ten years on from the Decade of the Brain, and for the reasons given above concerning the study of Palaeolithic art, this reassessment of the emergence and development of art by modern-type humans occurs in light of new neuroscientific data.

The neural principles that are most relevant for the study of art are neural and especially visual plasticity, and mirror neurons. Research has shown that the brain is a

[23] The emergence of cognitive archaeology during the 1980s as one of the newer branches of archaeology has contributed widely in attempting to understand the complexities of the archaeological record and human evolution. See Donald, 1991; Flannery & Marcus, 1983, 1993; Gowlett, 1984; Isaac, 1986; Mithen, 1990, 1994, 1996; Perles, 1992; Renfrew, 1982, 1985; Renfrew & Bahn 1998; Renfrew et al, 1993; Renfrew & Zubrow, 1994; Shennan, 1989, 1991, 1996; Wynn ,1979, 1981, 1991a, 1991b, 1996

[24] Stout, 2005; Renfrew, Frith and Malafouris, 2008, Uomini, 2009

[25] Official 'Decade of the Brain' website http://www.loc.gov/loc/brain/

[26] Two key proponents of this debate were Semir Zeki and V.S. Ramachandran

dynamic organ, it changes its structure throughout our lifetime, adapting to environments and the motor and sensory experiences through which we relate to it, the most important of which in relation to art is visual experience. As we navigate our environment the visual cortex contains cells or neurons that continually reorganise themselves, identifying and categorising novel features, picking out important objects and making associations with stored information. Effectively resulting in a changing but interconnected dictionary of shapes and objects, an important aspect of this is that the more we look at something with any attention the more adeptly and rapidly those neurons will fire on exposure to that object. This strengthens our preference for looking at such objects and even those that share similar properties. This is an important resource when considering the earliest art. For if we know the types of visual experiences to which people in the past have been exposed we may have some foundation for why objects look the way they do. This may also help to explain any similarities and/or differences, and may inform our thinking about why some patterns, materials or representations might acquire symbolic status in particular contexts.

While neural and visual plasticity help us to understand brain function at the level of the individual or group, mirror neurons help explain how we understand each other on a more general level. The mirror neuron system comprises a particular class of visuo-motor cells that give us an autonomous understanding of other people's actions and intentions. They are at the core of our ability to imitate and communicate and are likely to play a significant role in our capacity for empathy. Recent studies also indicate that the human mirror neuron system is active in areas of the brain associated with motor action, vision and memory, and more widespread than first thought. Yet this capacity is not confined to conspecifics, as long as the motor action is mapped onto the observer's repertoire, we will understand and respond. The importance of the mirror neuron system for art production is that they may help us understand why we imitate, or why we may empathise with certain animals, or parts of animals, with which we share similar attributes. In addition, they can inform our thinking about how cultural learning may take place without invoking the concept of fully developed language abilities.

In addition, a principle that has its roots in psychology, but is increasingly being taken up by neuroscientists is that of Environmental Enrichment. The logic of Environmental Enrichment proposes that a combination of elements such as physical activity, social interaction and mental stimulation that involves some degree of experiential learning alters neurological structures in measurable ways. Of these, one significant change is that visual sensitivity may be heightened. This may be important when thinking about the migration of modern-type humans into new and challenging environments, and the potential relationship with the perceptual learning of an environment. A possible corollary is that Environmental Enrichment may be one of a number of contributing factors to the way in which cultural complexity developed and may help us account, in some way, for the expansion of artefacts in Upper Palaeolithic Europe.

A neural approach to the emergence and development of artistic activity by modern-type humans is not intended to discount other contributions; quite the opposite. The approach taken here can only exist because of the meticulous and comprehensive research and analysis carried out by archaeologists providing the principal framework for the study of this archaeological material. This approach however may help us understand why particular objects are made in a particular way at a particular time; and may go some way to explaining why an object might acquire symbolic status.

The following chapter reviews the current state of the field in both Palaeolithic art studies and neuroscience. The history of the discovery of Palaeolithic art and the ways in which it has been interpreted has resulted in legacies affecting our current thinking and interpretative strategies. In contrast, the history of neuroscience is qualitatively different, in that it is only because of recent developments in research and neuroimaging techniques that we are now in a position to use this information about the brain to help us in our enquiries. In examining these two areas of study, the aim is to exemplify the complex issues involved in Palaeolithic art studies, and how the recent interest in art and the brain can act as a tool in facilitating fresh insights.

The most relevant information of brain function that helps with our understanding of the earliest art are discussed in Chapter 3. Neural and visual plasticity, and mirror neurons are described and explained not only as neural principles, but in terms of their implications and usefulness in this archaeological enquiry. In addition, this chapter introduces the concept of Environmental Enrichment studies. This principle is explained in relation to the movement of modern-type humans both within and outside of Africa, examining how the movement into new and challenging environments may have contributed to new ways of learning and observing. As such, this chapter includes the types of palaeoenvironments modern-type humans may have encountered, and their potential impact upon neural resources.

The collections of objects under discussion are presented in Chapters 4, 5 and 6. The data set is presented in a detailed and systematic manner, taking a chronological and geographical approach. The data from Middle Stone Age Africa is presented in Chapter 4. This comprises all the evidence from 100,000 – 28,000 BP. Chapter 5 presents the data from India, Papua New Guinea, Australia and the Levant, as modern-type humans migrate out of Africa. The European data set is presented in Chapter 6. This comprises objects from c 45,000 BP as modern-type humans' move into Europe, until 28,000 BP. The starting date of 100,000 BP is selected as this is the earliest evidence we have of artistic activities by modern-type humans. The end date depends on two factors; 28,000 BP is the time when the first representational art appear in Africa, but it also coincides with the end of the Aurignacian period in Upper Palaeolithic Europe. After this period cultural objects acquire greater complexity, and there is not room in this thesis to address the intricacies of that period here. Because of the different quantities of evidence from each of these geographical locations, the size of the chapters reflects this disparity. The criteria for choosing the data under discussion is based on artefacts that are dated either absolutely by radiometric dating or relatively in a secure stratigraphic context. In regulating the artefacts in this way I have constrained the number of objects included in the catalogue; however those that are included are reliably dated and therefore allow for a potentially more stable and authoritative argument.

The appendix comprises the catalogue of objects referred to and discussed in this thesis. Each artefact or group of artefacts has its own data entry with all the accompanying archaeological information currently known for that object or group of objects. This will include as much detailed contextual information as possible, as well as current interpretations.

Chapter 7 provides a brief statistical analysis. The data analysed pertain to the types of objects and materials found and simply shows how object types and materials alter, or not, as modern-type humans move into different environments. In some cases because of the limited data set there is not a great deal on inference to be made. Nevertheless, it is useful to see what, if any, patterns in the data can be observed.

This culminates in the final discussion chapters. This is divided into two sections; Chapter 8 includes Middle Stone Age Africa and Chapter 9, the remaining data as modern human migrate out of Africa. These two chapters consider what mental processes might have led to the making of these objects. Using the principles of neural and especially visual plasticity and mirror neurons, the earliest art can be considered in light of the visual and motor contexts of the humans involved in its production. The aim is to find the source of the visual interest that may have led to their production. Each object or group of objects will be discussed in relation to the environment (physical, social and cultural) in which it was produced, seeking out possible visual and neural motivations. Chapter 9 also addresses the role that Environmental Enrichment may play in helping to explain how behaviours might change with differing social, physical or learning contexts. While these two chapters are concerned with the influence of the environment (physical, social and cultural) on the visual cortex through neural plasticity, it must be stressed that the relationship between acquired visual memory and the production of specific types of artefacts necessarily remains speculative. The capacity for understanding art production as the result of brain function is still in its infancy and therefore the aim here is to make any propositions as plausible as possible, in the light of the information available.

The concluding chapter reflects on the way in which this approach has implications for our understanding of the earliest art. Looking to the mental processes of why something should be made in the first instance may help to understand similarities and differences in art production. Therefore, rather than assuming symbolic behaviour, this approach may help us understand why something may acquire symbolic status. This chapter will reflect on the application of a neural approach and possibilities for future research.

CHAPTER 2

The History of Research in Palaeolithic Art and Neuroscience

2.1 INTRODUCTION

The reasons why the time is ripe for a study of Palaeolithic art in the light of neuroscience emerge clearly from a consideration of the present state of research in both fields. The focus of this chapter is twofold in that it presents a brief historiography of both the fields of Palaeolithic art studies and Neuroscience, understanding the ways in which each discipline has progressed and developed, culminating in a survey of the current state of the field of each discipline. The aim is to demonstrate that the recent increase in information about the brain may complement and inform current perspectives of Palaeolithic art.

To divide this into two parts, the first section will focus on the history of Palaeolithic art, resulting in current approaches and interpretive strategies. The second section will address the more recent history of brain research, demonstrating that the later 20th century and early 21st centuries have not only seen a significant increase in neuroscientific knowledge, but a growth in the application of that knowledge to other disciplinary fields, most notably the Humanities. It is this conjunction that has instigated this enquiry.

PART ONE

2.2 Introduction to Palaeolithic Art Studies

The study of Palaeolithic art was, for a long time, the preserve of French archaeologists. More recently, it has come to preoccupy others around the globe and has developed into a stimulating area of study involving such disciplines as anthropology,[27] palaeoanthropology,[28] evolutionary psychology,[29] linguistics,[30]

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[27] Ingold, 1974, 1984, 1994, 2001; Lewis-Williams & Dowson, 1988; Ingold & Gibson, 1993; Gosden, 1999; Abramson, 2000; Lewis-Williams, 2002; White, 2003.

[28] Stringer & McKie, 1996; Tattersall, 1998, 2002; Stringer, 2005;

environmental science,[31] art history,[32] and cultural primatology.[33] Today these are joined by neuroscience,[34] which can be included in this cross-disciplinary field due to increasing neurological research and interest concerning the relationship between brain and behaviour and this chapter explores these shifts of approach.

Available methods of understanding past human behaviour from material remains are both rich and productive. Yet, after more than a century of archaeological discoveries and interpretations, the present picture of Palaeolithic art remains in many aspects unclear. In some cases, contextual information is simply missing, leaving us with gaps in our knowledge and understanding;[35] in others, contemporary anthropological parallels have been invoked cross-culturally and retrospectively in order to make sense of the past.[36] Numerous explanatory frameworks have been developed during the past century and a half's worth of discoveries of Palaeolithic art, but when it comes to evaluating the assumptions on which they rely, there is little common ground. One exception is the belief that art as a symbolic and creative act is the product of what is termed 'modern human behaviour'.[37] Although its geographical and temporal origin remains a hotly debated topic, the consensus is that art is a characteristic behaviour of modern humans, *Homo sapiens sapiens*.[38]

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[29] Donald, 1991; Humphrey, 1998; Corballis & Lea, 1999; Dunbar *et al*. 1999, 2005; Dunbar 2004; Coolidge & Wynn, 2004,2006

[30] Wilkins & Wakefield, 1995; Whitcombe,1995; Bickerton, 1996, 2003; Deacon, 1997; Hauser, Chomsky & Fitch, 2002; Botha, 2003, 2005; Christiansen & Kirby, 2003; D'Errico *et al*, 2003; Hurford, 2004a,b;

[31] Bell & Walker, 1992; Dincauze, 2000; Evans, 2003; Gamble *et al*. 2004; Burroughs, 2005; Anderson *et al*. 2007

[32] Lippard, 1983; Dissanayake, 1992; Sandars, 1995; Onians, 1996, 2004; Renfrew, 2003;

[33] Savage-Rumbaugh, 1986; Loy and Peters 1991; McGrew, 1992, 2004; De Waal & Lanting, 1997; Savage-Rumbaugh *et al*. 1998; De Waal & Thompson, 2005.

[34] Humphrey, 1999; Martindale, 1999; Ramachandran & Hirstein, 1999; Zeki, 1999a,b; Ramachandran, 2000, 2004; Rizzolatti & Graighero, 2004; Tanaka, 2004; Solso, 2005; Lahn, 2006.

[35] See White, 2003:221 for a discussion on this issue.

[36] An example is the debate concerning trance experiences and their potential relationship with prehistoric art. J.D. Lewis-Williams & T.A. Dowson (1988), proposed the 'Three Stages of Trance' model, which suggests that 'altered states of consciousness' inspired Palaeolithic cave art. For a critique of this, see Helvenston &.Bahn (2003).

[37] For an account of the criteria of modern human behaviour in the archaeological record, see McBrearty & Brooks, 2000. pp: 491-493.

[38] For an alternative view that the origin of artistic activity emerged much earlier, see Bednarik 1992, 1994, 1999, 2003

2.3 Discovery

The earliest discoveries of Palaeolithic art in the nineteenth century consisted of mobiliary or portable art. Between 1830 and 1875, hundreds of decorated fragments of bone, antler, and stone were excavated under improving archaeological conditions, and with an increasing recognition of their antiquity.[39] These small carved and sculpted artefacts, (at first ascribed to the Celts),[40] were later unearthed in more defined contexts where an association with other Palaeolithic material was unequivocal, thus validating their more ancient origins. In 1864, the French archaeologist Edouard Lartet and the English ethnologist and philanthropist Henry Christy published a paper in the *Revue Archéologique*[41] demonstrating that the engraved and carved bone and stone found in undisturbed deposits in the Dordogne and Pyrenees were the products of Upper Palaeolithic people. This brought a revolution in prehistoric archaeology. Previously, the investigation of the remote past had been a pursuit for amateurs and country gentlemen; now, it was transformed into a scientific endeavour, with specialists using established practices, methods, and terminology.[42]

The recognition of the antiquity of mobiliary art was comparatively well-received; parietal art, when first encountered was not so easily accepted. In 1878, in the northern Spanish village of Santillana del Mar, Count Don Marcelino Sanz de Sautuola had been excavating Palaeolithic flints and animal bones from the floor of a cave on his property, the sort of area where all trained archaeologists expected to find the most significant discoveries. His daughter, whose level of expectation was less fixed, looked up and discovered paintings on the ceiling.[43] She had found, by accident, the now famous painted bulls on the roof of Altamira cave. The Count's colleagues in the world of prehistory and art history presumed either that these major works were beyond the capabilities of Palaeolithic people, or doubted that such works could be preserved for such a long time. Many considered Sautuola an impostor and a fraud. For a quarter of a century, the archaeological establishment

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[39] White, 2003:45
[40] Ucko & Rosenfeld, 1967:116
[41] Lartet, Edouard & Christy, Henry. 1864. Objets gravés et sculptés des temps pré-historiques dans l'Europe Occidentale. *Revue Archaéologique,* 1: 233-270.
[42] Bahn, 1996:118
[43] Daniel & Renfrew, 1988:49

dismissed the paintings as too good to be ancient; "a dauber's vulgar joke".[44] For the most part, Altamira was treated either with mistrust or dismissed as inconvenient in terms of current assumptions, except among some of the foremost prehistorians of the day, one of whom was Edouard Piette (1827-1906). A magistrate and a geologist, his pioneering series of excavations along the Pyrenees at sites such as Brassempouy, Gourdan, Lortet, and Le Mas d'Azil, led him to important conclusions about the sequence of archaeological cultures in the late Ice Age.[45] In 1887 he claimed that the Altamira paintings were Magdalenian[46] in date, and their authenticity was accepted in his *Equidés de la Période quaternaire d'après les Gravures de ce Temps,* as well as Chauvet's *Les Débuts de la Gravure et de la Sculpture*, both published in that year. In 1902, a meeting of the great prehistorians of the day convened at La Mouthe, and shortly after, Altamira was officially declared authentic. From this point on, Palaeolithic art "now begins to be treated as it should be, as the first artistic manifestation of man in Europe, not merely as a curious feature of ancient man".[47] So begins the systematic study of Palaeolithic art.

Now, though, the floodgates had been opened and the late nineteenth and the early twentieth century saw a torrent of new discoveries in France; namely La Mouthe (1895), Pair-non-Pair (1896), Les Combarelles (1901) and Font-de-Gaume (1901).[48] Furthermore, Lartet's work in the Dordogne triggered an "uncontrolled 'gold rush' as people began to pillage rock-shelters with pickaxes"[49] looking for stone and bone tools and especially portable Ice Age art. Unfortunately, many objects of significance were unearthed with no consideration of noting the position or context of finds.

In the first half of the twentieth century, many Palaeolithic sites in western Europe were intensively excavated.[50] Bringing order to the past through chronology, typology, and stratigraphy remained key concerns, but little attention was paid at the

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[44] Bahn, 1996:116
[45] Bahn, 1996:122
[46] See Glossary
[47] Daniel, 1975:132
[48] Daniel, 1975:132
[49] Bahn, 1996:119
[50] In 1922, Peche Merle revealed some sixty painted and engraved animal figures dating to c.25,000-10,000 BP. In 1923, excavations at Montespan in the Pyrenees uncovered engravings on the walls and clay statues and reliefs. Discoveries of mobiliary art include excavations undertaken by Gustave Riek at Vogelherd in southwest Germany in 1931, which yielded a series of small Aurignacian ivory carvings of animals dating back at least 30,000 years, placing them among the oldest such objects ever found. (See Conard & Bolus, 2003; Conard 2003, Teyssandier, Bolus & Conard 2006).

time to what the finds meant (in human terms).[51] France in particular yielded a series of Ice Age decorated caves of major importance.

One of the most famous discoveries was made in the unoccupied zone of France during the Second World War, and until recently, was regarded as the most richly decorated cave known anywhere in the world.[52] Lascaux Cave, located near Montignac, in the Dordogne, yielded six hundred wall paintings and nearly fifteen hundred engravings, preserved with astonishing clarity. Lascaux's art is often thought of as a single composition painted around 17,000 years ago, but more probably comprises images of many different dates. Nearly sixty years after its discovery, as Bahn asserted, "The French cave of Lascaux remains the most spectacular gallery of Ice Age art ever discovered".[53] It is worth noting the impact of Upper Palaeolithic art does not seem to wane with successive generations of archaeologists.

The artistic accomplishment of Lascaux has, however, been challenged by the more recent discovery of Chauvet cave in the Ardéche region of France in 1994, by French speleologists Jean-Marie Chauvet, Eliette Brunel and Christian Hillaire. Chauvet cave has revealed some of the most naturally realistic renderings and the oldest parietal art yet discovered in western Europe, some of which dates back 32,000 years, 15,000 years older than Lascaux.

The importance of Chauvet lies in the way it transforms our view of the Upper Palaeolithic, showing that very early in modern human migration into Europe people were creating representational imagery, demonstrating "not only the artists' very acute sense of observation but also a well-developed knowledge of ethology".[54] The evidence from Chauvet, as well as sites from the Swabian Jura in southern Germany first excavated by Riek,[55] and more recently by Conard,[56] which has yielded numerous ivory animal figurines, indicate there is now increasing evidence for an early florescence of art during the early Upper Palaeolithic period.

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[51] Bahn, 1996:206
[52] Bahn, 1996:209
[53] Bahn, 1996:209
[54] Clottes, 2003:202
[55] Riek, 1931,1934
[56] Conard, 2003, 2009; Conard & Uerpmann, 1999; Conard & Floss, 2003; Conard *et al*. 1999, 2003a,b, 2007

2.4 Interpretation

In its discovery and its subsequent study, Palaeolithic art has remained an area of uncertainty and anxiety. Initially, as has been discussed, insecurities centred on its antiquity and authenticity, but lurking in the shadows were the problems surrounding its analysis and interpretation. Once the dating of Palaeolithic art had been confidently dealt with, these issues gained a new prominence.[57]

Portable or mobiliary art was the earliest evidence of artistic activity discovered, and in 1864, Lartet and Christy made the first attempt at some explanation.[58] Their attempt at explaining the phenomenon of Palaeolithic art was in terms of the influence of exceptionally rich environmental conditions. Their theory maintained that although Palaeolithic people were evidently culturally primitive, the abundance of wild game could have made survival activities so easy that they had plenty of leisure time, and that it was this leisure time that promoted artistic production.[59] As their hunting activities were relatively stress-free and not protracted affairs, their free time provided the opportunity not only to "decorate their weapons, but also the luxury of wearing ornaments".[60] The explanation of art being the product of an abundance of free time made it unnecessary to credit its origin to anything consequential.[61] While acknowledged as artistic endeavours, Palaeolithic societies' creative forays required no explanation beyond the notion of "art for art's sake". Interestingly, art historians regarded them as relatively minor (decorative) arts, and while important, they were by no means "controversial or revolutionary".[62]

Lartet and Christy's rationale preceded the recognition of parietal art, and while accepted only for a short time, its indirect influence has been considerable. Twenty years after their original proposition, discussion of Palaeolithic art remained focused on ideas of aesthetic adornment and enhancement. The possibility of this art being symbolic was deemed remote.[63]

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[57] Bahn, 1996; Daniel, 1975; Ucko & Rosenfeld, 1967; White, 2003.
[58] Lartet & Christy's study was published in the following article, Lartet and Christy, 1864. 'Figures d'animaux gravées ou sculptées' in *Revue Archéologique*, 9.
[59] Lartet & Christy, 1864
[60] Lartet & Christy, 1864
[61] Another variation can be founding the work of Riddell who maintained that only in winter could Palaeolithic people find the time to be artistic while relying on the hoards of food preserved by the ice. See Riddell, 1940
[62] Lartet & Christy, 1864
[63] Ucko & Rosenfeld, 1967:118

Towards the end of the nineteenth century, however, this situation changed. Ethnographic reports filtering out from Australia described the indigenous people as living similar cultural lives to those of Palaeolithic people; they also produced remarkable and complex paintings, some of which were on rock shelters.[64] These accounts began to transform interpretations of Palaeolithic art, demonstrating, for example, that Lartet and Christy's assumption that artistic activity by hunter-gatherers required exceptionally rich environmental conditions was flawed.[65]

By the end of the nineteenth century serious ethnographic research was flourishing,[66] providing rich descriptions of little known cultural groups, "in which representation was anything but for its own sake".[67] Moreover, the fact that many Palaeolithic parietal representations were located in the far reaches of deep underground caverns, in itself, elicited reservations about the "art for art's sake" explanation.[68] The implication was that the seemingly inordinate investment of time and energy in cave art was disproportionate for a casual preoccupation. What resulted was "a tacit equation in the minds of both archaeologists and ethnographers between the primitiveness of hunters and gatherers living in the remote times of the Palaeolithic and the primitiveness of hunters and gatherers still living in the remote corners of their own world".[69] Thus, contemporary ethnographic data in the late nineteenth century was used retrospectively to understand people in prehistory.[70]

Stimulated by the proliferation of ethnographic accounts,[71] two interpretive themes emerged at the beginning of twentieth century, totemism, and sympathetic magic.[72] The concept of Totemism is a belief system whereby natural objects are revered,[73] and is a custom by which an individual or group claims descent from some

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[64] European researchers concerned with the discovery and interpretation of Upper Palaeolithic art, were heavily influenced by the publication of Tylor's *Primitive Culture* (1873), Frazer's *Golden Bough* (1890) and Spencer and Gillen's *The Native Tribes of Central Australia* (1899)
[65] Ucko & Rosenfeld, 1967:117
[66] During the 1880s and 1890s anthropology as a discipline was institutionalised in Britain, Germany, France, and the USA, with separate sets of issues being raised in each of the four countries. For a comprehensive account of ethnographic research during this period, see Eriksen & Nielsen 2001.
[67] White, 2003:50
[68] White, 2003:50
[69] Ucko & Rosenfeld, 1967:117
[70] For a contemporary usage of a similar methodology, see Lewis-Williams, 2002.
[71] E B Tylor. 1871. *Primitive Culture* and James George Frazer. 1890. *The Golden Bough*, together provided a synthesis of the complexity of modern primitive peoples' thoughts and actions and grouped together the cultural activities of men both in antiquity and in the present.
[72] White, 2003:50
[73] The term *Totem* originated from among North American nations and has its counterpart among the nations of Australia.

plant, animal, or other natural object, which then serves as an emblem for that individual or group.[74] Sympathetic magic on the other hand, is founded in a belief system based on correspondence. It is predicated on the belief that one thing or event can affect another at a distance, because of a sympathetic connection between them. Particularly influential was the view that prehistoric art represented sympathetic hunting magic, an idea espoused in 1903 by Salomon Reinach, director of the Musée des Antiquités Nationales, in Saint-Germain-en-Laye, France.[75] In particular, sympathetic magic observed in early twentieth century Australia [76]and Africa[77] served as sources of inspiration for early attempts at understanding the functions of, and motivation for, the imagery documented from the European Palaeolithic.

The ‘Art for Art’s sake’ remained current at least into the 1920s[78] but two forceful proponents of the ‘art as magic’ notion were Count Henri Bégouen[79] and the foremost authority on Palaeolithic cave art in France, Abbé Henri Breuil (1877-1961).[80] From 1901, Breuil began to publish the results of his comprehensive study of Palaeolithic art.[81] His influence was to dominate studies of prehistoric art for decades, due as much to his personality as to his scholarship. Indeed, he was referred to as the ‘Pope of Prehistory’.[82] From the outset, Breuil was convinced that the explanations of Lartet and Christy were too simple to explain the complexities of Palaeolithic art. Instead, he relied on ethnographic parallels to expose the real meaning of the art, and at an early stage in his career accepted the significance of Palaeolithic art as possibly being religious, ‘fetishistic’ or totemic.[83]

During the Second World War, he began a long campaign of copying rock art in parts of southern Africa, and by the end of his life in 1961 Breuil was responsible

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[74] OED online
[75] Reinach, S., 1903. L'art et la magie. A propos des peintures et des gravures de 1'Age du Renne. *L'Anthropologie* 14, 257-66.
[76] For a 19th century perspective on Australian art see Rev John Mathew ‘The Cave Paintings of Australia, Their Authorship and Significance’ in *The Journal of the Anthropological Institute of Great Britain and Ireland*, Vol. 23. (1894), pp. 42-52.
[77] See Orpen, 1874 for an account of therianthropic imagery recorded at the Melikane rock shelter in the Lesotho mountains in the nineteenth century.
[78] The French geologist, palaeontologist, and physical anthropologist Marcellin Boule staunchly argued the ‘art for art’s sake’ position into the 1930s in *Les Hommes Fossiles*, 2nd ed.
[79] Count Begouen was a convinced supporter of this interpretation; see Begouen, 1929. ‘The magic origin of prehistoric art’, in *Antiquity* 3.
[80] Henri Breuil trained as a priest, but was initiated into the study of Palaeolithic art in 1897 by Edouard Piette. (Bahn, 1996:123)
[81] By his own calculation he spent more than 700 days underground, copying cave drawings (ibid)
[82] Bahn, 1996:123
[83] L Capital, D Petrony, H Breuil. 1910. *La Caverne de Font de Gaume, aux Eyzies (Dordogne).* Monaco.

for more documentation of Palaeolithic art than any other scholar of prehistory. His eminence in the world of archaeology and prehistory ensured his views became the most widely accepted of all interpretations. Despite being an "irascible and egotistical man",[84] Breuil's image as the 'pope of prehistory' was so ingrained that he was often regarded as virtually infallible. So much so, that "it is only in recent years that it has become possible in France to criticise and re-examine his work openly",[85] where his vast legacy of publications and tracings are found to contain many errors and misjudgements.

An articulate sceptic of the 'art as magic view' was G. H. Luquet,[86] who explained the origin of artistic activity as "some sort of spontaneous invention".[87] Luquet was a pioneer in the study of children's art[88] and brought this research to bear on his investigations of prehistoric art.[89] He postulated that art might have begun in something like finger painting, the accidental production in impressionable material, such as soft clay of shapes that resembled real things,[90] which inspired in people the "realisation of their ability to create certain images, not only by chance, but by a deliberate process".[91] For Luquet, in its beginnings at least, art had no purpose or function beyond itself. Luquet's considerable *oeuvre* on Palaeolithic art has been largely ignored, perhaps because he was a psychologist and art historian, not a prehistorian.[92] He argued that large numbers of images and objects provide no compelling reason for a magical interpretation and his position was that a multiplicity of meanings and motivations lay behind Palaeolithic representations.[93]

Radical changes in the approach to interpretation occurred in the 1950s when Structuralist theory grew to be one of the most popular approaches in academic fields concerned with the analysis of language, culture, and society.[94] The term

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[84] Bahn, 1996:62
[85] Bahn, 1996:63
[86] Luquet, G-H. 1926, 1930.
[87] Geidion, 1962:2. This interpretation is not unlike Colin Renfrew's (2006) assertion that the art of the Upper Palaeolithic was a "side channel or flash in the pan".
[88] G-H. Luquet, 1913, 1927
[89] G-H. Luquet, 1930.
[90] This line of reasoning has been re-examined in the light of contemporary neuroscientific research; see Onians, 2007.
[91] Luquet 1930:132
[92] White, 2003:51
[93] White, 2003:54
[94] Structuralism appeared in academia for the first time in the 19th century. The linguist Ferdinand de Saussure is often termed the 'Father of Structuralism' as well as the 'father of semiotics', which relates to the study of sign processes or signification and communication. Saussure proposed a

"structuralism" itself appeared in the works of the French anthropologist Claude Lévi-Strauss[95] and subsequently the approach was applied to the study of Palaeolithic cave images. Structuralism as a theoretical approach attempts to grasp the general qualities of meaningful systems in terms of relationships.

The primary proponent of a Structuralist approach in Palaeolithic art was the French archaeologist André Leroi-Gourhan.[96] This new perspective, provoked exhaustive studies that documented and mapped every recognisable image, every abstract form, line, dot and possible doodle of parietal art. Much of the interest of a Structuralist approach lies in the analysis of spatial relationships among these elements and their relationship to the natural cave structure. The benefit in this approach, in contrast to that of Breuil, was that it made it essential to date the images accurately,[97] ensuring that the images studied were contemporaneous.[98] Structuralism was the last grand attempt at a definitive decoding of cave art, but its overarching theory, that the paintings mediated binary oppositions, left many particularities and irregularities unresolved.

While Leroi-Gourhan tended to treat all caves as equal in structure, recent researchers such as Denis Vialou[99] and Michel Lorblanchet[100] focus on the peculiarities of each individual cave. Lorblanchet describes the encounter between Palaeolithic artist and complex underground spaces as a “dialogue with the cave”.[101] Essentially, the focus is on the ways in which complex and variable 3-D underground spaces were appropriated in the process of representation. The choices made by Palaeolithic artists in subject, technique and use of colour are studied in relationship to pre-existing forms of the cave and correlations with surfaces, textures, light conditions, and even acoustic qualities.[102] Lorblanchet and Vialou see caves as ‘mythograms’, working as a visual or experiential adjunct to verbal narratives.[103] However, like language, the relationship between structure and meaning is negotiable. Most notably, Lorblanchet’s work in experimental techniques of painting

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dualistic notion of signs, relating the *signifier* as the form of the word or phrase uttered, to the *signified* as the mental concept.

[95] 1908 – 2009. For an account of Levi-Strauss, see Eriksen &Nielsen, 2001. pp:104 -108

[96] Leroi-Gourhan, 1968, 1982

[97] This coincided with the advent of radiocarbon dating.

[98] White, 2003:46

[99] Vialou, D. 1986

[100] Lorblanchet, M. 1995

[101] White, 2003:57

[102] White, 2003:57

[103] White, 2003:118

(and paint analysis) is providing unique insights into the production of cave paintings.[104]

Jean Clottes and his team in the ongoing research undertaken at Chauvet cave are currently exploring the work pioneered by Lorblanchet. Clottes suggests that the art at Chauvet demonstrates “evidence of a state of mind and a certain conception of the subterranean world”.[105] One of the intriguing questions surrounding the Chauvet imagery is why they appear to demonstrate a predilection for representing dangerous animals .[106] Alluding to Lorblanchet’s work, Clottes’ proposition, and he suggests “most plausible explanation”[107] is that a change or an evolution occurred in the fundamental myths which the art cannot fail to express, even when it is executed – wherever that may be – within the framework of shamanic[108] practices and beliefs”.[109]

An anthropological perspective of Chauvet provided by Joëlle Robert-Lamblin[110] incorporated within the report suggests there is a duality in the parietal art based on the depiction of social and non-social animals, with the layout of the cave being divided into two particular sections and the specific use of colours in these different areas. This strong dichotomy supposedly “makes it possible to put forward the hypothesis of a dual structure of the universe among the Aurignacians”,[111] predicated upon the idea of a universal binary principle in the cosmos. This conception of the universe as both an opposition and fusion between humans and animals, together with the location of the cave, suggests, for the researchers, notions of religious function, shamanistic practices and sacred spaces. Indeed, comparisons of environments and ways of life between contemporary Inuit populations and the Palaeolithic hunter-gatherers of the Ardèche are invoked to justify a claim that

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[104] Lorblanchet, 1991
[105] Clottes, 2003:210
[106] Clottes does make clear that although they have termed them ‘dangerous’ animals they are fully aware of the subjective nature of such a term, and that it is more a term of convenience.
[107] Clottes, 2003:213
[108] The term “shaman”, originating in the Tungus language in Siberia, is used to refer to healers, sorcerers, witch doctors, medicine men, magicians and related figures (Vitebsky 1995).
[109] Clottes, 2003:213. For further information on this topic, see Clottes & Lewis Williams 1996.
[110] Joëlle Robert-Lamblin, is an anthropologist, director of research at the Centre national de la recherche scientifique (CNRS), Head of the Laboratory: "Dynamics of Human Evolution"(Paris). She specialises in traditional peoples of Arctic regions. She was solicited for the Chauvet research team for her knowledge of populations who live under climatic conditions similar to those of the Palaeolithic era.
[111] Robert-Lamblin, 2003:202

similarities in cosmogony may account for the depictions in Chauvet cave.[112] These hypotheses resonate with past approaches incorporating Structuralist thought and the use of ethnographic analogies.

The shamanic interpretation as advocated by Clottes is an approach endorsed by David Lewis-Williams in his book *The Mind in the Cave* (2002). Inspired by recent ethnographic studies of South African bushmen and Arctic Inuit,[113] Lewis-Williams' line of reasoning is that the parietal art of the Palaeolithic, especially that located deep in the cave systems is related to the pursuit of contact with the spirits and that certain geometric images are the product of hallucinations experienced in a trance state. The question of meaning in cave art may be problematic but Lewis-Williams is sufficiently confident to believe that his "suspicion seems well-founded enough to be called a hypothesis".[114] Although he uses and applies principles of neuroscience as an explanatory tool, "the book is not as much based upon the rigid empirical analysis of data as on carefully constructed arguments".[115]

A recent approach to the study of Palaeolithic art has been undertaken by Guthrie in his 2005 publication, *The Nature of Palaeolithic Art*. Bringing his expertise in zoology, palaeontology and modern hunting practices to bear, Guthrie seeks to "place Palaeolithic art in a larger dimension of natural history and of linking artistic behaviour to our evolutionary past".[116] Rather than searching for hidden meaning, Guthrie attempts to view the art as window into the life of Palaeolithic people. This recent line of reasoning by Guthrie is important because he seeks to find clues concerning the symbolic significance of Upper Palaeolithic in terms of past human behaviour and environmental factors, a rationale of this thesis.

A number of authors have been concerned with experiential approaches to the environment.[117] Such approaches are concerned with the ways in which historically, western thought and science have separated the two worlds of humanity and nature. As such focus ahs been directed more towards humans operating within their environments and the diverse capacities of humans growing up and engaging in

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[112] Robert-Lamblin, 2003:206
[113] It is interesting to note that shamanic practices have been advocated for parietal art in the Upper Palaeolithic based on two geographical disparate populations, the Inuit of the Arctic and the San Bushmen of southern Africa.
[114] Lewis-Williams, 2002:206
[115] Helskog, 2003:269
[116] Guthrie, 2005:viii
[117] Gibson, 1979; Tilley, 1994; Cartledge, 1998; Bowden, 1999; Ingold, 2000; Golledge, 2003; Bender, Hamilton and Tilley, 2007

different surroundings. Tilley integrates philosophical approaches to landscape perception, with anthropological studies of the significance of the landscape in small-scale societies. This perspective examines the importance of place in terms of prehistoric sites and the relationship to their topographic settings. Ingold in particular proposes that the differences we call cultural are indeed biological, but negate any racist associations whatsoever. By refocusing on the human-being-in-its-environment, Ingold disperses with the need for a species-specific characterisation of humankind, and so also with the opposition between species and culture.[118] The importance of the environment in people's psyche plays an important role in these approaches, where landscape is socialised and is part of a cultural context.

One of the first cross-cultural studies to analyse the relationship between visual perception and the environment was undertaken by Segall, Campbell and Herskovitz and published in the '*The Influence of Culture on Visual Perception*' (1966). The authors studied subjects from three European and fourteen non-European cultures and tested three hypotheses about the effects living in certain types of environments on susceptibility to various visual illusions. Although under the rubric of a cultural enquiry (they were all anthropologists) effectively the study demonstrated biological and neurological lines of enquiry; that the environment to which an individual is exposed affects their visual brain in such ways that shapes their perceptions of dimension, space and colour.

A later study undertaken by Maurer and Baxter (1972) showed that different cultures exposed to a similar environment create different visual representations. They compared sketch maps of a specific place made by Afro-American and Anglo-American individuals and revealed first that the Afro-American sketches were less spatially accurate than those of the Anglo-Americans; and secondly, that different sets of landmark features appeared to dominate the sketches of each group. Ramadier and Moser's 1988 study supported such results; they also showed differences when comparing African and European students' representations of Paris. Students from Africa produced a more diagrammatic or spatially objective view of the city, whereas European representations emphasised value and historical meanings as key identifiers of places and relations.

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[118] Ingold, 2000:391

What such studies demonstrate are the direct role of experience-dependent plasticity, whereby the brain's neural networks are configured based on personal experience; and more specifically that the way in which we see and understand the world is based on the way our visual brain is organised based on previous visual experiences. The role of the environment then has been the subject of many and diverse studies in relation to human behaviour, and certainly has been the focus for understanding human behaviour in prehistory.

One of the most significant issues in the study of Palaeolithic art is the dichotomy in scholarship. There are those scholars who seek to imbue art with meaning and significance, co-opted from a variety of sources, and those who use Palaeolithic art to search for clues on past lives. However, by combining these two perspectives, we may speculate on what factors in the lives of people in the past may have played a sufficient role that particular aspects of it took on a symbolic significance. Notwithstanding the problems outlined in analysing and interpreting art of the Upper Palaeolithic, the picture has been blurred by a recent change of geographical focus.

2.5 Changing the focus from Europe to Africa

One reason for having reservations about current approaches to the Upper Palaeolithic is that in recent years they are all thrown into doubt by the discovery of art-like activities in earlier contexts and different geographical areas. For well over a hundred years, the archaeological spotlight has shone on Upper Palaeolithic Europe as the time and place when 'art' first makes an appearance. More recently, archaeological work undertaken in Africa, the geographical origin of *Homo sapiens sapiens*, has contested this notion of an emphasis in Europe.

Genetic and fossil evidence supports the Out of Africa hypothesis,[119] which proposes that anatomically modern humans arose in Africa somewhere after 200,000 years ago, and migrated out between 80,000-60,000 BP, reaching Europe at around 45,000 BP. The Out-of-Africa theory was bolstered in the early 1990s by research on mitochondrial DNA by Allan Wilson and Rebecca Cann, which suggests that all humans ultimately descended from one female, named Mitochondrial Eve, who lived in Africa. The logic of this research would suggest that the behavioural traits

[119] Cann, Stoneking & Wilson, 1987; Stringer & Mckie, 1996; Cameron & Groves, 2004;

witnessed so explicitly in Europe could potentially have their antecedents in the archaeological record in Africa, prior to the migration.

Until recently, this logic was highly questionable, but a paper published in 2000 by Sally McBrearty and Alison Brooks entitled, '*The Revolution That Wasn't: a new interpretation of the origin of modern human behavior'* challenged this conventional wisdom.[120] Their premise was that the criteria used to define modern human behaviour[121] could be seen in the archaeological record from sites throughout Africa, dating to the Middle Stone Age. Their paper has been a landmark on several levels: for its comprehensive reassessment of the African archaeological record during the Middle Stone Age, for its significance in relation to the debate about the origin of artistic phenomena and for discussions of the evolution of fully syntactical language. Whatever our conclusions on these issues, the data from Africa add a new complexity.

One of the principal sites supporting the notion of an African origin for modern human behaviour and for the early emergence of art is Blombos Cave on the southern Cape shore of South Africa. Excavations undertaken by Chris Henshilwood have recently unearthed perforated shells and ochre plaques with incised geometric patterning, dating to 77,000 BP.[122] For Henshilwood these artefacts indicate that, "the cognitive abilities and capacity for abstract thought are in line with what we would expect of modern human behaviour".[123] Further evidence of similar marked pieces of stone comes from Wonderwerk Cave and Klein Kliphuis, South Africa, dating to 100,000 BP and 50,000-80,000 BP respectively. In addition, perforated *Nassarius* shells from Grotte des Pigeons in Taforalt, Morocco, North Africa, dating to 82,000 BP,[124] and further examples from Oued Djebanna in Algeria, and Skhul Cave, Israel, dating to 75,000 BP and 100,000 BP respectively, have supported an African origin for modern human behaviour.

One significant problem that needs to be acknowledged here is that there appears a 100,000 year time lag between the appearance of *Homo sapiens* as a

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[120] The name of the paper refers to a book edited by Paul Mellars in 1989 entitled *The Human Revolution: behavioural and biological perspectives on the origins of modern humans*. Edinburgh: Edinburgh University Press

[121] For a list of the criteria that defines modern human behaviour in the archaeological record see McBrearty, and Brooks. 2000. p:492

[122] Henshilwood, 2001.

[123] Science press release By Roger Highfield, science editor 'Engraved ochres from Blombos Cave' published on Blombos website

[124] Bouzouggar *et al*. 2007

species and the first appearances of art-like activities. Over the first 100,000 years of the existence of *Homo sapiens*, our species was spreading within Africa and encountering new environments. Yet, there is no evidence that anything resembling art-like activities is present in the archaeological record prior to 100,000 BP. This is difficult to explain. Either there was a change in the way visual and neural plasticity operated at a neurological level or there was a change in the way humans began to represent things in material form. At present I am unable to propose a process to account for this emergence capacity, and potentially time will assist with this dilemma. For now it may be prudent to consider the proposed evolutionary scheme of neuro-psychologist Merlin Donald, and the beginnings of what he terms 'external symbolic storage', as later modified by Renfrew.[125] Donald argues that material culture externalises memory and amplifies the permanence and power of distributed cognition.[126] Donald understands the emergence of visuo-symbolic invention as a method of external memory storage, the 'codes' for which are transmitted culturally across time and space.[127] This external memory storage is different to an individual's memory which Donald terms *biological memory*. Rather, external symbolic storage is a collective memory, a memory that resides in a number of different external stores, memories that can be transmitted to other individuals.[128] Donald sees the emergence of external symbolic storage emerging in Upper Palaeolithic Europe. However, these more recent finds in MSA Africa suggests external symbolic storage may have emerged much earlier. Yet this still does not account for the 100,000 year time lag. What we may say is that with the emergence of *Homo sapiens* 200,000 years ago memory remained biological memory, that is memory of the individual, and that over time memory becomes externalised, manifest in the earliest forms of art, such as perforated shells and incised stone and ochre.

2.6 A Cognitive Approach

Drawing inferences about human behaviour from the empirical evidence in Palaeolithic archaeology has been a growing concern among archaeologists. The

[125] Donald, 1991; Donald, 1998; Renfrew, 1998
[126] Distributed cognition is a framework that involves the co-ordination between individuals, artefacts and the environment.
[127] Donald, 1991:308
[128] Donald, 1991:308

emergence of cognitive archaeology[129] as one of the newer branches of the discipline has contributed to an understanding of the complexities of the archaeological record and human evolution. The undertaking for cognitive archaeologists has been "to devise methods of study and frameworks of inference which will, in practice, allow the archaeological evidence to be used to make contributions to the discussion which go beyond more general speculation".[130] Renfrew's position is that the way that the mind of *Homo sapiens* worked at 40,000 years ago, or around the time of the European Upper Palaeolithic, is not recognisable by us modern humans, and it only begins to approach the 'modern' human mind in the early Holocene.[131]

One of the most articulate proponents of cognitive archaeology, Steve Mithen, proposes that during the last two decades of research the explanation for the Middle/Upper Palaeolithic transition has been aided more by the cognitive scientists than the archaeologists.[132] The relevance of cognitive science is that its practitioners share common ideas about the development and evolution of the human mind, which archaeologists have utilised in their search for understanding human behaviour in prehistory.

A great deal of work has been undertaken in the area of cognitive archaeology, focusing on many aspects of human behaviour, especially the various ways in which symbols may operate.[133] Cognitive archaeology has forged a new path into the realms of the complex relationship between brain and behaviour but scholars have been cautious about defining its nature. Although there have been hints of the significance of the neurological capacities of anatomically modern humans in recent archaeological literature, apart from a few exceptions, this avenue of research remains underexplored.

2.7 A Neural Approach

Against this background the archaeologists who refer to neuroscience stand out. Richard Klein in *The Human Career* (1999) sees the explosion of representation

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[129] Colin Renfrew introduced the term 'Cognitive Archaeology' and his 1994 publication, *The ancient mind: elements of cognitive archaeology*, edited with Ezra Zubrow are an early collection of papers introducing some of the problems.
[130] Renfrew & Zubrow, 1994 :5
[131] Renfrew, 1998, 2006, 2008
[132] Mithen, 1996:174. The cognitive scientists Mithen is referring to are Steven Pinker, Leda Cosmides, John Tooby and David Buss
[133] Renfrew & Zubrow, 1994; Flannery & Marcus, 1993; Mithen, 1990, 1996

in the late Pleistocene in Eurasia, Africa, and Australia after 50,000 years ago as the result of a neurological mutation associated with the emergence of behaviourally modern humans. Randall White's view is that "representation in material form was an invention by people who long had the neurological hardware for representational thought",[134] albeit he distinguishes between the neurological capacity for a particular action and the performance of the action. He cites as an example the inability of non-Western people often to 'read' photographs, until taught. It is not that they are neurologically unequipped; rather they do not have the "social, cultural, technological and historical context for understanding and applying the visual logic of photography".[135] White makes an important point here, that the way we perceive and understand our world is embedded in the environment in which we live. We now know that this may be due to neural plasticity and the way one's environment (physical, social, cultural, technological) shapes the brain, both as it is developing and in adulthood.[136]

More recently there has been a growing interest among archaeologists using neuroscientific ideas and techniques in areas archaeological research, and a deliberate attempt to focus on the correlations between brain and material culture. One notable example is the work of Dietrich Stout, whose experiments have included the use of brain imaging techniques in understanding the neural circuits involved in stone tool production. Work on technical choices, styles and operational sequences have been well-researched in archaeology for the ways that experience, training and existing things condition, both intentionally and unconsciously, the look of other things.[137]In this field scholars have been interested in a theory of material culture that takes into account all facets of human technical activity, and the ways that meaningful choices can be discerned in aspects of technology. Stout's work contributes significantly because it makes connections between the physical activity of technology production and particular areas of the brain involved, demonstrating that such activities involve an overlapping of neural circuits, linking tool production to areas of the brain involved in vision and memory (discussed in more detail in the following chapter).

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[134] White, 2003:13
[135] White, 2003:13
[136] This will be more fully explained in Chapter 3.
[137] Leroi-Gourhan, 1971, 1973; Dietler and Herbich, 1998; Dobres, 2000; Lemonnier, 1992, 1993, 2004; Lechtman, 2007

Malafouris (2008) uses a neurological approach in the context of African Middle Stone Age perforated marine shells,[138] in which he examines the perforated shells from Blombos Cave, dated to 75,000 BP in light of the claims of claims of their symbolic status. He seeks to understand the beads as evidence of when and how a human sense of self developed. This partnership between archaeology and neuroscience is exemplified in a set of articles in the *Cambridge Archaeological Journal* entitled, 'Steps to a Neuroarchaeology of Mind',[139] with an introduction by Lambros Malafouris and Colin Renfrew. The aims of this special edition were to promote the understanding of some key recent developments in neuroscience; to articulate some of the possible questions and approaches that can be seen as emerging at the interface between cognitive/social archaeology and cognitive/social neuroscience; and to investigate the possible role and contribution of archaeological and anthropological research to key debates within the neurosciences.[140] The same two scholars with Chris Frith were also responsible for a set of contributions in the *Philosophical Transactions of the Royal Society*,[141] providing an introductory essay to a series of ideas that allow us to think about brains, bodies and material things in combination and thus to understand the possible links between neural and cultural plasticity. These first forays linking neuroscience and archaeology represent the early stages of a discipline, but the incentive to pursue such an approach is the potential to answer questions that might otherwise remains elusive.

2.8 Summary and Discussion

The study of the historical development of Palaeolithic art reveals not only how the earliest art was discovered and by whom, but significantly, the ways in which the art has been interpreted. The preoccupation with interpretation has engaged successive generations of specialists since the initial discovery of cave paintings in the 1870s. Interpretations have fallen in and out of favour, as new discoveries were made, tastes changed, and concepts about early cultures developed. In addition, there seems to have been a prevailing tendency to account for all Palaeolithic cave art with a single explanatory model – art for art's sake, hunting magic, fertility magic, mythograms, or shamanism. As a result, carefully selected

[138] Malafouris, 2008
[139] Renfrew and Malafouris, 2008
[140] Malafouris and Renfrew, 2008:381
[141] Renfrew *et al*. 2008

images are often presented to support one or another of these interpretations, leaving the vast majority of images unexplained. The questions that have been asked in relation to Palaeolithic art have been (and indeed continue to be) tied up with accessing meaning, and potentially this may be an undertaking that in many cases is impossible.

More recently, questions of when and where art first emerged are at the forefront of archaeological thinking. If the capacity for art first emerged in Middle Stone Age Africa, then how do we account for the so-called ‘cultural explosion’ in Upper Palaeolithic Europe? Moreover, can the same complex set of theories used to explain Upper Palaeolithic art be applied to Middle Stone Age Africa?

It is evident from the examination provided above that the role of the brain and its relationship to human behaviour and perception has been alluded to over the course of the development of various disciplines, notably archaeology and art history. The next section focuses on the recent history of brain research, culminating in the wealth of new research in the 1990s and the examination, initiated by neuroscientists, between art and the brain.

PART TWO

2.9 Introduction to Neuroscience Literature Review

Having provided an overview of the historical trajectory of the discoveries and subsequent study of Palaeolithic art, this section will focus on the more recent history of brain research. Biological and particularly neuroscientific explanations of prehistoric art are now being developed and it is appropriate to review the background to this situation. There has been a gradual transition in neuroscience from an exclusively philosophical analysis of the brain’s functions, to a more rigorous anatomical-physiological approach, leading to contemporary developments in the increasingly specialised studies in the brain sciences. The very recent growth in neuroscientific data has fuelled the interest in the liaison between artistic production and reception and brain functioning.

The introduction of modern brain imaging techniques in the 1970s permitted neuroscientists to monitor human brain function in a safe yet increasingly detailed and quantitative way. The advent of modern brain-imaging techniques, such

Magnetoencephalography, (MEG); Computed tomography, (CT); Single photon emission computed tomography, (SPECT); Positron emission tomography (PET) and Functional magnetic resonance imaging, (fMRI), and the even more recent Diffusion Tensor Imaging have altered the landscape of neuroscientific research considerably.[142] These differing techniques have enabled scientists to pinpoint with increasing accuracy regions of the brain associated with particular activities and behaviours. Neuroimaging is a relatively new discipline within medicine and neuroscience, and much of the recent progress has had to do with our ability to utilise computers in analysing the data.[143]

2.10 Decade of the Brain

In conjunction with the recent improvement in brain-imaging technology, the 1990s saw a profound and rapid increase in neurological research. It has been suggested that most of what we know of brain function emerged in the 1990s and the so-called ‘Decade of the Brain’. The ‘Decade of the Brain’ was a designation from 1990-1999 by U.S. President George H. W. Bush as part of a larger effort involving the Library of Congress and the National Institute of Mental Health of the National Institutes of Health, to enhance public awareness of the benefits to be derived from brain research.[144] Many other nations, including the European Community, adopted the Decade.

Aadvancement in the area of Neural Plasticity is one of the most exciting, and potentially valuable areas of research of the past decade or so, and of particular relevance in this thesis. Researchers during the 1990s revealed the brain was capable of far greater plasticity than was previously thought, and the notion that the brain does not have the capacity to regenerate firmly discredited.[145] The intensification in the growth of neuroscience research all over the world, mostly in the US, UK and Europe was facilitated by the simultaneous development of a host of techniques and technologies permitting investigations from the molecular level to the study of the intact human brain. The foundations laid down during this decade provide an invaluable insight into the liaison between brain and behaviour.

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[142] See Wilson, 2003:127
[143] Thompson, 2002; Leighty & Fragaszy, 2003
[144] See Library of Congress website http://www.loc.gov/loc/brain/proclaim.html
[145] Fawcett & Geller, 1998; Berger, 1998; Gould, Reeves & Graziano, 1999

2.11 Art and the Brain

One exciting liaison that emerged during the 1990s was the configuration of a new relationship, that of art and the brain. Forty years previously, in 1959, C.P. Snow[146] addressed the relationship between the humanities and the sciences as he delivered the influential Rede Lecture called *The Two Cultures*, which provoked widespread and heated debate. Snow's premise was that the intellectual gulf between the humanities and the sciences was increasing.

An active participant in attempting to close Snow's gap is neuroscientist Semi Zeki who, in the 1990s, brought into sharp focus the relationship between art and the brain. Zeki is one of the world's foremost researchers on the visual brain and in 1993 published *A Vision of the Brain*, in which he explains how the different components of our visual world - the colour, movement, and form of a visual scene - are analysed in different regions of the brain. By the end of the decade after further research and an extended invitation to the Getty Museum in Santa Monica, Zeki published *Inner Vision* (1999), in which he explores what has been learned about the workings of the visual brain in relation to aesthetic experience. Zeki describes how different areas of the brain respond to elements of the visual arts such as colour, form, line, and motion and argues that our experience of art strongly relates to how the brain works. In 2001, he set up the Institute of Neuroesthetics, at the University of Berkeley, California, and University College, London, which seeks to establish the biological and neurobiological foundations of aesthetic experience. He aims to account for the characteristics of works of art in terms of neurobiology, and believes that the origins of art lie in the brain's capacity for abstraction and concept formation. More recently, Zeki has turned his attention to the neural correlates for subjective mental states such as creativity, love, and beauty. Zeki's contribution is significant because he provides "the first extended treatment of its subject"[147], an exploration of art and the brain.

Another leading proponent focusing on neuroscience as a way of understanding art is V.S. Ramachandran, Director of the Centre for Brain and Cognition at the University of California, San Diego. A trustee for the San Diego

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[146] Charles Percy Snow was an English physicist and novelist. Published as *The Two Cultures and the Scientific Revolution*, the Rede lecture argued that the breakdown of communication between the "two cultures" of modern society — the sciences and the humanities — was a major hindrance to solving the world's problems.

[147] Onians, 2007:190

Museum of Art, Ramachandran has lectured widely on art, visual perception, and the brain. Ramachandran's early work was on visual perception, but he is best known for his experiments in behavioural neurology, which have had a profound impact on the way we think about the brain.

In 1999, Ramachandran and William Hirstein published an article entitled *'The Science of Art'* in which they proposed a neurological theory comprising eight universal laws of aesthetic experience that "artists either consciously or unconsciously deploy to optimally titillate the visual areas of the brain".[148] The consequence of the paper opened up useful dialogue between artists, neuroscientists, perceptual psychologists and art historians. As expected, the article had its critics, however, while it provoked wide interest in the neuroscientific community, art historians found it more difficult to accept. In all probability, this is likely to lie in the proposition of universal laws, which for art historians only served to undermine the individuality or specificity of art production. However, this reading misunderstands Ramachandran's intentions and only serves to perpetuate Snow's 'gap'. Ramachandran has since written on mirror neurons and their potential relevance to imitation learning and rapid cultural transmission; examined in the following chapter.

In 1999, the *Journal of Consciousness Studies* published a special issue of a collection of thematically related academic papers entitled 'Art and the Brain', drawing its name from the included paper by Semi Zeki. The volume is divided into four main groups; the focus paper by Ramachandran and Hirstein[149] and commentators has a more psychological aspect, while Zeki[150] takes a more neurobiological approach. Nicholas Humphrey[151] combines anthropological and biological ideas, Erich Harth[152] takes a cognitive-evolutionary view, Ralph Ellis[153] makes use of Gibsonian affordances,[154] and Jason Brown[155] combines process theory with clinical pathology. While methodological debates endure, the multiple

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[148] Ramachandran & Hirstein, 1999:15
[149] Ramachandran & Hirstein, 1999
[150] Zeki, 1999b
[151] Humphrey, 1999
[152] Harth, 1999
[153] Ellis, 1999
[154]This refers to Eleanor Gibson (1988) whose work focused on the domain of perceptual learning, and that the way a scene strikes us is determined by the patterns of activity it affords for the active eye and brain.
[155] Brown, 1999

perspectives the papers in this publication present certainly go some way to closing the gap between Snow's 'two cultures', and opening up new areas of research, demonstrated by the subject matter of this thesis.

2.11.1 Neuroarthistory

A key player from the Humanities in the development of a neural approach to art is John Onians, and after more than a decade of personal research has introduced Neuroarthistory as a field of scholarly enquiry. Neuroarthistory is the term Onians has coined to describe the application of neuroscience within the discipline of art history. Similarly he coined neuroarchaeology and neuroanthropology, in much the same way, However, for Onians, neuroarthistory is not a theory as such, it is more of an approach; "Its defining feature is only a readiness to use neuroscientific knowledge to answer any of the questions that an art historian may wish to ask",[156] or for that matter any question an archaeologist or anthropologist may wish to ask.

In contrast to Zeki's Neuroesthetics, which is a more general study of art and aesthetics as a biological phenomenon, Neuroarthistory seeks to understand the visual and motor preferences of artists separated from us either in space or in time as a way of understanding art production. However, a defining feature of any enquiry into art that uses neuroscience as a tool is its propensity for change, as the knowledge on which it is based is reviewed and revised.

2.11.2 Further Research

Elsewhere, other art historians and archaeologists are moving in the same direction. David Freedberg based at the Italian Academy in New York has recently turned his attention to the importance of the new cognitive neurosciences for the study of art and its history.[157] James Cutting at Cornell University interests lie in film, art, and psychology; the perception of motion, depth, and layout; event perception; and structural and functional analyses of perceptual stimuli. Based at the University of Chicago, Barbara Stafford is exploring the intersections between the visual arts and the physical and biological sciences. Stafford's most recent book, *Echo Objects: The Cognitive Work of Images*, argues for those in the humanities to

[156] Onians, 2007:17
[157] Freedberg & Gallese, 2007; Battaglia & Freedberg, forthcoming; Arienzo, Parra, Freedberg *et al*. forthcoming

utilise neuroscience to enlighten the underpinnings of cultural objects. In Cambridge in the UK, archaeologists Colin Renfrew and Lambros Malafouris are working within a neuroarchaeological framework and questioning the role of neuroscience in the study of material culture, while at University College, London, Dr. Dietrich Stout is using fMRi scanning techniques in trying to understand the neural processes involved in the making of stone tools.

An important point to mention here is that just as art historians may not agree on particular interpretations or analyses of art, not all neuroscientists agree with particular theories about the brain. Indeed, not all neuroscientists agree on particular neurobiological analyses of art; for example Zeki considers Cubism a failure in neurological terms,[158] while Ramachandran presents a very specific explanation of why Cubism is a success.[159] As an approach, we in the Humanities are dependent upon a very fast-moving and sometimes conflicting field, but the incentive is the potential to answer questions that might otherwise remains elusive.

2.12 Summary and Discussion

The most significant breakthroughs in brain research have occurred in the 19th and 20th centuries, demonstrating that a great deal of what we currently know of brain function is a very recent occurrence. It is only because of this abundance of research promoted so vigorously during the Decade of the Brain and subsequently continued, did debates surrounding the production and reception of art and its relationship to brain function emerge.

At the same time as these new neurological debates appeared, the arena of Palaeolithic art was challenged in its conventional wisdom by new finds emerging from Middle Stone Age Africa suggesting that the first evidence of art was older than originally thought. While neuroscience was moving forward in forging new relationships, the study of Palaeolithic art was looking backwards, simply using the same theories constructed to explain Upper Palaeolithic art in Europe and applying them retrospectively to African data. It is out of these two scenarios that this thesis emerges.

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[158]See Zeki, 1999a:50-57. Zeki considers Cubism a failure because in attempting to portray so many perspectives in a painting it ceases to be recognisable to the human brain, and thus in some instances only recognisable through its title.

[159] See Ramachandran & Hirstein, 1999. Ramachandran considers the success of Cubism a result of particular neurons hyperactivating and responding more strongly to multiple views presented simultaneously.

The following chapter explores in more detail areas of brain function that are useful and relevant to this enquiry. Areas such as neural and especially visual plasticity, and mirror neurons will be explained as functional processes of the brain and their relevance to our understanding of the earliest art.

CHAPTER 3

Understanding Brain Function

3.1 INTRODUCTION

Having reviewed the two fields of Palaeolithic art studies and neuroscience, it is evident that there are points of interdisciplinary convergence in current thinking about art and the brain. The debates that emerged at the end of the 1990s concerning art and the brain, have led to new approaches to the understandings of the production and reception of art and it is these which provide the point of departure for this thesis. The importance lies in first understanding exactly what elements of brain function are relevant in our enquiries.

Our brains have allowed us to develop an extraordinarily rich culture, and so the study of the human brain is not just the study of an organ. By studying its structure and operation we can also come to understand how the brain helps us to function in the world in which we live and to acquire cultural skills. In order to accomplish this task, this chapter will examine the structure of the brain. It will also review the most important properties affecting the brain's relation to the environment including neural and especially visual plasticity, and the operation of mirror neurons in order to understand the mental processes involved in art production.

3.2 The Structure of the Brain

The adult human brain, a spongy, three-pound (1300-1400g) mass of fatty tissue contains billions of neurons and these are organised into hundreds, even thousands of interconnected regions that guide us through our lives, regulating the functions of thinking and feeling, as well as ruling our complex motor and sensory systems. The cerebral cortex (usually referred to simply as the cortex) is the outside layer of the brain consisting of many infoldings or convolutions;[160] the cortex is the largest part of the human brain, associated with higher brain function such as thought and action. The cortex is divided into four sections, called 'lobes': the frontal lobe,

[160] The folds of the cortex are called gyri (singular, gyrus), and serve a functional purpose, to pack more cortical surface into the skull, the advantage of which is that neurons are brought into closer three dimensional relationships to one another. Gazzaniga *et al.* 2009:67

parietal lobe, occipital lobe, and temporal lobe (Figure 3.1)[161] The central sulcus divides the frontal lobe from the parietal lobe, and the Sylvian (lateral) fissure separates the temporal lobe from the frontal and parietal lobes.[162] The lobes of the cerebral cortex have a variety of functional roles in neural processing, and while separate systems can be localised within each lobe, processing also occurs across lobes.

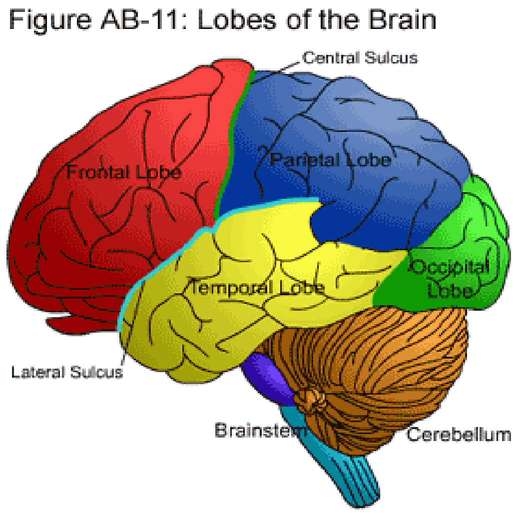

Fig. 3.1 Main Lobes of the Brain

(Image: The Huntington's Disease Outreach Project for Education, Stanford University)

The Frontal Lobe plays a major role in the planning and execution of movements, and has two main subdivisions, the motor cortex and prefrontal cortex.[163] This lobe is associated with reasoning, planning, speech, movement, emotions, and problem solving. The Parietal Lobe is associated with limb proprioception (limb position) and with the perception of stimuli related to touch, pressure, temperature and pain. The Occipital Lobe, located at the back of the brain comprises the primary visual cortex and is connected with visual processing. The cortex in this area has six layers and begins the coding of features such as colour, form and motion, features that will be discussed further in this chapter. The Temporal Lobe is located beneath the Sylvian fissure or lateral sulcus,[164] on both the

[161] Kolb & Whishaw, 2001:3
[162] Gazzaniga *et al*. 2009:68
[163] Gazzaniga *et al*. 2009:73
[164] The lateral sulcus (also called Sylvian fissure) is one of the most prominent structures of the human brain. It divides the frontal lobe and parietal lobe above from the temporal lobe below. It is in both hemispheres of the brain but is longer in the left hemisphere.

left and right hemispheres of the brain. This area comprises the primary auditory cortex, and is important for the processing of semantics in both speech and vision. The temporal lobe contains the hippocampus and plays a key role in the formation of long-term memory.[165]

The full extent of the brain's capabilities is as yet unknown, but it is the most complex single organ in the human body, controlling all bodily activities, ranging from heart rate to sexual function, learning and memory, and it shapes our emotions, thoughts, hopes, dreams, and imaginations.[166] In short, the way in which the brain works is what makes us human.

3.3 The role of Neurons

The brain is composed of cells called neurons and glial cells, functional units that enable us to receive information, process it and generate appropriate actions. Neurons have specialised projections called dendrites and axons.[167] Dendrites bring information to the neuron cell body and axons carry information away from the neuron cell body. Neurons communicate with each other via synapses, of which the human brain has a huge number[168] (Figure 3.2). Each of the 100 billion neurons has on average 7,000 synaptic connections to other neurons**.**[169] Glia cells function to support and provide nutrition to neurons, and some scientists consider glia to be the "sleeping giants",[170] regarding them as much more important to information processing in the brain than is currently appreciated. Although their role is subordinate, without glia, the brain could not function properly. Research has shown that brain size does not determine intelligence,[171] nor do the actual number of cells. Rather, the key to our brainpower lies in the number and strength of our neuronal connections.

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[165] Kolb & Whishaw, 2001
[166] For reading on the emotional brain, see Darwin, 1872/1955; Aggleton, 1993; LeDoux, 1998; Adolphs, 2002; Dolan, 2002; Dagleish, 2004.
[167] Kolb & Whishaw, 2001, pp:78-91
[168] For more information on how neurons communicate via synapses see Kandel *et al*. 1995, 2000; Kolb & Whishaw, 2001; Nichols *et al.* 2001; Bear *et al.* 2007; Gazzaniga *et al*. 2009
[169] Kolb & Whishaw, 2001; Wilson, 2003; Bear *et al*. 2007
[170] Bear *et al.* 2007:47
[171] The relationship between brain size and intelligence is a subject that has come under much discussion in human evolution. See Jerison, 1973; Deacon, 1990, 1997; Dunbar, 1992, 1993; Aiello & Wheeler, 1995; Calvin, 2003; Falk, 2006.

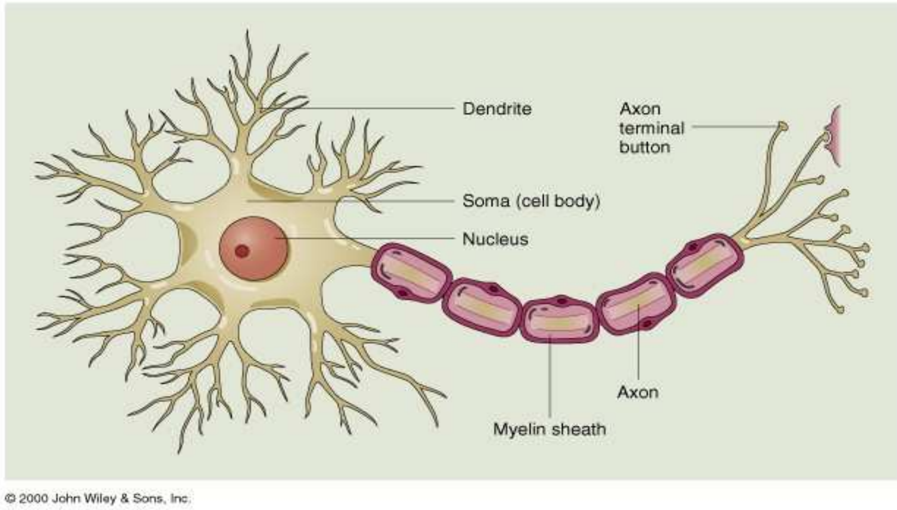

Fig. 3.2 Structure of a Neuron

(Image: www.utexas.edu)

This neuronal connectivity can either strengthen or weaken depending on a person's experiences; repeated experiences stimulate neuronal connections improving or reinforcing a particular activity or perception. Neurons are surprisingly active in both producing new dendrite branching and losing old ones, and neurons are changing in our brain from day to day and from year to year. Another important property of neurons is their longevity. Most neurons are never replaced; rather they survive with us throughout our lives. This re-wiring of brain areas in response to changes in environment is termed neural plasticity.[172]

3.4 Neural Plasticity

Neural plasticity refers to "the lifelong changes in the structure of the brain that accompany experience".[173] As the term suggests, the brain is malleable and capable of reconfiguration. Once thought to be stable in adulthood, the brain is now understood to have dynamic properties for change, due to the ability of neurons to form new connections, so creating new pathways through the cortex, and allowing the neurons to take on new roles and functions.[174] A principal stimulus for this modification is experience.

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[172] The coining of the term plasticity in regards to neuronal process is attributed to the Polish neuroscientist Jerzy Konorski (1903-1973).
[173] Kolb & Whishaw, 2001:259
[174] See Singer, 1995; Kolb & Whishaw, 1996; Otte, 2001; Toates, 2002; Greenfield, 2003; Ramachandran, 2004; Gazzaniga *et al*. 2009

The types of such experiences are infinite; including both the pre- and postnatal, and involve both sensory and motor activity.[175] It is these experiences that cause the connections between neurons to change. While neural plasticity probably exists in the nervous systems of all species, it appears to be most marked in specific regions of the human cerebral cortex, in areas that subserve the so-called higher cortical functions, including language, mathematical ability, musical ability, and goal directed behaviour, known as “executive functions”.[176]

Rather than the old adage ‘Practice makes perfect’, in the case of neural plasticity, “Practice doesn’t make perfect; practice makes permanent”,[177] because practice triggers the enhancement and consolidation of connections. Whilst this capability to alter is dependent on many variables, the most important are environment and experience. However, to what extent environmental inputs influence the development of a child’s brain as well as the structure of an adult’s brain has generated much recent interest and discussion, and has revived the old “nature versus nurture” debate.[178]

3.4.1 Mechanisms of plasticity

Research and experimentation in the area of brain plasticity have proved significant in understanding the development of neural networks during an individual’s lifetime and the potential relationship between plasticity and behaviour. Neural plasticity does not consist of a single type of morphological change, but rather occurs through a series of steps.[179] Theoretically, experience can alter the brain and thus behaviour in two ways: by modifying existing networks or by creating new ones. Plasticity enables the process of developing and pruning of connections between neurons and synapses in many contexts, including an organism's exposure to its environment. Neural systems are not only able to deal efficiently with consistent

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[175] Huttenlocher, 2002

176 ‘Executive function’ is a recently formulated neuropsychological concept. Those areas of the brain that provide executive functions are the last to mature, usually not until early adulthood. See Huttenlocher, 2002. Merlin Donald terms these functional subsystems as executive processes of the mind, because they are in a position of control; they are typically placed at the peak of cognitive hierarchy. See Donald, 2001

[177] Quote from Warren Buffett (b.1930) in a boardroom report to shareholders of Berkshire Hathaway Inc. (1992). Buffett, an American investor, businessman and philanthropist, was ranked by *Forbes* as the richest person in the world, as of February 11, 2008.

[178] Cartledge, 1998; Huttenlocher, 2002; Dowling, 2004; Kramer *et al*. 2004;

179 Kolb & Whishaw, 2001; Huttenlocher, 2002; Wilson, 2003; Bear et al, 2007

and familiar environments but given time, capable of adjusting to novel and changing environments with equal competence.[180]

The term plasticity refers to the visible characteristics resulting from the interaction between genetic makeup and the environment. In addition to genetic factors, the brain is shaped by the characteristics of an individual's environment and by the motor and sensory actions and experiences of that individual within the environment, which can result in the emergence of a particular trait or characteristic. Learning a new skill, such as playing a musical instrument,[181] or reading Braille[182] requires extensive practice, and this practice is instrumental in changing the neuronal connections in relevant brain regions. The importance of this principle means that people from different cultures, because they have different motor and sensory experiences in different environments, will acquire differences in brain organisation that will necessarily affect their behaviour.[183]

Quartz and Sejinowski (1997) have developed a compelling case for the adaptive importance of neural plasticity and the response of the developing brain to environmental stimulation. Termed "neural constructivism",[184] they argue that features of the cortex are built from the dynamic interaction between neural growth mechanisms and environmentally derived neural activity. According to neural constructivism, the evolution of human cognition is not simply a "progressive increase in specialised structures"[185] in the cortex. Rather, it is an increasing neural flexibility that "allows environmental factors to shape the human brain's structure and function".[186] Essentially, this body of research propose two major claims, a) that cognitive development involves the experience-dependent construction of new neural mechanisms (not just the maturation or tuning of already established ones), and b) that these mechanisms result from a dynamic interaction between the environment in which the agent is embedded and the agent's existing neural architecture. A consequence of this approach is the capacity for rapid learning. What is learnt affects the very neural architectures that support future learning; therefore the way we learn changes as we learn.

[180] Dennett, 1993:187
[181] See Johansson, 2006
[182] See Hannan, 2006
[183] Kolb & Whishaw, 2001:259
[184] Quartz & Sejinowski, 1997:537
[185] Quartz & Sejinowski, 1997:555
[186] Quartz & Sejinowski, 1997:555

A salient issue in neural plasticity in the context of the emergence of art production in humans rests is the role of visual experience, and research has shown that plasticity in the visual brain works on the same principle as neural plasticity.[187]

3.5 Visual Plasticity

In evolutionary terms, vision is our primary sensory experience and "far more of the brain is used for vision than for any other of our senses".[188] Compared with the other sensory systems the visual system has received the most scientific investigation.[189] The anatomy, physiology, and function of the visual cortex have been studied more extensively than any other cortical region.

By understanding the organisation of the visual system and by following the routes by which visual information travels, we can begin to appreciate what the brain is doing with visual input and how the brain creates our visual world. There are two principal pathways into the visual brain, the geniculostriate, and the tectopulvinar systems.[190] Each of these pathways eventually travels through the thalamus,[191] where each divides again; in particular, from the geniculostriate area, a 'ventral'[192] or lower stream progresses to the temporal lobe and a 'dorsal'[193] or higher stream to the parietal lobe (Figure 3.3).

Identification of the temporal- and the parietal-lobe pathways led researchers to seek to establish the possible functions of each. One way to examine these functions is to ask why evolution would produce two different destinations for the pathways in the brain. The proposition is that each route must create visual knowledge for a different purpose. Milner and Goodale (1995) proposed that, "the ventral stream of projections from the striate cortex to the inferotemporal cortex plays the major role in the perceptual identification of objects, while the dorsal

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187 Black *et al*. 991; Dragoi & Sur, 2004; Kourtzi & diCarlo, 2006
188 Kolb & Whishaw, 2001:281.
189 See Courtney & Ungerleider, 1997; Hubel, 1988; Milner & Goodale, 1995; Posner & Raichle, 1997; Weikrantz, 1986; Zeki, 1993.
190 Kolb & Whishaw, 290. The geniculostriate system is responsible for conscious visual awareness and 'pattern' vision; the tectopulvinar system relates to eye movements in response to visual stimuli.
191 The thalamus is located at the most rostral (or top) end of the brainstem, and has been referred to as the "gateway to the cortex" because with the exception of some olfactory inputs, all sensory modalities make synaptic relays in the thalamus before continuing to the primary cortical sensory receiving areas. (Gazzaniga *et al.* 2009:82)
192 The ventral stream is the visual processing pathway that originates in the visual cortex and progresses into the anterior temporal cortex. It controls the visual recognition of objects.
193 The dorsal stream is a visual processing pathway that originates in the visual cortex and progresses into the posterior parietal cortex. It controls the visual guidance of movement.

stream projecting from the striate cortex to the posterior parietal cortex mediates the required sensorimotor transformations for visually guided actions directed at such objects".[194] In other words the two purposes are to identify what a stimulus is, (known as the "what" function) and to use visual information to control movement (the "how" function). It seems plausible from a functional standpoint that separate processing modules would have evolved to mediate the different uses to which each can be put, such as visually guided reaching, grasping and actions where close coordination is required between movements of fingers, hands, upper limbs, head and eyes.[195] This division of labour between the ventral and dorsal streams is not absolute, rather the authors Goodale and Milner suggest the two systems "will often be simultaneously activated… providing visual experience during skilled action".[196] Indeed, the two systems of perception and action appear to engage cooperatively in direct crosstalk.

The 'what' and 'how' distinction came from an analysis of where visual information goes when it leaves the striate cortex or V1 area; there are at least six different visual regions, V1, V2, V3, V3a, V4, and V5 (Figure 3.3).

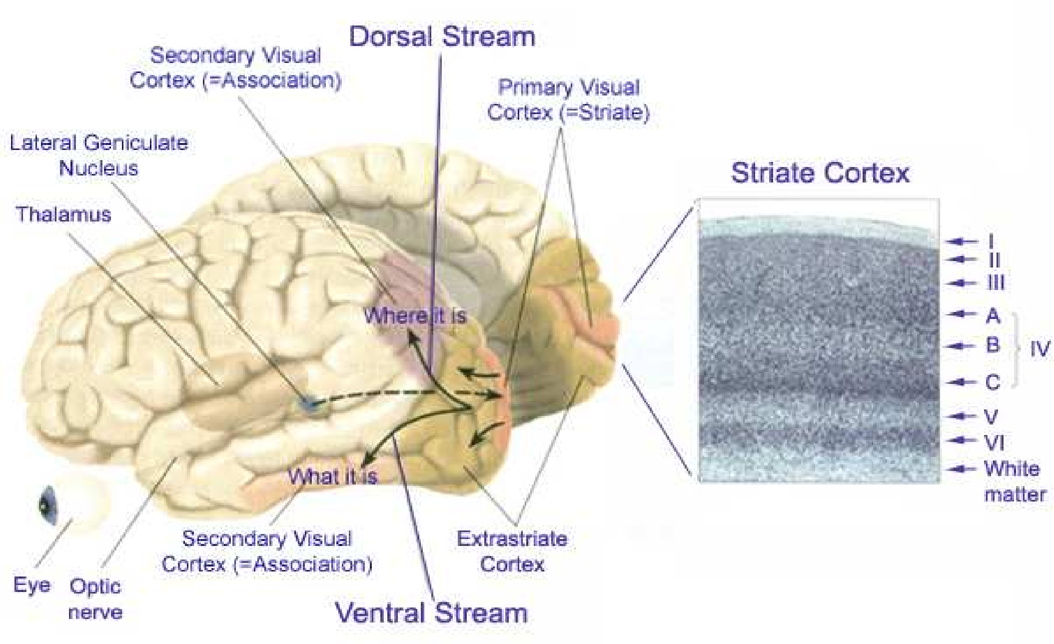

Fig. 3.3 Primary Visual Cortex

(Image: (www.colorado.edu/intphys/Class/IPHY3730/image/figure7-3.jpg)

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[194] Goodale & Milner, 1992:20
[195] Goodale & Milner, 1992:20
[196] Goodale & Milner, 1992:24

V1 is the striate cortex, also referred to as the primary visual cortex. A unique feature of the V1 region is its distinct, yet seemingly homogeneous layering. However, experiments undertaken by Wong-Riley and colleagues discovered that there is an unexpected heterogeneity in region V1.[197] They sectioned the V1 layers in such a way that each cortical layer was in one plane or section.[198] The surface of each flattened layer demonstrated that within region V1 input that arrives is divided into three separate types of information – colour, form, and movement.[199] The information is then sent to region V2, which lies next to V1. Here the colour, form, and movement inputs remain segregated, but in different ways from V1, in that V2 has a pattern of thick and thin stripes intermixed with pale zones. The thick stripe receives input from the movement-sensitive neurons in V1; the thin stripes receive input from the colour-sensitive neurons of V1 and the pale zones receive input from the form-sensitive inputs from V1.[200]

Many cells in the primary visual cortex (V1) respond only to lines of specific direction, termed ‘orientation detectors’,[201] the significance of which is that they are genetically determined; they ‘pre-exist’ within us.[202] A characteristic of the cortical structure is that these cells are organised into functional columns. For example, Figure 3.4 shows that neurons within the same column respond to lines oriented in the same direction. Adjacent columns accommodate cells that are responsive to different line orientations.[203] Neurobiologists commonly consider these cells to constitute the building blocks of form perception, and contribute to the “neural elaboration of forms”.[204]

Such contour orientation seems to be one of the most important components in early mammalian vision.[205] Blakemore and Cooper (1970) demonstrated that kittens exposed only to contours of one orientation during a critical period of development are greatly impaired in seeing contours of other orientations. This

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[197] Wong-Riley *et al*. 1993
[198] Much like peeling an onion and laying them flat on a table
[199] Kolb & Whishaw, 2001:293.
[200] Kolb & Whishaw, 2001:294
[201] Kolb & Whishaw, 2001:301.
[202] Zeki, 1999:96
[203] Kolb & Whishaw, 2001:304.
[204] Zeki, 1999:113. Mondrian thought that the universal form, the constituent of all other more complex forms, is the straight line; physiologists think that the cells respond specifically to what some artists at least consider to be the universal form are the very ones that constitute the building blocks which allow the nervous system to present more complex form
[205] Hubel & Wiesel, 1962

behavioural impairment is accompanied by permanent changes in the responses of orientation selective neurons in the cat's visual cortex. Once thought to be passive filters, it has emerged in the past two decades that the responses of cells in the primary visual cortex are strongly influenced "by the spatial and temporal context in which local features are presented, and their responses are modulated as well by previous visual experience, including perceptual learning and adaptation".[206]

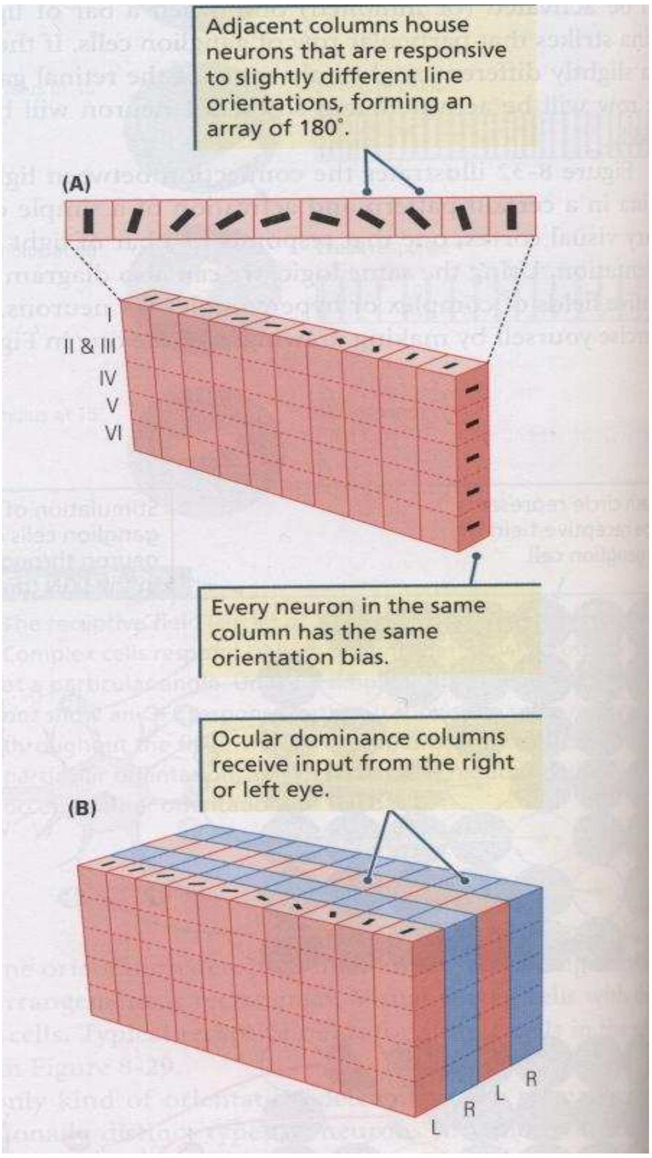

Fig. 3.4 A model of the organisation of functional columns in the primate visual cortex
A) Cells with the same orientation preference are found throughout a column. Adjacent columns have orientation preferences that are slightly different from one another.
B) Ocular dominance columns are arranged at right angles to the orientation columns, producing a three-dimensional organisation of the visual cortex.

(Image: Kolb and Whishaw, 2001:304)

[206] Dragoi and Sur, 2004:1654

A prominent form of plasticity in the adult visual cortex relates to orientation tuning. There are several ways in which orientation plasticity has been demonstrated in adult V1 neurons, but the method that is most relevant here relates to learning-induced plasticity. Evidence demonstrates that orientation selectivity of neurons alters with visual experience.[207] Thus, cortical neurons have the capacity to change their responses with perceptual learning, a particular form of plasticity that, “allows us to improve visual performance after active exposure to a structured visual environment”.[208]

The pathways proceed from region V2 to the other occipital regions and then to the parietal and temporal lobes, forming the dorsal and ventral streams. Within the dorsal and ventral streams, the function of the visual pathways becomes far more complex than simply colour, form, and movement. In these two streams, the colour, form and movement information are combined to produce a rich unified visual world made up of complex objects and surfaces.

Essentially, visual identification terminates in the temporal lobes, where neurons respond to complex visual stimuli such as faces and objects. Neurons along the ventral stream in region TE[209] of the temporal lobe are maximally excited by complex visual stimuli, such as faces or hands; and these neurons can be remarkably specific in their responsiveness. They may be reactive to particular faces head-on, to faces viewed in profile, to the posture of a head, or even to particular facial expressions,[210] yet despite these innumerable impressions our perception of a particular face remains stable. This stability, called 'invariance,'[211] is fundamental to our ability to recognise objects.

In fact, we use one-third of the visual brain in object recognition,[212] but such object recognition is not hard-wired. As we navigate our environment, the brain's visual centres continually reorganise themselves, classifying novel features, and learning to pick out important objects, effectively creating a changing dictionary of

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[207] Shiu & Pashler, 1992. This 1992 study investigated whether the sensitivity of human observers to contour orientation can be improved with training. Results demonstrated that intensive practice in discriminating orientation differences increases neuronal sensitivity to contour orientation

[208] Dragoi & Sur, 2004:1655

[209] Area TE is located immediately lateral to the perirhinal cortex (PR) and consists of a band of cortex lying primarily on the middle temporal gyrus; it is important for the perceptual processing of visual stimuli.

[210] Kolb & Whishaw, 2001:305

[211] Li & Di Carlo, 2008.

[212] Zeki, 2006; personal communication

shapes.[213] Further research has found that the brain is optimally adapted to the complex real world scenes that we see in everyday life,[214] and indeed natural stimuli are processed and classified more efficiently by the brain than are simple geometric shapes.[215]

The question is, just how far does this specialised responsiveness extend? Dr Keiji Tanaka[216] from the Riken Brain Science Institute in Japan approached this question by presenting macaque monkeys with many 3D representations of animals and plants to find stimuli that were effective in activating particular neurons of the inferior temporal cortex neurons. Having identified stimuli that were especially selective, such as faces or hands, he then wondered which specific features of these stimuli were critical to stimulating neurons. Tanaka found that most neurons in the TE area required rather complex features for their activation. These features included a combination of characteristics such as orientation, size, colour, and texture. Significantly, neurons with similar, although slightly different responsiveness to particular features tended to cluster together in columns. Recent fMRI studies have shown a similar pattern for the Lateral Occipital Cortex, a brain region in the human visual cortex central to object recognition and believed to be the human homologue of area TE in monkeys (Figure 3.5).[217]

An object is thus represented in the temporal cortex not by the activity of a single neuron, but by the activity of many neurons with slightly varying stimulus specificity grouped together in a column that results in object recognition. This finding is important because it provides an explanation for what is called 'stimulus equivalence',[218] or the tendency to see something as remaining the same, despite being viewed from different orientations. If each neuron in the column module varies slightly in terms of the features to which it responds, but the effective stimuli largely overlap, the effect of small changes in incoming visual images will be minimised resulting in the sense of object constancy.

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[213] Låg et al, 2006
[214] Gallant, 2004; Laws *et al.* 2003; Riesenhuber & Poggio, 2002, Tanaka, 1993
[215] Kayser *et al.* 2004:471
[216] Tanaka, 1996, 1997, 2004
[217] Tanaka, 1997
[218] Oldfield, 1957

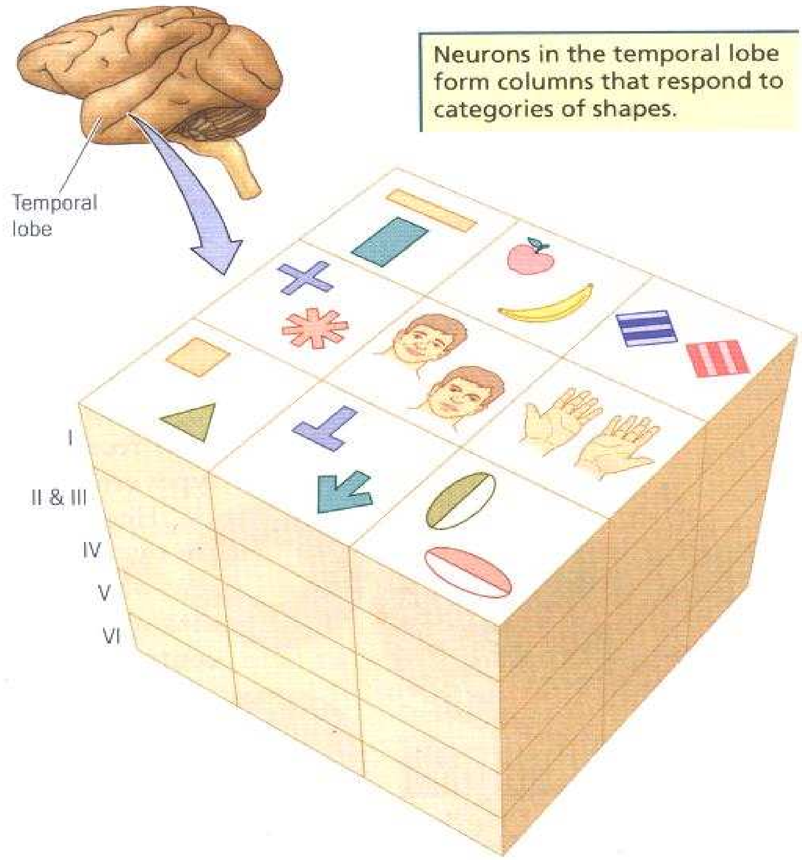

Fig. 3.5 Neurons in the temporal lobe form columns that respond to shapes

(Image: Kolb & Whishaw)

Neurons in the primary visual cortex (V1) traditionally have been considered passive filters, extracting elementary features of visual stimuli and responding invariantly to the physical properties of the stimuli present in their receptive fields. However, in the past 15 years research has demonstrated that V1 responses are strongly influenced by the spatial and temporal context in which local features are presented, and their responses are modulated as well by previous visual experience, including perceptual learning and adaptation.[219]

In summary, at the neuronal level, the more frequently an object or shape is observed, the more adeptly and rapidly those neurons will fire on exposure to that object, and they are highly tolerant of identity-preserving changes, e.g. changes in position or size.[220] Furthermore, neighbouring neurons are more likely to respond to

[219] Dragoi & Mriganka, 2004: 1654
[220] Kourtzi & DiCarlo, 2006:152.

similar features.[221] The stimulus specificity of these neurons is altered by experience, and fMRI studies have shown that specificity can increase with stimulus familiarity.[222] This demonstrates that the role of the temporal lobe in visual processing is not entirely determined genetically but rather is shaped by experience, even in adults. We can speculate that this experience-dependent characteristic was selected for because it allows the visual system to adapt to different demands in changing visual environments.[223]

An important element connected with perceptual preferences arises from the connections the brain makes with stored information. The brain has information-acquisition mechanisms that reward us for learning about our environment. The complex response to a stimulus carrying positive associations are mediated by a variety of neural pathways, but ultimately depend on the release of dopamine in the basal ganglia. Dopamine is a chemical produced naturally in the body, and is central to the reward system, and the formation of emotional responses. The basal ganglia (Figure 3.6) where the reward is processed are directly connected to the visual areas in the brain, giving them an intermediary role in “rewarding acquisition with a neuro-chemical frisson of pleasure”.[224]

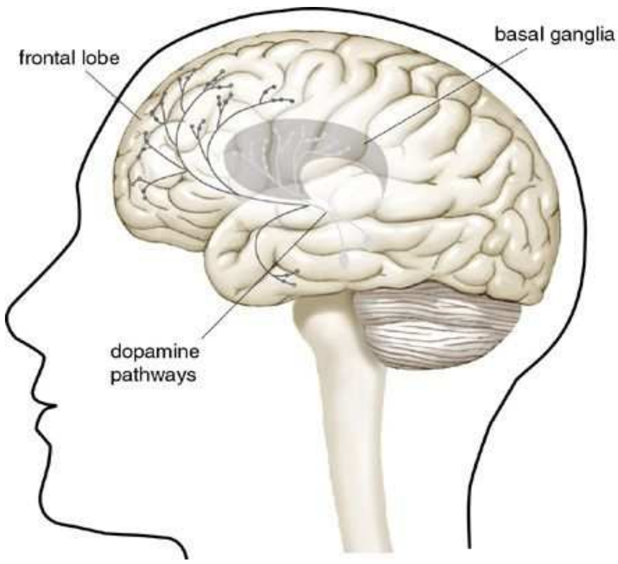

Fig. 3.6 Location of the basal ganglia and Dopamine pathways

(Image: nobleprize.org)

[221] Reddy & Kanwisher, 2006:411
[222] Reddy & Kanwisher, 2006:411
[223] Kolb & Whishaw, 2001:305
[224] Biederman & Vessel, 2006:255

A series of breakthrough experiments conducted on the activity of midbrain dopaminergic neurons in primates, by Schultz and colleagues in Switzerland in the early 1990s, found that as the animal learns a task, it ceases to respond to the actual reward delivery and responds instead to the visual stimulus.[225] The implication of this is that dopamine release in response to a visual stimulus is based on the prediction of future reward. The role of the basal ganglia in cognitive functions was once a controversial issue, but the increase in brain-imaging data demonstrates their involvement in mental imagery, sensory discrimination, planning, and attention.[226]

The implication of this is that a visual stimulus can trigger a gratifying response without us having to be aware of it. Detecting and recognising meaningful objects in complex environments is a process that occurs quickly, automatically and effortlessly. However, the computational challenges of visual recognition are far from simple. Understanding our capacity for robust object recognition is dependent upon the context of the computational problems faced by the visual system in complex environments. In other words, just as in archaeology, in life context is everything.

The important issue to highlight from this research is that increased familiarity with a visual stimulus does not require our conscious attention. This means that our visual brains become very proficient at observing certain shapes and objects in the environment without us even being aware of the fact. Essentially, the brain acquires a visual lexicon of its particular environment, effortlessly and proficiently.

This potential for visual preferences developing, albeit unwittingly, as a result of a distinct environmental exposure has substantial implications for the study of the development of art. The logic of visual plasticity studies, indicates that this is potentially a more powerful and influential impetus in the production of art than has been previously realised. By exploring the visual environments in which people lived, it may be possible to understand cultural production as an echo of that environment, both physical and cultural.

As discussed previously, the earliest art is correlated with symbolic thought and language, the latter being a pre-requisite for a shared meaning to be conveyed. Yet a recent discovery of so-called mirror neurons may shed some light on how we

[225] Schultz *et al*. 1993, 1997; Schultz 1998
[226] Doya, 2000: 736

communicate and learn from each other that may have implications for the emergence of language and indeed cultural learning and transmission.

3.6 Mirror Neurons

In all communication, both verbal and non-verbal, it is essential for the sender and receiver to have a common understanding of the system used.[227] If an individual speaks a word or makes a gesture it is effective only if the other person interprets it correctly, therefore to ensure efficacy in communication, "the processes of producing and perceiving a message must have some kind of shared representation in the brain of the sender and receiver".[228] Yet how do both the sender and receiver of a potentially ambiguous gesture come to understand what that gesture means? How do individuals understand the actions and emotions of others?

A chance discovery during the 1990s by Giacomo Rizzolatti, Luciano Fadiga, Leonardo Fogassi, and Vittorio Gallese at Parma University, Italy, suggested an answer to such questions. They identified neurons in the frontal lobes of macaque monkeys that contribute to a greater understanding of the processes of non-verbal communication.[229] These neurons, which Rizzolatti termed 'mirror neurons'**,** are a particular class of visuomotor neurons found in area F5 of the monkey ventral premotor cortex (Figure 3.7) that discharge when the monkey does a particular action, such as reach for or bite a peanut, but more importantly, also when it observed or heard another individual, monkey or human, doing a similar action. Thus, the neuron 'mirrors' the behavior of another animal, as though the observer were itself performing the action.

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[227] This is particularly pertinent if we consider art as a form of communication, and even more so when one of the complexities of Palaeolithic art lies in the fact that the common understanding between the sender and receiver is absent, and as such, we are desperately searching for correct interpretations. Material art (as opposed to performing art) involves some form of storage and transmission, related to Donald's external symbolic storage. Donald, 1991

[228] Kolb & Whishaw, 2001:541

[229] Rizzolatti *et a*l. 1996a

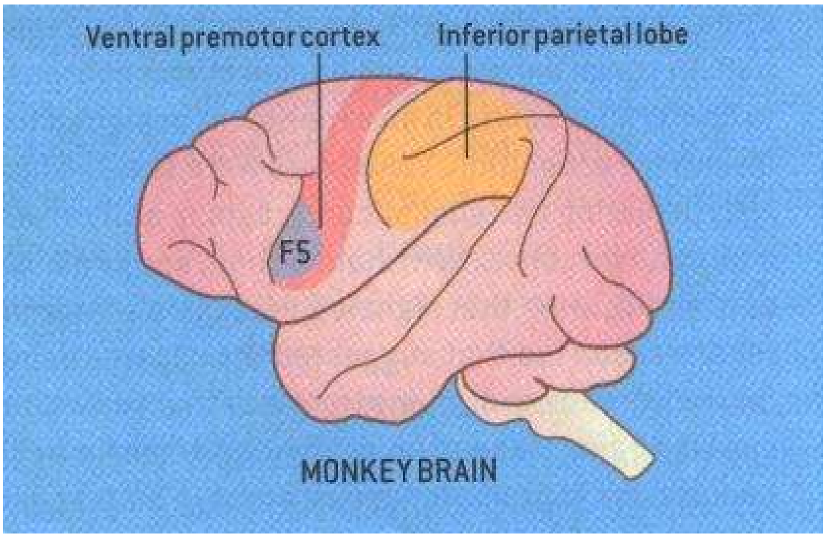

Fig. 3.7 Area F5 in Ventral premotor cortex of monkey brain

(Image: Rizzolatti et al. 2006:57)

The core of the proposal is that the observation of an action leads to the activation of parts of the same cortical neural network that is active during its execution (Figures 3.8 and 3.9).[230]

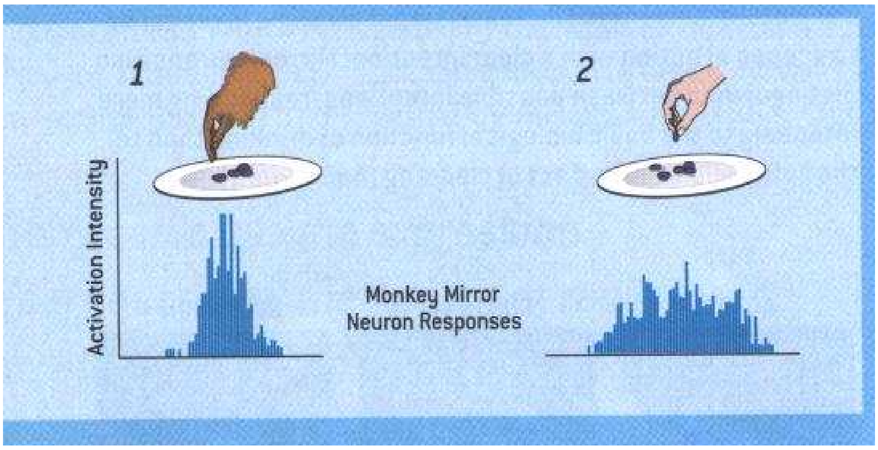

Fig. 3.8 Mirror Neuron responses

(Image: Rizzolatti et al. 2006:57)

[230] Di Pellegrino *et al.* 1992, Gallese *et al.* 1996, Rizzolatti *et al.* 1996b

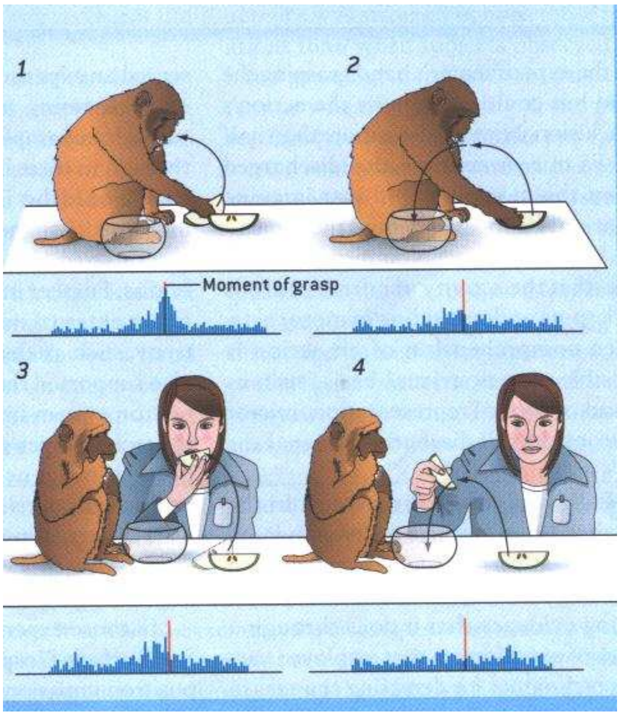

Fig. 3.9 Mirror Neuron responses

(Image: Rizzolatti et al. 2006:57)

Neurons responding to the observation of actions done by others are present not only in area F5, but also in the cortex of the superior temporal sulcus (STS).[231] Neurons in this area respond to such movements as walking, turning the head, bending the torso, and moving the arms. A small set of STS neurons discharge also during the observation of goal-directed hand movements.[232]

3.6.1 Mirror Neurons in Humans

Using neurophysiology and brain-imaging techniques Rizzolatti and his colleagues looked for the same neurons in humans.[233] Activity from single neurons in humans could not be recorded in the same way that they could in monkeys, because doing so requires attaching electrodes directly to the brain. Thus, direct evidence for the existence of mirror neurons in humans has been lacking, and so evidence has come from neurophysiological and brain-imaging experiments. Neurophysiological experiments demonstrate that, "when individuals observe an action done by another individual their motor cortex becomes active, in the absence of any overt motor

[231] Perrett *et al*.1989, 1990; Jellema *et al*. 2000, 2002
[232] Perrett *et al*. 1990
[233] Rizzolatti & Craighero, 2004:174

activity".[234] Studies have indicated that a mirror-neuron system appears to exist in humans and that it possesses important properties not observed in monkeys. First, intransitive meaningless movements, (and not only goal-directed movements) produce mirror neuron system activation in humans, whereas they do not activate mirror neurons in monkeys.[235] Second, the characteristics of cortical excitability, during action observation, suggest that human mirror-neuron systems code also for the movements forming an action and not only for the action itself, as monkey mirror-neuron systems do.[236] These properties of the human mirror-neuron system should play an important role in determining the humans' capacity to imitate others' action.[237]

One major difference between humans and monkeys is that in humans the mirror neurons are localised in the left hemisphere, although why this is so is not immediately clear. Further research shows that stronger MEG responses related to the mirror neuron system have been recorded in women than men.[238] Potentially, this finding may be consistent with the idea that the mirror neuron system is related to empathy,[239] and that women are considered more compassionate.

A large number of brain imaging studies have shown that the observation of actions done by others activates in humans a complex network formed by occipital, temporal, and parietal visual areas, and two cortical regions whose function is fundamentally or predominantly motor.[240] These two last regions (the rostral part of the inferior parietal lobule and the lower part of the precentral gyrus plus the posterior part of the inferior frontal gyrus) form the core of the human mirror-neuron system.[241]

However, a very recent study has succeeded in making a direct recording of mirror neurons in the human brain.[242] The researchers recorded both single cells and multiple-cell activity, not only in motor regions of the brain where mirror neurons

[234] Rizzolatti & Craighero, 2004:172
[235] Fadiga *et al.* 1995, Maeda *et al.* 2002, Patuzzo *et al.* 2003
[236] Rizzolatti & Craighero, 2004:176
[237] Rizzolatti & Craighero, 2004
[238] Cheng *et al*. 2006
[239] Wicker *et al.*2003; Singer *et al*. 2004, Jabbi, Swart & Keysers, 2007
[240] Grafton *et al.* 1996; Rizzolatti *et al.* 1996b; Iacoboni *et al*. 1999, 2001; Buccino *et al.* 2001; Perani *et al.* 2001; Decety *et al.* 2002; Grèzes *et al*. 1998, 2001, 2003; Nishitani & Hari 2000, 2002; Koski *et al.* 2002, 2003; Manthey *et al.* 2003
[241] Rizzolatti & Craighero, 2004:176
[242] Mukamel *et al*. 2010

were thought to exist but also in regions involved in vision and in memory. [243] The data demonstrated mirror spiking in the medial frontal cortex and the medial temporal cortex—two neural systems where mirroring responses at single-cell level have not been previously recorded.[244] Taken together, these findings demonstrate that mirror neurons are located in more areas of the human brain than previously thought. This recent study is a significant contribution to the study of the mirror neuron system, not least for its direct confirmation of mirror neurons in humans, but also their more widespread distribution in the human brain.

As previously mentioned, the mirror-neuron system is involved in action understanding, but an interesting issue is whether this occurs solely with conspecifics, or whether it is true also for actions done by individuals belonging to other species. Recently, an fMRI experiment undertaken by Buccino[245] and colleagues (2004) addressed such questions. While being scanned, fourteen volunteers were asked to observe carefully a series of video sequences, each presenting a single mouth action performed by a man, a monkey, and a dog. The mouth actions observed were biting and oral communicative actions (such as silent speech, silent lip-smacking, and silent barking).[246] Observation of biting, regardless of the species of the individual performing the action, produced two points of neural activation, but the activation was stronger during the observation of actions made by conspecifics. The observation of speech reading and lip-smacking produced neural responses but the observation of barking did not produce any activation in the frontal lobe.

These results suggest that actions made by other individuals are recognisable through different mechanisms. Actions belonging to the motor repertoire of the observer (e.g., biting and speech reading) are mapped on the observer's motor system. Actions that do not belong to this repertoire (e.g., barking) do not excite the motor system of the observer and appear to be recognised essentially on a visual basis without motor involvement.[247] It is likely that these two different ways of

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[243] The researchers drew their data directly from the brains of 21 patients who were being treated at Ronald Reagan UCLA Medical Center for intractable epilepsy. The patients had been implanted with intracranial depth electrodes to identify seizure foci for potential surgical treatment. Electrode location was based solely on clinical criteria; the researchers, with the patients' consent, used the same electrodes to facilitate their research.
[244] Mukamel et al. 2010:6
[245] Giovanni Buccino, Dept of Neurology, Parma University.
[246] Buccino *et al*. 2004:115
[247] Buccino *et al*. 2004:123

recognising actions have two different psychological counterparts. In the first case, the motor "resonance" translates the visual recognition into an internal personal experience, whereas this is lacking in the second case. Understanding actions made by others is a fundamental cognitive function on which social life and the survival of individuals depend. Buccino *et al.* (2004) propose that at the basis of action recognition is a sensorimotor matching mechanism.

The operation of the mirror neuron system has wide-ranging implications in the areas of communication, action understanding, imitation and empathy. Some neuroscientists, such as Ramachandran,[248] consider mirror neurons one of the most important findings of neuroscience in the last decade.[249]

3.7 Implications of a Neural Approach for Archaeology

The focus of this chapter has been on the types of mental processes and brain function that may help in the context of this enquiry. The relevance of the areas of brain function discussed above, are that they are the most important neural principles affecting the brain's relation to the environment.

Neural plasticity works on the principle that our brains have the capacity to change structure in response to environment and experience, and that this faculty occurs throughout one's lifetime. This means that if we know to what sort of environments and experiences people have been exposed, we have some basis for their behaviour. The logic of this would suggest that if we only have the material manifestations of that behaviour (in the case here, art), then we could look to the environment and the types of experiences the environment might present, to discover why those material manifestations (art) might exist, or might have acquired meaning to the maker. Furthermore, the dynamic interaction between neural growth mechanisms and the environment drives the learning process; thus, the way we learn changes as we learn. This suggests that it may help us understand the nature of the acquisition of cultural complexity. Our current knowledge of neural plasticity allows for a more fine-grained approach in making correlations between people and environment, but also it can shed light on existing theories, especially in relation to

[248] V.S. Ramachandran is Director of the Centre for Brain and Cognition and Professor with the Psychology Department and the Neurosciences Program at the University of California, San Diego, and Adjunct Professor of Biology at the Salk Institute.
Selected bibliography see Ramachandran & Hirstein 1999; Ramachandran 2000, 2004

[249] EDGE 69 — June 1, 2000 http://www.edge.org/documents/archive/edge69.html

the use of ethnographic analogies. Fundamentally, it may help us understand what elements of the environment in prehistory may have acquired significance or importance, or indeed why certain objects or practices might have acquired symbolic status.

Our current knowledge of the visual brain is a particularly useful tool in attempting an alternative approach in deciphering why art emerged in the first instance, and developed in the way it did. As we navigate our environment our visual brains establish lexicons of shapes, faces, places etc., both consciously and non-consciously. The more we look at an object with any attention, the stronger the neuronal connections and the more adept those neurons will fire on exposure to that object. Another important consideration is that we make associations with objects that share similar properties. In the context of art production this is a constructive resource, for knowing that something only has to look like something else, or have similar properties for the formation of a positive or negative response, allows us to make more meaningful associations.

Indeed, the visual processing system has the potential to act as an informative device when thinking about why the earliest art looks the way it does in particular places, and how the visual brain makes connections between objects, places, stored memories and emotions. This link between the plasticity of the visual cortex (and its connections with other brain areas) and the environment (both the natural environment and the cultural environment) on the one hand and the artefacts produced by modern humans on the other is of interest here, and may help to inform our thinking about why we think an object might have been of symbolic significance of art. An object may be quite explicitly indexical of symbolic behaviour because of its context or association with other artefacts, but when taking into consideration some of the earliest art production, other complexities arise because the symbolic nature of an object might me more equivocal.

As discussed above, the neural relationship between perception and action is activated by the interaction of the ventral and dorsal streams. This correlation between vision and action is an important one, especially in any discussion concerning technical production. In recent years a neural approach to prehistoric technologies has been explored by Dietrich Stout.[250] Stone tool making has been

[250] Stout et al.2000; Stout, 2005; Stout & Chaminade, 2007; Stout et al. 2008

practised in one form or another for 2.5 million years, exemplifying a basic human technology until the recent past, and an important area of study for cognitive neuroscience. Stout's experiments have focused on early practices of stone tool-making, most notably the Oldowan[251] and Acheulian[252] industries. Observations suggest that neural circuits supporting tool-making activities partially overlap with language circuits, but also engage perceptual-motor systems. Following practice of tool-making, activations are seen in higher order visual association areas of the middle and inferior occipital gyri, located in the dorsal and ventral streams of visual processing which contribute to the visual control of action and the perception of objects.[253] Studies have shown that new functional areas in the dorsal intraparietal sulcus (IPS) may provide enhanced capacities for visual analysis during object manipulation and tool handling.[254] Stout's research has contributed significantly to our understanding of the relationship between different functioning cortical areas during technical production and may shed light on linguistic abilities of our early ancestors. The importance here lies in the way the brain uses both visual and motor regions of the brain in technological activity and that the visual areas may even be enhanced by persistent and regular activity.

The implications of the neural correlates for stone-tool making for the emergence and development of artistic production are important. Repeated practice appears to be linked with enhanced capacities for visual analysis, implying that there is a neurological distinction between novices and experts. Indeed, Solso (2001) has undertaken fMRI scans of a skilled portrait artist and of a non- artist as each drew a series of faces. He observed that there was a discernible increase in blood flow in the right-posterior parietal region of the brain for both the artist and non-artist during the task, a site normally associated with facial perception and processing, which was not surprising. However, the level of activation appeared lower in the expert than in the novice, suggesting that a skilled artist may process facial information more efficiently. In addition, the skilled artist who sees and thinks about faces

[251] The Oldowan tool tradition represents the first manufacture of any tool noted in the archaeological record. It lasts from about 2.6 million years ago to 1.7 million years ago, when Acheulian sites make their appearance in the archaeological record. Sometimes called "pebble tools," so named because the blanks chosen for their production already resemble, in pebble form, the final product.

[252] Developed out of Oldowan technology some 1.8 million years ago Their distinctive oval and pear-shaped handaxes have been found over a wide area and some examples attained a very high level of sophistication.

[253] Stout and Chaminade, 2007:1097

[254] Stout and Chaminade, 2007:1093

professionally, may require little involvement of this area of the brain normally associated with facial processing. Solso suggests that this indicates that an expert artist uses “higher-order” cognitive functions, such as the formation of associations and planning motor movements, when viewing and drawing a face.

While it is premature to make a generalisation to all creative experts on the basis of this observation of one portrait painter, the results suggest that not only repeated practice but exceptional practice may alter the way one conceptualises the finished artefact. In Solso’s exploratory, the skilled artist “thinks” portraits more than he “sees”[255] them. We can consider then the art of making in two different but interrelated ways, that being absorbed in, and concentrating on, an activity is inextricably linked with focused and engaged visual attention, but also that accomplished ‘doing’ may be more compatible with higher order ‘thinking’. This may be of significant value when considering how modern humans acquired and developed cultural complexity. We may speculate that early artistic activities such as incised ochre and perforated shells may comparable with the ways in which ‘novices’ process information about an activity, and concerned with ‘seeing’, as in Solso’s scenario. Whereas, later examples of art production such as Chauvet Cave (Cat. 29) and the Swabian Jura figurines (Cat. 31-34) may be perceived as ‘experts’ engaged in ‘thinking’ about representational imagery and how it is used. As particular practices become more proficient, the ways in which objects are produced alter, and are altered by, ways of thinking.

The beginnings of art in Middle Stone Age Africa, when cultural artefacts were less numerous and complex than the later Upper Palaeolithic Europe, were probably the first signs of a symbolic culture, and we should think about why particular objects or patterns may have acted as a signifier. To make signs, particularly a limited number of signs, is not the same as to engage with a system of symbolic representation. It is my view that the earliest artistic activity may have been visually influenced in varying degrees between the cultural and natural environments. As humans started to develop and increase their repertoire of cultural artefacts, as social groups increased in size and new environments were exploited, so the possible range of objects in the visual cortex expanded and elaborated, enhancing connections with places, people, stored memories and reward mechanisms. By the

[255] Solso, 2001:34

Upper Palaeolithic the role of objects in people's visual repertoire was inextricably tied up with social, economic, cultural and natural worlds.

Although this thesis is not specifically concerned with language, the fact is that for many archaeologists, evidence of art (however early in the archaeological record) is both intentional and symbolic, and consistently linked with syntactical language.[256] The role of mirror neurons in this debate suggests that our ability to learn, empathise and understand others' intentions and behaviour potentially have mirror neurons as the basis, and that language is not necessarily a pre-requisite for artistic behaviour. As mentioned previously, Ramachandran is a keen proponent of the importance of the mirror neuron system. Indeed, he addresses the 'Big Bang'[257] of human culture in the Palaeolithic in terms of mirror neurons.[258] Ramachandran argues that the great leap forward in human culture in Upper Palaeolithic Europe occurred because "certain critical environmental triggers"[259] acted on a brain already pre-adapted for some other reason; one of the key pre-adaptations being mirror neurons. Mirror neurons are necessary but not sufficient to account for the big bang of human culture, but their emergence and development was the decisive step.

Appropriately, he observes that what archaeologists perceive as the big bang is "tenuous",[260] and may simply be an artefact of archaeological sampling. Instead, the characteristic innovations of modern human behaviour such as music, shelters, tailored clothing, speech, art etc emerged between c. 100,000 – 5,000 years ago.[261] The increase in cultural complexity over this period was enhanced by the mirror neuron system in two ways; firstly, any innovation would have served as a catalyst for others and second, the increase in sophistication of the mirror neuron system improved the ability to imitate, learn and teach, thus explaining the explosion of cultural change. In this sense, human culture is inextricably linked with the human brain. Mirror neurons have the potential to change our understanding of how humans learn, how we interact socially, and how we communicate. In addition, an important

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[256] In linguistics, syntax is the study of the principles and rules for constructing sentences in natural languages. In addition to referring to the discipline, the term syntax is also used to refer directly to the rules and principles that govern the sentence structure of any individual languages. When used in terms of modern human behaviour, "it is the ability to present and interpret [their] knowledge and experience in an infinite variety of meaningful sentences" (Ehret, 2006).

[257] See Mithen, 1996

[258] Ramachandran also suggests the 'Big Bang' of Upper Palaeolithic Europe occurred through environmental triggers acting on the brain. This will be discussed further in Chapter 7.

[259] Ramachandran, 2000:4

[260] Ramachandran, 2000:4

[261] Ramachandran, 2000:4

element in the mirror neuron system is that it is not confined to conspecifics, so that as long as the action is mapped onto the observer's repertoire, a meaningful resonance occurs. This may help us understand why certain animals are represented or particular animal's body parts selected as items of personal ornamentation.

So, while we know that mirror neurons did not emerge with *Homo sapiens*, potentially mirror neurons began to operate in a somewhat different way with modern humans. Recent research into mirror neurons in humans demonstrates that they are distributed more widely than those found in primates and work in different ways. Ramachandran considers that there is a correlation between mirror neurons, the environment and the development of cultural complexity up to 100,000 years ago, and more specifically links the 'Human Revolution' of Upper Palaeolithic Europe with a change in the ways in which mirror neurons functioned. In Ramachandran's hypothesis, he does not go so far as to clarify what type of environmental influences potentially acted as the trigger for a more sophisticated mirror neuron system, and thus cultural complexity, what is more interesting is that he considers there *is* a correlation. This is an important point because it allows us to think about what mechanisms might be present in environments where we see the emergence and of development of cultural complexity.

Theories that the migration into Europe by *Homo sapiens sapiens* triggered some kind of 'cognitive change'[262] that resulted in the 'Human Revolution' model have proved engaging, but lacking in any verification. More recently, it has been proposed that the innovative behaviours seen in Europe occurred much earlier at different times and in different regions in Middle Stone Age Africa. [263] The neural mechanisms that produce enhanced effects in the brain are only now being understood, but their implications were anticipated decades ago, in the theory of Environmental Enrichment (EE),[264] and may help to inform our thinking about the development of the mirror neuron system.

The logic of Environmental Enrichment studies is based on how the brain changes in response to complex stimulation by a novel environment, emphasising the behavioural and neurobiological consequences of specific elements of enrichment. Its value in the context of this thesis is that it may be an effective way of helping us

[262] Klein, 1989
[263] McBrearty & Brooks, 2000
[264] The term was introduced by Mark Rosenzweig of UC Berkeley, in collaboration with biochemist Ed Bennett, psychologist David Krech and neuroanatomist Marian Diamond.

to understand the consequences of modern humans moving into new and challenging environments (both within Africa and as they migrate out), and the innovations that occurred in different places and at different times.

3.8 Environmental Enrichment Studies

Donald Hebb formulated the modern conceptual framework for environmental enrichment in the 1940s, without any detailed knowledge of neuronal plasticity. Hebb was a psychologist who thought that psychology should by necessity, have an intimate relationship with the other biological sciences, especially neurophysiology.[265] His primary aim was to present a theory of behaviour that had common ground with psychologists and neurologists alike.

Hebb demonstrated that laboratory rats allowed to run freely in his house had better memory and learning capacity than rats housed in laboratory cages.[266] He found that his home provided a more challenging environment than that supplied through standard laboratory conditions, and the home rats performed far better on the tasks than the caged rats, displaying enhanced intelligence and superior problem-solving skills. He therefore concluded that intelligence must be influenced by experience, and based on his research reasoned that people would maximise their intellectual potential if brought up in a stimulating environment.[267]

Hebb's view was broadened in the early 1960s by David Hubel and Torsten Wiesel. These first controlled studies with animals demonstrated that enriching the environmental condition in which they were confined could alter both the chemistry and anatomy of the cerebral cortex and, in turn, improve the animal's memory and learning ability[268]. Importantly, in the 1960s Rosenzweig and colleagues "introduced enriched environments as a testable scientific concept".[269] Using rats housed twelve to a cage with stimulating objects Rosenzweig compared learning ability to differences in brain chemistry. The rats housed in an enriched environment had increased activity of acetylcholinesterase (the enzyme that initiates the synaptic

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[265] Hebb, 1949: xii
[266] Hebb, 1947:737–745.
[267] Indeed, it was the logic of environmental enrichment studies undertaken by Hebb, which led to the development of pre-school television programmes such as *Sesame Street* in America. Its aim was to provide a form of enrichment for young children who otherwise would have little pre-school exposure to reading. (Kolb & Whishaw, 2001:260)
[268] Wiesel & Hubel, 1965; Hubel & Wiesel, 1968,1970
[269] van Praag *et al*. 2000:191

transmitter, acetylcholine), but Rosenzweig also found unexpected changes in cortical morphology (Figure 3.10); an eight percent increase in thickness of the cerebral cortex,[270] and an increased number of neurons and synapses.[271] Later studies have shown that the enlargement noted was the result of various forms of neural plasticity, ranging from dendritic arborisation (increased length and branching of dendrites)[272] (Figure 3.11), Neurogenesis, (the birth of new neuronal cells), Gliogenesis (cell proliferation), and improved learning.[273] The dentate gyrus is also one of the few regions of the brain where neurogenesis takes place. It is thought to play a role in the formation of new memories, and has been found to increase in response to physical exercise.[274]

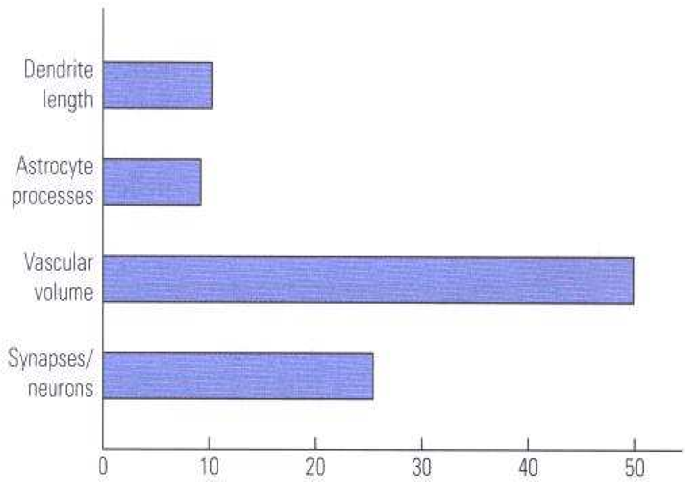

Fig. 3.10 A schematic summary of some of the changes that take place in the cortex in response to experience.[275]

(Image from: Kolb & Whishaw, 2001:515)

[270] Diamond, 1967; Diamond et al. 1972
[271] Rosenzweig *et al.* 1962, 1969a 1969b
[272] Volkmar & Greenough, 1972; Greenough, 1976
[273] Kolb & Whishaw, 2001
[274] Kemperman, Kuhn & Gage, 1997
[275] Based on data from Turner and Greenough, 1985; Sirevaag and Greenough, 1987; Gibb, Garney & Kolb, 2001

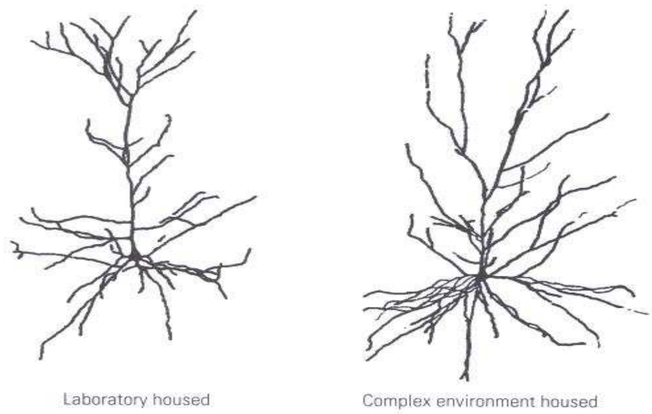

Fig. 3.11 Representative neurons from the parietal cortex of a laboratory-housed rat and of a complex-environment-house rat.

(Image from: Kolb and Whishaw, 2001:261)

More recently, in Kolb's experiments on rats in enriched environments,[276] an increase in overall brain weight of approximately 7%-10% after 60 days has been observed. This increase in brain weight represents increases in glia, blood vessels, neuron size, dendritic elements, and synapses. It would be difficult to estimate the total number of increased synapses, but in the cortex is estimated to be about 20%, which is an extraordinary change. Not only are there more synapses per neuron in animals with enriched experience, there is an increase in astrocytic material, (cells that surround neurons protecting the Central Nervous System) blood capillaries, and a high mitochondria volume (mitochondrial volume is used as a measure of metabolic activity). Generally, it has been found that enrichment not only increases dendritic length but also increases the density of synaptic spines on the dendrites. It is therefore clear that when the brain changes in response to experience there are not only the expected neural changes but there are also adjustments in the metabolic requirements of the larger neurons. Some corroborating studies have involved cats[277] and monkeys;[278] overall, these studies have found similar results.

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[276] Kolb & Gibb, 1991; Kolb & Stewart, 1991, 1995; Kolb *et al*. 1997
[277] McCune, 1997; Loveridge, 1997; Saigeman, 1998; Beaulieu & Colonnier, 1989; Beaulieu & Cynader, 1990
[278] McCune, 1997; Loveridge, 1997; Saigeman, 1998; Gould & Gross, 2002

3.8.1 Environmental Enrichment Studies in Humans

It is much more difficult to get comparable data for humans, but there have been isolated but notable studies in this field. Jacobs *et al*. (1993) used a portion of human cerebral cortex responsible for word understanding (Wernicke's area), and compared the effects of enrichment in tissue from deceased individuals[279] who had had a College education with those who had obtained a high school education. They demonstrated that there was a direct correlation between increased dendritic arborisation and College educated individuals, compared to less extensive dendritic branching for those with a high school education, revealing that, "Education had a consistent and substantial effect such that dendritic measures increased as educational levels increased".[280] The results of this study support documented research in animals; that dendritic systems proliferate in response to active interaction with novel and challenging environments. These results also correspond with other investigations on the general characteristics of dendritic systems in humans,[281] and their ability to provide a kind of "organic autobiography".[282]

We can thus now identify a large range of neural changes associated with experience including changes in brain size, cortical thickness, neuron size, dendritic branching, spine density, synapses per neuron and glial numbers.[283] The magnitude of these changes should not be underestimated. One important finding was that an enriched experience increased the number of excitatory synapses per neuron and decreased the number of inhibitory ones in the visual cortex. Thus, enrichment can modify the excitatory-inhibitory equilibrium of the visual cortex. One prediction from this observation is that neurons in the cortex of enriched animals may be more reactive to visual stimulation. We may speculate if a higher visual acuity is a result of an enriched environment (and this may be dependent on many variables within the EE paradigm) the more acute or intense the enrichment, the greater visual acuity may occur. This is particularly germane when considering the connection between the migration of modern humans into Europe and the enhancement of visual culture seen in the archaeological record. If we consider the migration from Africa into Europe as a particularly intense experience in terms of physical activity, social interaction and

[279] Tissue was obtained from the Veteran's Hospital in West Los Angeles.
[280] Jacobs *et al*. 1993:97
[281] Scheibel *et al*. 1985, 1990
[282] Scheibel, 1990:264
[283] As previously mentioned above, glial cells act as a supporting role to neurons, without them neurons functionality would be severely diminished.

mental stimulation involving experiential learning, then such variables may have prompted an acceleration of the development of the visual system. We may speculate that such a morphological change in the visual system may have contributed to an alteration in the perception of the environment that included materials, animals, colours, patterns, shapes etc. To what extent such traits were passed down from one generation to another is subject to debate, but the emerging field of epigenetics suggests that elements of an enriched environment are subject to transgenerational inheritance.[284]

Neuroscientists are typically cautious about making broad recommendations for two-legged mammals based on results in the four-legged variety. However, at the cellular and molecular level, human brains and rodent brains are remarkably similar. As Marilyn Albert, director of cognitive neuroscience at Johns Hopkins, points out, “The importance of the animal studies is that they give you a sense of what the underlying mechanisms might be... To me, it’s the combination of the human data with the animal models that makes you think there is something meaningful to the findings.”[285] Examining the neural effects of “Environmental Enrichment” (EE) is a growing sector of neuroscience research, one with profound implications for human brain health from birth to death

There are debates surrounding the semantics of the term Environmental Enrichment, and its ability to infer judgement calls on environmental situations.[286] The measure of an enriched environment is entirely dependent in comparison with prior experience. It does not infer any value judgements, other than it augments, expands, develops, elaborates or advances an already established neurological capacity. The elements considered to comprise enrichment include physical activity, social interaction, and mental stimulation that involve some degree of experiential learning.[287]

The suggestion made here is that the movement of modern-type humans both within Africa and as they migrated out of Africa would have presented novel experiences and challenges to the motor and sensory capacities of those modern humans, as well as challenging processes of learning and memory. Furthermore, the

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[284] See Arai *et al*. 2009
[285] From the Dana Foundation website – www.danaorg.com. The Dana Foundation is a private philanthropy with principal interests in brain science, immunology, and arts education
[286] See Cohen, 2003
[287] Dana Foundation website – www.danaorg.com

movement into new environments would have included the criteria of EE, including physical activity, mental stimulation and social interaction, albeit in differing degrees. The importance of these enrichment studies in the context of this thesis is that it supports the proposition that the movement of modern-type humans within an African environment, and later as they migrated out of Africa to other environments may have altered neurological structures sufficiently to promote changes in behaviour. These changes were not abrupt; the migration from Africa to Europe may have taken 15,000 – 20,000 years. But during this time, each time humans walked into another new environment, their neurological structures adapted and altered to the challenges of the new surroundings, drawing on stored memories and inherited traits from previous environments. The debates surrounding the emergence of art focus mainly on Africa and Europe. Thus to develop this theory some knowledge of how the African and European environments were sufficiently different to activate those neurological changes is required

3.9 The Pleistocene Environments of Africa and Europe

The study of Pleistocene environments and palaeoenvironmental reconstruction is a vast area of research,[288] and space constraints do not allow a detailed review of the current state of the field. The task here is to provide a brief overview of how the Pleistocene environments in which modern-type humans inhabited differed, in order to make the case of Environmental Enrichment as a trigger for alteration in neurological structures, and the potential impact upon cultural production.

3.9.1 Middle Stone Age Africa

According to both genetic and fossil evidence, archaic *Homo sapiens* evolved into anatomically modern humans solely in Africa, between 200,000 and 100,000 years ago, with members of one branch, mitochondrial haplogroup L3, migrating out of East Africa (probably by coast) by at least 60,000 years ago (Figure 3.12).[289]

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[288] *General***:** GRIP, 1993; Crowley & North, 1996; Vrba *et al*. 1996; Kasting & Ono, 2006;
Europe: Van Andel, 1989; Van Andel & Tzedakis, 1996a, 1998; Barron & Pollard, 2002; van Andel, 2002; Markova *et al*, 2002; Huntley *et al.* 2003; van Andel & Davies, 2003; Alfano *et al*. 2003; van Huissteden *et al*. 2003; Hughes *et al*. 2007
Africa: Maslin *et al.* 1996; Maslin & Trauth, 2009; Trauth *et al*. 2009

[289] Stringer & McKie, 1986; Cann, Stoneking & Wilson, 1987; Cooper *et al*. 2001; Oppenheimer, 2003; Wells, 2003; Hua *et al*. 2006

It has been estimated that from a population of 2,000 to 5,000 in Africa, only a small group of possibly 150 people crossed the Red Sea. This is because, of all the lineages present in Africa, only the daughters of one lineage, L3, are found outside Africa.[290] Thus, while we know that other lineages migrated within Africa, journeying south, west and north,[291] and indeed much of the earliest artistic evidence we have derives from southern and northern Africa,[292] genetic evidence indicates East Africa could be the key to understanding the impact of environmental enrichment.

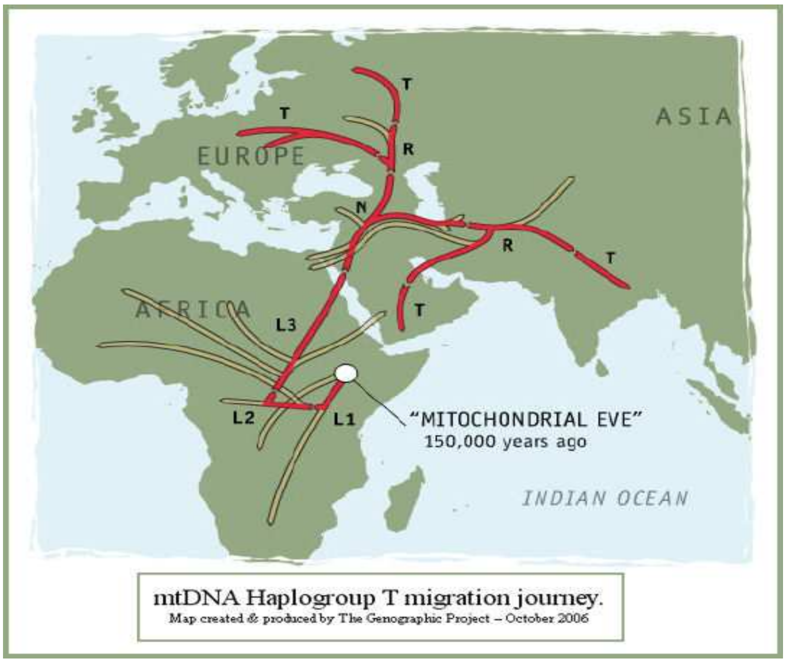

Fig. 3.12 Genetic Groups Out of Africa

(Image: The Genographic Project)

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Eastern Africa spans a variety of habitats from arid near-desert conditions, through rich grassland ecosystems, woodlands, lowland rainforests, and montane forests. Being situated at the convergence of two rainfall systems may have served to ameliorate glacial aridification.[293] In addition, variations in altitude provide a diversity of habitats, some of which are thought to have remained productive through cool and arid conditions.[294] What is most interesting is that eastern Africa does not

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[290] Hudjashov *et al.* 2007
[291] Chen *et al.* 2000; Gonder *et al*. 2007
[292] See Chapter 4
[293] Marean & Assefa,, 2005:110
[294] Such as Lukenya Hill (Marean, 1992b), Porc-Epic (Clark *et al*. 1984), Nasera and Mumba Rockshelters (Mehlman, 1989)

show the distinct shift in lithic technology that is evident in northern and southern Africa (Figure 3.13); the majority of assemblages employ a succession of basic technological characteristics.[295]

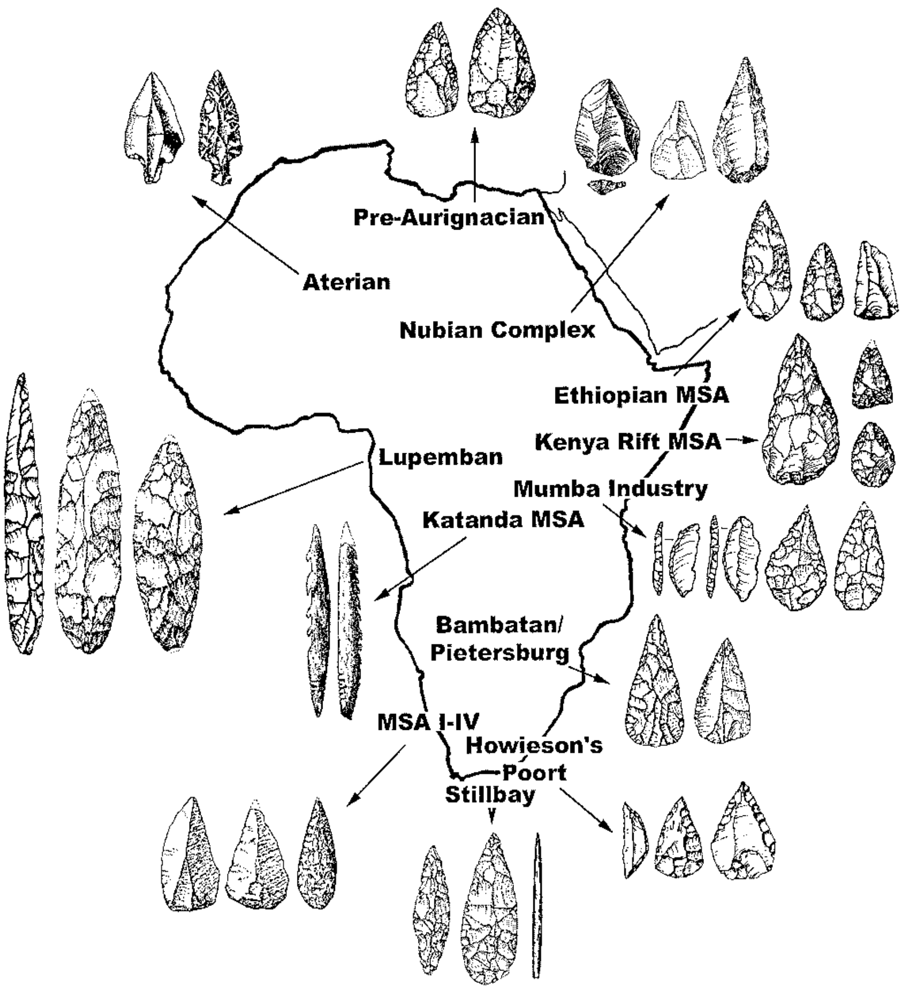

Fig. 3.13 Map of distribution of point styles in the African MSA

(Image: McBrearty and Brooks, 200:487)

Long, continuous marine core records form the basis of palaeoclimatic reconstruction,[296] using the Marine Isotope Stage (MIS) sequence, with even-numbered stages indicating colder phases and odd numbered designating warmer interglacials (Figure 3.14).[297]

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[295] Marean & Assefa, 2005:110

[296] Terrigenous (derived from land erosion) dust flux from marine sediments off subtropical West Africa, the eastern Mediterranean Sea, and the Arabian Sea, and lake records from East Africa are analysed using statistical methods to detect trends, rhythms and events in Plio-Pleistocene African climate. See Trauth *et al.* 2006

[297] See Evans & Heller, 2003; Walker, 2005

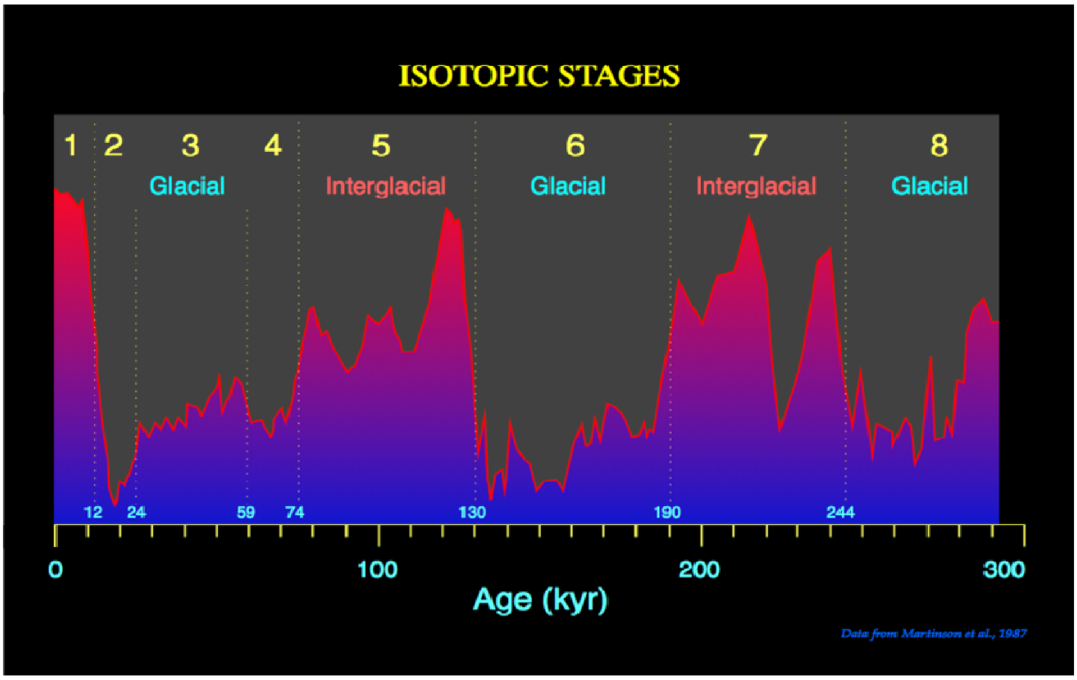

Fig. 3.14 Graph showing the last three glacial/interglacial cycles of the Quaternary

(Image: Hannes Grobe, Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany. Data from Martinson *et al.* 1987)

The data covered in this thesis cover the period from 100,000 – 28,000 years ago, of which the correlating Marine Isotope Stages are MIS 5 and MIS 4. MIS 5 covered the period from c.130,000 – 75,000 years ago[298] and comprises a sequence of alternating warm and cold phases, each lasting about 10,000 years;[299] these stages are conventionally labelled from e –a. As a whole, MIS 5 was marked by an early interval of warmth (MIS 5e) (Figure 3.15), followed by an irregular but in general a downward trend in temperatures, resulting in the glacial conditions of MIS 4.[300]

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298 Sirocko *et al*. 2007
299 Shackleton *et al*. 2003
300 Barham & Mitchell, 2008:239

		Years BP	**Marine Isotope Stage**	**Inferred World-wide Climate**	**Geological Time Scale**
Present Interglacial			**1**	Very warm	**Holocene**
	LATER STONE AGE	12 000			
			2	very cold	
		32 000			
Last Glacial	MIDDLE STONE AGE		**3**	cold with warm oscillations	
		64 000			**Late**
			4	very cold	**Pleistocene**
		75 000			
		82 000	**5a**	warm	
			5b	cold	
		105 000	**5c**	warm	
			5d	cold	
Last Interglacial			**5e**	Very warm	
		128 000			
			6	cold with warm oscillations	**Mid Pleistocene**

Fig. 3.15 Table showing Marine Isotope Stages 1-6

(Image: Blombos Cave website - http://www.svf.uib.no/sfu/blombos)

In eastern Africa, human activity during sub-stages 5d-a (c.100,000-80,000 BP) are evident in the archaeological record, particularly in the Aduma region of Ethiopia's Middle Awash valley.[301] The distribution of sites in this region and the ecological evidence indicate a variety of habitats were used both close to and away from the river, but the river remained the focus for food, including hippopotamus, crocodiles and large catfish.[302]

The climate associated with MIS 4 was colder and drier, lasting around 10,000 years, (c.70,000 – 60,000 BP) with sea levels about 75m lower relative to the present day. The Sahara and Kalahari deserts expanded substantially, with grassland environments extending at the expense of more closed vegetation zones.[303] Temperatures were 5-7 degrees lower than today, with 20% - 40% less rainfall,[304] and reduced carbon dioxide levels had an impact on the extent and composition of the equatorial forests.[305] Between 57,000 – 24,000 BP evidence suggests that conditions were generally more moderate, although frequent and rapid fluctuations existed.[306] In North Africa conditions were not much drier than today, but in southern Africa, both wetter and drier extremes are observed.[307] South Africa's winter rainfall was wetter than or as wet as present,[308] but such conditions were not found everywhere, and there is no evidence of increased rainfall in the Sahara.[309] The climatic effects on the size and extent of human populations was significant, some areas were abandoned altogether, such as the Sahara, and settlement in others sporadic.[310] East Africa, presents a clearer picture,[311] and suggests that occupation was more continuous than other parts of Africa.[312]

In summary, modern-type humans living in eastern Africa inhabited and exploited, in general, grassland environments, close to rivers. The lithic technology did not show the diversity found in other areas of Africa and the climate appeared more moderate than that of southern Africa. It must be stressed that in any discussion

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301 Yellen *et al*. 2005
302 Yellen *et al*. 2005
303 Barham & Mitchell, 2008:263
304 Thomas, 2000
305 Jolly & Haxeltine, 1997.
306 Grootes, 2001
307 Stokes *et al*. 1997
308 Cowling *et al.* 1999; Carr *et al.* 2006
309 Brooks *et al*. 2003
310 Barham & Mitchell, 2008: 265-270
311 This reflects more intensive fieldwork and better conditions for chronometric dating and organic preservation.
312 Ambrose, 1998b

of the African environment, the continent does not comprise a single entity and different areas represent very different environments and thus, very different worlds to inhabit.

3.9.2 Upper Palaeolithic Europe

In Europe, the period between 58,000 -28, 000 BP is known as the Interpleniglacial and in terms of the marine record[313] covers MIS 3 and the onset of MIS 2.[314] The Interpleniglacial is characterised by five interstadials, widely recorded in the pollen record from the north of the continent, each lasting between 2,000-4,000 years.[315] The Interpleniglacial saw an increase in grasses and herbs, which produced the steppe-tundra that supported the mixed communities of large grazing herbivores.[316]

From an economic perspective, the tundra and steppe-like environment extending over large areas of eastern, central and western Europe, provided ideal conditions for numerous species of cold-adapted herd animals such as reindeer, wild horse, bison, as well as mammoth and woolly rhinoceros. Many of these species are known to have formed large roaming herds (amounting in some cases to several hundred if not thousands of animals) which followed more or less regular migration trails between summer and winter pastures, at regular and largely predictable times of year. Upper Palaeolithic communities were keenly aware of these seasonal migrations and frequently located settlements close to migration trails.[317]

The Interpleniglacial was punctuated by three major temperate oscillations, of which the Würm concerns us here, lasting from c 46,000 BP – 28,000 BP.[318] During this period average annual temperatures may have been 10°C or more below modern European estimates, with precipitation half or less of that received by Europe today.[319] The Würm saw the spread of steppic grasslands in Southern Europe, (with woodland occurring in sheltered valley systems), arctic steppe, and tundra above 45° N latitude,[320] and possible ice advances in Northern Europe.[321] The most severe

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[313] Marine core records come from Greenland ice-core studies (Meese *et al.* 1997; Sowers *et al.*1993) and North Atlantic Ocean cores (Bond *et al.* 1997; Völker *et al.* 1998)
[314] Gamble, 2002:272. See also Dincauze, 2000
[315] Gamble, 2002:280
[316] Gamble, 2002:280
[317] Gamble, 2002; Gamble *et al*. 2004
[318] See Churchill & Smith, 2000
[319] Guiot *et al*. 1989
[320] 45° N latitude is the halfway point between the Equator and the North Pole,

period occurred during Würm IIIa, c. 35,000 BP, with average annual temperatures about 12°C below modern day norms,[322] and with winter temperatures estimated to have reached minus 20°C.[323]

Until recently, the widely held opinion among palynologists has been that "low tree pollen percentages in glacial peats from midlatitude Europe indicate a severely cold climate".[324] However, new research indicates that a treeless landscape may not entirely be an accurate picture.[325] Between 44,000 – 47,000 BP there is evidence of pinewoods at Bohunice in what is now the Czech Republic and a wooded environment has been proposed near the site of Istallosko.[326] Micromorphological data from Geissenklösterle indicates that in the lower Aurignacian period there was a decrease in tundra elements and an increase in boreal fauna indicating a slightly warmer period. By around 35,000 BP, there was an even further decline in tundra elements and intensification of wooded and boreal species.[327] Bird species that prefer woodland or forest are usually present - except during the very coldest intervals - mixed in with species characteristic of more open vegetation, suggesting isolated clumps or pockets of woodland, rather a continuous cover.[328]

Although only a brief outline of the distinction in the African and European environments, the move northwards into Europe from the southern hemisphere, entailed an engagement with diverse flora, fauna, topography and mean annual temperatures requiring new ways of learning and adapting to novel and challenging environments. Gamble's comprehensive book entitled *The Palaeolithic Societies of Europe (2002)* emphasises the "active engagement of people with their environment".[329] His accentuatation of the environmental aspect means that, "brains need to be put into a context of action" if we are to understand the changes they underwent. The logic of which suggests that different environments may necessarily require different types of engagement, and different contexts of action, resulting in neurological changes.

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[321] Van Andel & Tzedakis, 1996a
[322] Guiot *et al*. 1989
[323] Mellars, 1998
[324] Van Andel, 2002:2
[325] Van Andel, 2002
[326] Davies, 2008
[327] Conard *et al* 2006a:318
[328] Tyrberg, 1998
[329] Gamble, 2002:420.

The value of Environmental Enrichment studies is that it can be used not only as a foundation for understanding the so-called ‘Human Revolution’ in Upper Palaeolithic Europe, but also to understand the move into new environments within Africa and the behavioural changes that occurred. The brain’s ability to alter its structure in significant ways as a result of living in an ‘enriched’ environment has great value when considering the migration of modern humans from an African homeland and colonising the rest of the world.

3.10 Summary and Discussion

The aim of this chapter has been to focus on particular theories of brain function and mental processes that have the potential to inform our understanding of the development of artistic activity. It is clear that the way in which the brain is influenced by the environment in which it resides has wide-ranging implications for human behaviour. The core proposal in light of the neurological theories discussed above is that if we know “something of the factors that might have affected the unconscious mental formation of the makers and viewers of art in a particular place at a particular time, neuroscience helps us understand how those factors might also have affected the appearance of that art”.[330] Moreover, it may go some way towards maturing our thinking about why a particular pattern, object or practice may have acquired meaningful connotations to the maker.

The following three chapters will present the archaeological data. Chapter 4 presents the emergence of art-like activities in Middle Stone Age Africa at around 100,000 following the way in which art developed up to the first representational art at around 28,000 BP. Chapter 5 follows the journey as modern-type humans migrate out of Africa, visiting India, Papua New Guinea and Australia, detailing the sites and type of objects produced. Chapter 6 presents the data from Upper Palaeolithic Europe, as modern-type humans venture into Europe at around 45,000 BP, examining the increase in the types of objects produced and resources exploited. The journey finishes at 28,000 BP, the end of the Aurignacian period, which coincides with the advent of representational art in Africa.

[330] Onians, 2008b:284

CHAPTER 4

Middle Stone Age Africa - Presentation of Data

4.1 INTRODUCTION

The following three chapters present a cohesive and unifying account of the objects recorded in the catalogue, situated within a chronological and geographical framework. This chapter focuses on the earliest evidence from Africa, during the period c.100,000 – 28,000 BP. Within this chapter, I have included sites located in coastal Israel dating back 90,000 – 100,000 years ago, which also present evidence of perforated shells. The logic for including these sites within the African section is that the cave sites present similar perforated shells as contemporary African sites and it thus affords a certain convenience to include them here. Chapter 5 will address the objects from Australia, Papua New Guinea, India and the Levant as modern humans migrate out of Africa at around 60,000 BP[331], and Chapter 6 will focus on the artefacts from Europe, from around 45,000 – 28,000 BP. The quantity of evidence has required a division of the data into three chapters, but the division is also based on chronological and geographical classifications; the emergence and development of art-like activities in Africa, the evidence as modern humans move out of Africa and finally, the migration into Europe.

The aim is to examine, analyse, and assess each individual object in the catalogue thoroughly in terms of dating, location, contextual and archaeological evidence, focusing particular attention on the visual characteristics of the objects under discussion. Chapters 8 and 9 will discuss the mental processes that may have led to the production of objects detailed in this and the following two chapters.

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[331] Genetic and fossil evidence supports the view that anatomically modern humans arose in sub-Saharan Africa somewhere after 200,000 years ago. Isolated by hyperarid conditions in the Sahara and Arabian Peninsula during Oxygen Isotope Satge 6, the population remained bottlenecked (Ambrose, 2003). Climatic shifts at the onset of OIS 5e resulted in an amelioration of the Saharan belt, and remains from Skhul and Qafzeh in the Levant indicate modern humans had spread into that nearby region around 90,000 years ago, possibly as early as 110,000 years ago. (Schwarcz *et al.* 1988; Mellars & Stringer, 1989; McDermott *et al.* 1993; Mercier *et al*. 1993).

4.2 MIDDLE STONE AGE AFRICA

The earliest dated artefacts from Middle Stone Age (hereafter MSA) Africa, regarded as evidence of art-like activity[332] produced by modern humans emerge as two quite distinct categories of artefacts. Although limited in quantity, the two assemblages of artefacts include firstly, perforated natural objects, notably marine shells (Cat.1-5), and secondly, engraved or incised pieces of stone or ochre (Cat.6-8). An intriguing aspect of these artefacts is that their appearance in the archaeological record covers a period of c.25,000 years, and the sites where these objects occur can be up to hundreds, even thousands of kilometres apart from each other. Nevertheless, despite such temporal and spatial variability, there are particular correlations between objects that are worth noting.

The majority of shells collected for perforation are all of the same genus, *Nassarius*[333] and in three cases are of the same species, *gibbosulus*[334], the other being *kraussianus*.[335] The other species are *Glycymeris* bivalves from Qafzeh cave. Distribution of the species *gibbosulus* is from the Mediterranean to the Northern Red Sea, while *kraussianus* are located in South Africa, Egypt and Australia.[336] Therefore, it appears that the selection of the species is location-dependent, but it is significant that they are selecting the same genus of shell to perforate.

Incised stone and ochre have been discovered at three sites, all of which are located in southern Africa.[337] The incised markings all exhibit the same or similar patterning, inasmuch as incised vertical, horizontal and diagonal lines engraved on small pieces of stone and ochre resemble a crosshatch pattern.

This is a provocative feature of the earliest art made by modern humans; that the first forays into art making in MSA Africa exhibit noticeable visual qualities of similitude, despite the temporal and spatial variability of the sites. Why this should

[332] The earliest dated artefacts are a piece of incised stone with a crosshatched pattern from Wonderwerk Cave in south Africa, dating to c.100,000 BP (Beaumont and Vogel, 2006; Jacobs *et al.* 2008; Beaumont and Vogel, 2008) and perforated shells from Grotte des Pigeons in Morocco, north-west Africa dating to c.82,500 years ago (Roche,1953; Bouzouggar *et al*. 2007). Two perforated shells dating to c.100,000 BP have been found, but these were located at Es-Skhul cave in Israel. All these examples are discussed in more detail in this chapter.

[333] *Nassarius* are a marine gastropod mollusc found worldwide; there are approximately 361 species in the genus.

[334] *Nassarius gibbosulus* shells are found at Grottes des Pigeons in Morocco, Oued Djebanna in Algeria and Skhul Cave in Israel.

[335] *Nassarius kraussianus* shells are found at Blombos Cave in South Africa.

[336] Taken from the Global Biodiversity Information Facility website, http://data.gbif.org

[337] The sites are Blombos Cave on the southern Cape, Wonderwerk Cave in the Northern Cape and Klein Kliphuis on the Western Cape

be the case suggests two possible explanations; either that such similarities are the result of cultural diffusion[338] or, that similar innovations emerged independently of each other.[339]

4.3 SHELLS

The first category of artefacts examined comprises pierced marine shells. Currently, there are five locations across Africa and in Israel that provide evidence of perforated shells for which dating is secure. These are: Skhul Cave and Qafzeh Cave in Israel;[340] Grotte des Pigeons in eastern Morocco;[341] Oued Djebbana, Algeria[342] and Blombos Cave in South Africa,[343] and are dated to 100,000 BP, 92,000BP, 82,000 BP, 75,000 BP and 77,000 BP respectively. It is clear from the maps (Maps 1 and 5) that some of these sites are separated by great distances; even the closest two sites of Grottes des Pigeons and Oued Djebbana are separated by about 1000km as the crow flies. All sites are located on the coast, except the open-air site of Oued Djebbana, which during the whole of the Pleistocene was never closer than 190km to the sea.[344] The fact that three of the examples come from coastal sites is a good reason for arguing for independent innovation, in that comparable practices are occurring in similar locations. However, the presence of marine shells 190 km inland at the site of Oued Djebanna leads one to question this view. An alternative explanation might be that cultural diffusion in the form of some kind of exchange was occurring. Given that *Nassarius* shells are marine molluscs found sub-tidally or inter-tidally, their presence at an inland site is arguably the result of interaction. However, it may have simply been picked up at the coast and transported inland, without any implication of contact.

Why the same genus of shells is selected for at sites that differ in time and space may possibly indicate cultural diffusion as previously discussed. However,

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[338] Defined as the spread of cultural items - such as ideas, styles, religions, technologies, languages etc. - between individuals, whether within a single culture or from one culture to another. First conceptualised by Alfred L. Kroeber in his influential 1940 paper, *Stimulus Diffusion*.
[339] It may be pure chance that similar behaviours occur independently of each other; occurrences of such include examples such as, pyramid-shaped buildings, standing stones, or animal paintings in caves
[340] Garrod and Bate,1937; Ramsey and Cooper, 2002; Vanhaeren *et al.* 2006
[341] Roche, 1953; Bouzouggar *et al.* 2007
[342] Morel, 1974; Vanhaeren *et al.* 2006
[343] Henshilwood *et al.* 2001; d'Errico *et al.* 2003 and 2005; Henshilwood *et al*. 2004; Henshilwood, 2008.
[344] Vanhaeren *et al.* 2006: 1787

while people can travel long distances, the chronological differences between sites is more difficult to reconcile with diffusion. Potentially, the coincidence of the same genus of shells occurring at these sites may be a result of availability, that these shells were more abundant; or possibly that they exhibited some morphological characteristics that were favoured, such as size, colour or shape.[345]

Nearly all have perforations in the shells, but only those from Qafzeh, Grotte des Pigeons and Blombos are strongly consistent with deliberate modification by human agency, and shells from these sites show evidence of suspension and traces of ochre. The shells from Skhul and Oued Djebbana may be deliberately pierced but have not been confirmed as such, and considering that natural agents can perforate the shell in the same way,[346] the hole morphology is not compelling evidence for human action.[347] Nevertheless, if not intentionally pierced by humans, they may have been collected because of their natural perforations, signifying some intentionality of future suspension.

4.3.1 Skhul Cave

Skhul Cave is located on the slopes of Mount Carmel in Israel, 3km south of Haifa (Map 5). Two perforated *N. gibbosulus* shells (Cat.1), dated to around 100,000 BP, [348] exhibit a single perforation located in the centre of the dorsal[349] side. During the accumulation of the layers from which the shells originated,[350] the distance of Skhul from the sea varied between three and twenty kilometres.[351] Based on their good state of preservation, their small number, and the concentrated species range, it has been suggested that storms could not have been responsible for transporting the shells to the cave, not is it likely that they were brought by animals;[352] making their

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[345] The presence of *Nassarius* shells at these sites have been discounted as a food source because of the small amount of soft tissue they would amass. However, we should not forget that many people eat winkles, which are a similar size. (See d'Errico *et al*. 2005)
[346] A common predatory gastropod in the lower reaches of many estuaries is *Natica*, a major predator of Nassarius. Laboratory experiments revealed that *Natica tecta* would consume about four *Nassarius kraussianus* per week. Allanson and Baird, 1999
[347] Vanhaeren *et al.* 2006:1787
[348] The stratigraphic positions of the two *Nassarius* shells never were explicitly recorded in the original excavations by Garrod and Bate (1937) so sediment matrix adherent to one *N. gibbosulus* from Skhul and sediment samples from layers A, B1, and B2 kept at the Natural History Museum were compared to determine its stratigraphic origin (Vanhaeren *et al.* 2006:1787)
[349] Relating to or situated on the back
[350] Layers B1 and B2, dating to 100,000 to 135,000 years ago. (Vanhaeren *et al.* 2006)
[351] Vanhaeren *et al.* 2006:1787. See Siddall *et al*. 2003 and Ferranti *et al*. 2006 for climatic information
[352] Vanhaeren *et al*. 2006:1787

presence in the cave a consequence of human action. Moreover, they are not likely to be interpreted as food items as 100 specimens only provides 4.84g of dry soft tissue and require 30 minutes to extract.[353] As only two shells were found in the cave, the limited number does seem to preclude them as a food source on site, although this does not eliminate them as a possible food source at the point of collection. They may have been part of a larger accumulation at the seashore, of which only two were subsequently transported back to the cave. The two shells are considerably larger than modern examples, but this does not necessarily imply a preference for large shells, as the variability of size for *N. gibbosulus* shells through time is unknown.[354] Analysis cannot definitively prove their perforation by human action and therefore predators[355] may have naturally perforated the shells. If not perforated by humans, then the sight of the natural perforation may have induced their collection by modern humans.

4.3.2 Qafzeh Cave

Qafzeh Cave is also situated on Mount Carmel in Israel, from where ten *Glycymeris* bivalves were discovered dating to 92,000 BP (Cat.2). Some of the shells are stained with red, yellow, and black pigments of ochre and manganese. Each shell was perforated, with the perforations either natural and enlarged by percussion or completely created by percussion. The *Glycymeris* shells from Qafzeh bear a perforation on the umbo[356] and were found in the layers that have yielded burials attributed to anatomically modern humans. The marine shells are not associated with burials, but rather appeared scattered more or less randomly throughout the deposit. At the time of the occupation of the cave, the sea coast was about 45-50 kilometers away; ochre deposits are known to be located between 6-80 km from the site. No other marine resources were found in the cave site deposits.[357] A recent taphonomic

[353] Vanhaeren *et al*. 2006:1787
[354] However, Nassarius kraussianus shells found in archaeological contexts dating to the Holocene are much smaller than those from sites dating to the Pleistocene, a phenomenon that has been attributed to a change in human preference. Research has shown that the decrease in fossil shell size from Pleistocene to Holocene was likely due to increased temperatures as a result of climate change at the beginning of the present interglacial period. See Teske *et al.* 2007.
[355] Vanhaeren *et al*. 2006:1787
[356] A knoblike protuberance arising from a surface, as the prominence near the hinge of a bivalve shell.
[357] Mayer *et al*. 2009

study of *Glycymeris insubrica* on the eastern Mediterranean coast[358] demonstrates that shells with naturally perforated umbos are almost as abundant (41.5%) as non-perforated valves. Assuming that the *Glycymeris* population on the coast about 100,000 years ago was similar to that of today, it follows that the Qafzeh people targeted specifically shells with a hole in the umbo. Modern behaviors indicated at the cave include the purposeful burials, the use of ochre for body painting and the presence of marine shells, used as ornamentation. Modern behaviors indicated at the cave include the purposeful burials, the use of ochre for body painting and the presence of marine shells, used as ornamentation.

4.3.3 Grottes des Pigeons

Similar behaviour has been documented at Grottes des Pigeons**,** a cave site situated near the village of Taforalt in eastern Morocco (Map 1)**,** where thirteen *N. gibbosulus* shells were uncovered (Cat.3), eleven were perforated and two imperforated.[359] At the time of collection, the distance from the site to the contemporary coast was not less than forty kilometres, a little further than Skhul but a good day's walk. The occupation layer in which the shells were located is associated with a largely open and sparsely vegetated environment with some locally wooded habitat.[360] The shells were all located in contexts of a strong anthropogenic component, including archaeological finds and evidence of hearths.[361] Any suggestion that the shells were intended for human consumption is disputed on the basis that all show features characteristic of dead shells accumulated on a shore.[362]

Evidence for the stringing of the perforated shells as beads comes from the identification on ten specimens of a wear pattern different from that observed on both modern reference examples and two imperforated specimens from Taforalt.[363] The wear recorded on the reference collection examples consistently affects the entire surface of the shells and, "consists of a microscopic dull smoothing associated with

[358] Sivan *et al.* 2006
[359] Not perforated; having no perforation, foramen, or opening. (Oxford English Dictionary)
[360] Bouzouggar *et al.* 2007:9966
[361] Bouzouggar *et al.* 2007:9966
[362] Bouzouggar *et al.* 2007: 9967. Referred to in the archaeological literature as thanatocoenosis, the term simply means an assemblage of dead organisms or fossils that occurred together in a given area at a given moment of geologic time. Also known as a death assemblage.
[363] Bouzouggar *et al.* 2007:9967

micropits[364] and rare short, randomly oriented striations".[365] The wear on the presumed suspended examples is found on the perforation edge as well as areas on the ventral and lateral side, characterised by an intense lustre,[366] with microscopic residues of red pigment detected on one imperforated and nine perforated shells.[367] The literature proposes either, the deliberate perforation of shells or that they were carefully selected on the beach for their large perforation, and then used as personal items.[368] At Taforalt, the possible stringing of the shell beads and the association with red pigment may have given them added visual value because these were the only items with colourant in the cave.[369]

Thus, both at Skhul and at Grotte des Pigeons, the importance of *N.gibbosulus* shells as a food resource is construed as negligible. At Skhul, this likely coincides with the environmental evidence that indicates the caves on Mount Carmel at this time were strategically located to exploit animal migration routes between summer and winter grazing areas and therefore redundant as a food resource.[370] At Grotte des Pigeons, there is "unequivocal evidence"[371] that dead marine shells were collected on North African shores, verifying their role as a non-food resource, and by implication supporting their role as one of personal ornamentation.

At the time of writing 47 additional *N. gibbosulus* shells were unearthed from Grotte des Pigeons in even earlier levels than those discussed above, perhaps dating back to 110,000 BP. Most of the shells were perforated, with some examples covered in ochre.[372] The presence of modern humans in North Africa at such an early date coincides with modern humans at Skhul in Israel, and may suggest the selection of shells for perforation was an early practice arising independently.

4.3.4 Oued Djebanna

At the open-air site of Oued Djebanna, near Bir-el-Ater in Algeria, (Map 1) the context of a single *N. gibbosulus* shell (Cat.4) is ambiguous because it comes

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[364] Micro pitting is a fatigue failure of the surface of a material
[365] Bouzouggar *et al.* 2007:9967
[366] Bouzouggar *et al.* 2007:9967
[367] Bouzouggar *et al.* 2007:9967
[368] Bouzouggar *et al.* 2007:9968
[369] Bouzouggar *et al.* 2007:9968
[370] Vita-Finzi and Stringer, 2007:439
[371] Bouzouggar *et al.* 2007:9968
[372] From Oxford University news website: http://www.ox.ac.uk/media/news_stories/2009/090505.html. This newest evidence is to be published in the *Journal of Quaternary Science*, but was not available at the time of writing.

from a 0.80 m to 1.0 m thick archaeological layer in an open-air location, excavated in the 1940s.[373] There is limited information about its context except that the central area of the site, rich in ashes, contained the perforated shell. Dates obtained on other sites with similar stone tools (Aterian)[374] suggest the site may be between 60,000 and 90,000 years old, and a single conventional radiocarbon[375] date of >35,000 BP is available for this site.[376]

Dating the shell was determined by comparing it to modern representatives of this species. *N. gibbosulus* dated to the last interglacial bear a thicker and more developed parietal shield, which makes them wider than modern examples, a feature observed on the Oued Djebbana specimen supporting its attribution to marine isotope stage 5,[377] and thereby dating it to at least 75,000 years ago.[378] The specimen shows a single perforation located in the centre of the dorsal side. The faunal remains indicate a more humid savannah environment than at present, and unlike the other three coastal sites, Oued Djebbana was never, during the entire Upper Pleistocene, closer than 190km to the sea.[379] The remoteness of Oued Djebbana from the sea is invoked as robust evidence for their symbolic use as beads.[380]

4.3.5 Blombos Cave

The most high-profile site in discussions surrounding the emergence of artistic production and symbolic behaviour in MSA Africa is that of Blombos Cave,

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[373] Morel, 1974
[374] The Aterian is a name given by archaeologists to a type of stone tool manufacturing industry dating to the Middle Stone Age in the region around the Atlas Mountains and the northern Sahara. The new evidence of perforated shells from Grotte des Pigeons (2009) demonstrates that the Aterian in Morocco dates back to at least 110,000 years ago down to c. 28,000 years ago.
[375] MC 657
[376] Vanhaeren *et al.* 2006:1786
[377] Marine isotope stages (MIS) or marine oxygen-isotope stages are alternating warm and cool periods in the Earth's palaeoclimate, deduced from oxygen isotope data reflecting temperature curves derived from deep-sea core samples. Oxygen isotope ratio cycles are based on the ratio of two oxygen isotopes, oxygen-16 (^{16}O) and oxygen-18 (^{18}O), which is determined on calcium carbonate from shells of microfossils that accumulated year by year on the seafloor. The ratio is linked to water temperature of ancient oceans, which in turn reflects ancient climates, and depends on two factors, the temperature and the isotopic composition of the seawater from which the organism secreted its shell. Shells secreted from colder water contain more oxygen-18 relative to oxygen-16 than do shells secreted from warmer water. More recent core samples of today's glacial ice substantiated the cycles through studies of ancient pollen deposition. Marine Isotope Stage 5 is sub-divided into 5a – 5e, 75,000 years ago equates with Stage 5a (Odderade or St Germain II interstadial).
[378] Vanhaeren *et al.* 2006:1787
[379] Vanhaeren *et al.* 2006:1787
[380] Vanhaeren *et al.* 2006:1787

located near Still Bay on the southern Cape shore in South Africa (Map 1).[381] The discovery of forty-one *N. kraussianus* shells (Cat.5) and two incised pieces of ochre (Cat. 7a and 7b and discussed later in this chapter), all dating to 77,000 BP[382] have significantly contributed to the debate concerning the appearance of symbolically mediated behaviour[383] and language in modern humans.[384] Because of its importance in the modern human behaviour debate as a result of the artefacts found, this site has generated a great deal more research and analysis of the data compared with the sites discussed above.

The shells were unearthed in five find spots located towards the rear of cave; 33 of which were found in six groups of two to twelve shells, each group recovered in a single excavation unit or in two adjacent sub-units, eight of the shells are isolated recoveries.[385] Comparable in genus to the shells found at Skhul, Grotte de Pigeons and Oued Djebbana, *N. kraussianus* is a scavenging gastropod adapted to estuarine environments. The closest estuaries today to Blombos Cave are those of the Duiwenhoks and Goukou Rivers, located 20 km west and east of the cave respectively,[386] a similar distance to that of Skhul cave from the source of its shells. Sea levels dropped -25 m[387] during the Still Bay occupation (MIS 5a), but the coastline remained less than 3 km from the cave, and no evidence exists for closer palaeo-estuaries in the regional onshore and offshore topography.[388]

Dark orange or black in colour, within a group the shells display similar size, shade, use-wear pattern and type of perforation; suggesting that, “each cluster may represent beads coming from the same beadwork item, lost or disposed of during a single event”. [389] Microanalysis established that the shells were deliberately perforated by human agency, and experimentation demonstrated that piercing the shell through its aperture with a bone awl or crab claw was the most effective perforation method, as it required little pressure, no re-sharpening of the tool, and did

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[381] The site was found by Christopher Henshilwood in 1991, and under Prof. Henshilwood's direction the cave has been excavated in 1993, 1997, 1998, 1999, 2000, 2002, 2004, 2005, 2007 and 2008.
[382] Henshilwood *et al*. 2002 and 2004
383 See Chapter 1 for an explanation of the term ‘symbolically-mediated behaviour’ in the context of Middle Stone Age Africa.
384 McBrearty and Brooks, 2000; Klein and Edgar, 2002; Henshilwood *et al.* 2002; d’Errico *et al.* 2003; Henshilwood, 2004; Henshilwood and d’Errico, 2005; Henshilwood and Marean, 2006; d’Errico *et al*. 2005; Henshilwood, 2006.
[385] d’Errico, 2005:10
[386] d’Errico, 2005:10
[387] Ramsey and Cooper, 2002
[388] Van Andel, 1989
[389] Henshilwood, 2005:454

not break the lip.[390] Notably, bone awls were found in the same levels found at M2 and M1 levels at Blombos, and the species of crab used in the perforation experiments lives in the same habitat as *N. kraussianus*.[391]

Comprehensive microanalysis of the shells reveals a distinct use-wear, absent on Later Stone Age beads and natural shells, consisting of facets that flatten the outer lip or create a concave surface on the lip close to the anterior canal. The use-wear patterns recorded on the Blombos shells are consistent with friction from rubbing against thread, skin, or other beads,[392] and thus constitute one of the principal factors that define these shells as beads. Four of the shells show microscopic traces of red ochre within the shell and on the outer surface. D'Errico (2005) suggests the deposition of the ochre may have occurred during the manufacturing process if the perforating tool was ochred, rubbing against ochred skin, thread or due to the deliberate colouring of the beads.[393] More than 8,000 pieces of ochre were found in the MSA layers at Blombos[394] and therefore transference of the mineral onto the shells is likely to have been a simple, chance process. Moreover, if traces of ochre were the result of the manufacturing process, or the act of wearing the shells, it would seem plausible for more than four, out of the thirty-nine perforated, to exhibit traces of ochre. No ochre residues occur on other gastropods found in MSA layers,[395] which in itself is good evidence for deliberate behaviour. Undoubtedly, close visual perception was a factor in locating and choosing shells in river, as well as handling the shells in order to perforate. The traces of ochre may have enhanced the visual properties of the shells, but the small sample of shells showing traces of ochre perhaps makes this factor less important in their production.

The significance of Blombos as an archaeological site rests to a greater degree on the interpretation of these shells (in conjunction with the pieces of incised ochre, detailed later). D'Errico and Henshilwood (2005) forcibly argue that taphonomic[396], morphometric[397] and microscopic analysis of modified *N.*

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[390] d'Errico *et al.* 2005:13
[391] d'Errico *et al.* 2005:13
[392] d'Errico *et al.* 1993
[393] d'Errico, 2005:16
[394] d'Errico, 2005:7. The ochre is most prolific in the MSA levels dating 100,000-140,000 BP, and thus while 8000 pieces is a vast quantity it is spread over a period of around 70,000 years.
[395] d'Errico, 2005:16
[396] Archaeologists study taphonomic processes in order to determine how plant and animal (as well as human) remains accumulate and differentially preserve within archaeological sites. This is critical to determining whether these remains are associated with human activity. In addition, taphonomic

kraussianus shells at Blombos provides clear evidence that the shells were deliberately perforated and worn as personal ornaments.[398] Evidence of heavily worn perforations and apertures indicates the shells were used for prolonged periods, probably on a daily basis. Henshilwood suggests a bead-making tradition was integral to the material culture of these people, and an unambiguous marker of symbolically mediated behaviour.[399] The level of analysis undertaken on the Blombos shells is exceptionally comprehensive, and has contributed to the re-analysis and reassessment of perforated shells from other Middle Stone Age African sites, resulting in the hypothesis, "that a long-lasting and widespread beadworking tradition existed in Africa and the Levant well before the arrival of anatomically modern humans in Europe"[400].

4.4 MARK-MAKING

Similarly, incised or engraved ochre and stone found at three MSA sites in South Africa exhibit many of the same affinities as the shell evidence. Incised and/or engraved ochre and stone come solely from sites located in South Africa. Dating to 100,000 BP,[401] 77,000 BP[402] and 50,000-80,000 BP[403] (Cat: 6 – 8), these marked objects also demonstrate characteristics of resemblance. The three sites are located in closer proximity than the shell sites; Wonderwerk Cave in the northern Cape, Blombos Cave on the southern Cape shore, and Klein Kliphuis on the western Cape (Map 1). At all three sites, small pieces of stone or ochre have been discovered showing vertical, horizontal and oblique incised or engraved lines. The similarity lies in the depiction produced; all three resemble a crosshatch pattern. In comparison to the shell evidence, the proximity of the sites to each other more readily suggests an explanation of cultural diffusion to rationalise the parallels. However, the temporal distance between objects is so large it makes the likelihood of the patterning a

processes may alter biological remains after they are deposited at a site. Some remains survive better than others over time, and can therefore bias an excavated collection.

[397] Morphometrics is a field concerned with studying variation and change in the form (size and shape) of organisms.

[398] d'Errico and Henshilwood, 2005:18

[399] d'Errico and Henshilwood, 2005:19

[400] Vanhaeren *et al.* 2006: 1788

[401] Wonderwerk Cave, Northern Cape, South Africa

[402] Blombos Cave, Southern Cape, South Africa

[403] Klein Kliphuis, Western Cape, South Africa

cultural convention communicated across generations, difficult to reconcile (similarly with the shell evidence). Unequivocal archaeological evidence that modern humans from these sites were in contact with each other is absent and although an archaeological cliché, it remains a truism that absence of evidence is not evidence of absence. Nevertheless, the discrepancies in dates do nothing to support diffusion as a feasible theory. The next section will look at the evidence of mark making in more detail, and with reference to the shell evidence.

4.4.1 Wonderwerk Cave

The oldest object in this category comes from Wonderwerk Cave (Cat.6), located on the eastern flank of the Kuruman Hills, Northern Cape, in South Africa (Map 1). The incised stone was recovered during the initial excavation of Stratum 2 or MU2 [404] in Excavation 3 during the early 1980s; at the time, the associated artefacts were tentatively referred to as belonging to the Later Stone Age (LSA).[405] However, the subsequent greatly expanded lithic sample showed that the assemblage was typical pre–Howiesons Poort[406] MSA, dated to c.80,000-120,000 years ago, with a basal maximum Uranium-Series[407] age of 132,000 BP.[408] Thus, found in levels pre-dating 100,000 years, the stone is 2cm long, and initial descriptions simply refer to shallow zigzag lines. Personal observations suggest it is bounded top and bottom by horizontal lines, and the zigzag lines show a crosshatch pattern.

While much archaeological excavation and analysis has been undertaken at Wonderwerk cave, little close examination has been done on this particular incised stone.[409] The extreme aridity of the cave interior has resulted in superb preservation

[404] The deposit in Wonderwerk Cave extended to 6 metres deep, made up of 9 stratum groupings or Major Units (MUs), which are numbered from the surface downwards (from the youngest level, MU1, to the deepest and oldest one, MU9). MU2, in which the incised stone was found – the second level down – contained traditional Middle Stone Age material, defined by the absence of handaxes and the presence of pointed tools, known as ‘convergent points’. Uranium-series readings dated these artefacts at dates ranging between 70,000 and more than 220,000 years ago.
[405] Beaumont and Morris, 1990.
[406] Named after the Howiesons Poort (HP) shelter near Grahamstown, South Africa, the HP was a lithic industry of the MSA (See Stapleton and Hewitt, 1927, 1928). Technologically and typologically, the stone tools of the HP contain many elements that are rare or absent in preceding MSA assemblages. Dates for the HP have consistently placed it at around 60,000 years ago, or MIS4, a time of increased aridity and lowered sea levels in southern Africa. (Minichillo, 2006)
[407] Uranium Series dating is a dating method based on the radioactive decay of isotopes of uranium. It has proved particularly useful for the period before 50,000 years ago, which lies outside the time range of radiocarbon dating
[408] Peter Beaumont - Pers. Comm.
[409] Current excavation work has shown that within layers MU 2–4 (in which the incised stone was found), a number of other incised slabs were found,[409] featuring spaced parallel lines, “indicating an

of organic items, indicated for instance, by 800,000 year-old horn fragments of an extinct antelope that retain their keratin sheaths,[410] and an area of humified[411] grass bedding on which hominins slept some 400,000 years ago.[412] Wonderwerk is a vast tunnel-like cave, covering an area of around 2400 m²,[413] and due to the size, depth of the stratum and such excellent preservation conditions, the analysis undertaken to date has focused on the cultural sequence of the cave, which extends back 500,000 years. This has meant that the incised stones, while recorded, have had no microanalysis carried out and as such, no dedicated focus. Visually, there is a great deal of similarity in mark-making at Wonderwerk Cave with other sites in South Africa, and one of the most celebrated sites where such activity occurs is Blombos Cave (BBC).

4.4.2 Blombos Cave

Discussed previously in this chapter for the perforated marine shells, this site is equally important for the two incised pieces of ochre dating to 77,000 BP, which have generated great deal of literature on their significance to the origin of modern human behaviour debate.[414]

More than 8500 fragments of ochre have been recovered from the Middle Stone Age levels, most of which show evidence of scraping to produce powder. Two of the fragments, come from layers CC, square E6a, (SAM-AA 8937)[415]and layer CD, square H6a (SAM-AA 8938)[416] (Figure 4.1) during excavations in 1999 and

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engraving tradition extending to as far back as 500, 000 years ago". (Beaumont and Vogel, 2008:6). It is not the remit of this analysis to discuss pre-*Homo sapiens* behaviour, and despite the compelling evidence for a particular cultural tradition the focus will remain on the incised stone dating to 100,000 BP. However, analysing the possible antecedents for artistic activity of modern humans is potentially an area for future research.

[410] Beaumont and Vogel, 2006:219

[411] To humify is to turn a substance into humus, the organic component of soil derived from decomposed plant and animal remains.

[412] Beaumont and Vogel, 2006; Jacobs *et al*. 2008; Beaumont and Vogel, 2008

[413] The cave is so large that P.E. Bosman, the original farmowner on whose land the cave was sited lived in the mouth of the cave with his family from 1909–11, while building the present farmhouse, and later used it as a cart-house, and a sheep shelter in Winter until the early 1930s. (Beaumont and Vogel, 2006:17)

[414] d'Errico, Henshilwood and Nilssen, 2001; Henshilwood *et al.* 2002; d'Errico *et al.* 2003; Henshilwood and Marean, 2003; Henshilwood and d'Errico, 2005

[415] This reference number relates to the accession number attributed by the Iziko South African Museum in Cape Town where the ochre pieces are located.

[416] This reference number relates to the accession number attributed by the Iziko South African Museum in Cape Town where the ochre pieces are located.

2000, respectively. The incised ochre piece from layer CC (SAM-AA 8937) was located adjacent to a small hearth, and a number of small, basin-shaped hearths surrounded that from layer CD (SAM-AA 8938); a further seven engraved ochre pieces are under study.[417]

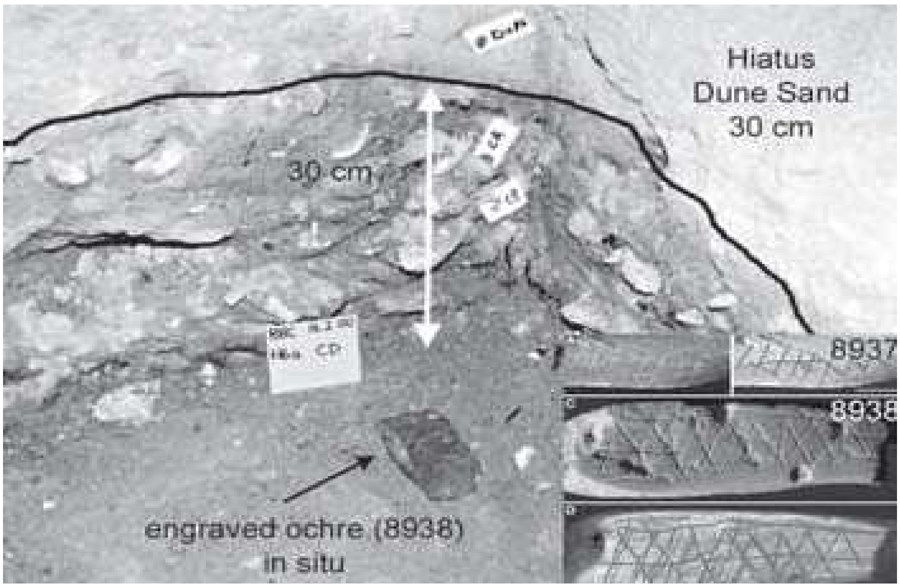

Fig. 4.1 Engraved ochre SAM–AA 8938 in situ in Square H6a, Level CD

(Image: Courtesy of Henshilwood, 2005, p:452, Fig. 8)

An enormous amount of microanalysis has been carried out on the two pieces of ochre, especially in terms of the *chaîne opératoire*,[418] proposing that the type of depiction suggests these abstract patterns are designs "representing a material expression of the same symbol".[419]

The first piece of ochre, reference SAMAA 8937 (Cat.7a), is 5.36 cm in length, 4.26 cm in breadth and 1.17cm in depth; both the flat surfaces and one edge are modified by scraping and grinding. The edge has two ground facets, and the larger of these bears a crosshatched engraved pattern. Henshilwood describes the crosshatching pattern as consisting, "of two sets of six and eight lines partly intercepted by a longer line".[420] However, on closer examination, the microscopic

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[417] Henshilwood *et al.* 2002: 1278
[418] The French term Chaîne Óperatoire can be translated into *operational sequences* – all human actions and choices made during tool or artefact production.
[419] Henshilwood and d'Errico, 2005:25
[420] Henshilwood *et al.* 2002:1278

images provided show eight vertical lines oriented in the same direction, and only five oriented in the opposite direction which haphazardly intersect the eight lines. The 'longer line' is horizontal and intersects only five of the eight vertical lines through the centre.

The second piece, reference SAMAA 8938 (Cat.7b) is 7.58 cm in length, 3.48 cm in breadth, 2.47 cm in depth, and exhibits more complexity in its patterning. The engraving consists of a row of crosshatching, bounded top and bottom by parallel lines, and divided through the middle by a third parallel line that partitions the lozenge shapes into triangles. Some of the lines are well-defined single incisions; others have parallel tracks along part or all of their lengths.[421] Microanalysis shows that the parallel tracking may have resulted from a change in position of the engraving tool causing simultaneous scoring from more than one projection, while the midline is the result of three marking events. The crosshatched lines were made first in one direction and then another; the horizontal lines overlie the crosshatching.[422] The similarities between 8937 and 8938 relate to abrading the surface prior to engraving, the location of the marks on the surface of the ochre, the engraving technique itself and of course, the final pattern.

The most likely source of the ochre is the Bokkeveld Group,[423] the nearest outcrops to Blombos are approximately 15km northeast in the Goukou valley and 17km west along the coast. These locations are close to where they were likely to be collecting the *Nassarius* shells, from the Goukou and Duiwenhoks rivers, located 20km east and west of the cave respectively.

Differences between these two pieces of ochre are rooted in technological, stylistic and visual variability. On 8938, the ground surface and the engraving are the only anthropogenic modifications detected, but on 8937 both aspects of the fragment and most of the edges are shaped by grinding. In addition, another engraving consists of "two sinuous, roughly parallel lines [was] made on a facet close to one end of the piece".[424] Further differences lie in the size of ochre selected, 8937 is too small to bear an engraving of the same level of complexity as 8938. This cannot be attributed to the lack of a more appropriate blank, ochre is common in the MSA layers, so

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421 Henshilwood *et al.* 2002:1279
422 Henshilwood *et al.* 2002:1279
423 Beds of sedimentary rock, which are related, or have some other affinity, may be mapped as a single formation. Formations may, in turn, be assembled into groups. Bokkeveld sediments are of marine origin and were laid down at a time when the western and southern Cape lay beneath a sea.
424 Henshilwood and d'Errico, 2005:258

selection of a thinner and smaller piece of ochre was likely a deliberate choice.[425] The last difference relates to the skills of the two engravers. Although 8938 is a more complex and elaborate piece visually, microanalysis indicates the engraver was less capable or experienced than that of 8937.[426] On 8938 the intersecting sets of lines are less parallel and not as straight as 8937. In a number of instances, grooves intended to be double stroke lines on 8938 become either joining or parallel, "because of the engraver's inability to precisely locate the tool tip in the groove already made by the first passage of the tool or to keep it in an existing groove".[427] There is a hesitant character to some of the lines, particularly the two lines bounding the edge, which may be attributable to the difficulty in incising close to the face edge. This does not seem to be the case for the horizontal line traversing the middle of the piece of ochre, which exhibits "the engraver's ability to make continuous straight uniform lines".[428]

The intense examination and analysis of these two pieces of ochre has resulted in some notable claims. Henshilwood's proposition is that they were made with symbolic intent; that they almost certainly had significance to the makers; and that the transmission and sharing of the meaning of the engravings relied on fully syntactical language.[429] Henshilwood proposes that the motifs suggest, "arbitrary conventions unrelated to reality-based cognition",[430] and deliberate abstract markings signify abstract thought and therefore modern human behaviour. For Henshilwood, the incised pieces of ochre at Blombos are the most complex and best-formed evidence for early abstract representations. Claiming they are not isolated occurrences or the result of idiosyncratic behaviour, Henshilwood proposes that, "they would not look out of place in an Upper Palaeolithic context".[431] This is a significant statement, because it articulates very clearly that, for Henshilwood, these pieces of ochre are as important as the art that appears later in Upper Palaeolithic Europe, in both behavioural and cognitive terms.

[425] Henshilwood and d'Errico, 2005:258
[426] Henshilwood and d'Errico, 2005:259
[427] Henshilwood and d'Errico, 2005:259
[428] Henshilwood and d'Errico, 2005:259
[429] See Chapter 1, Introduction, for a full explanation of the 'modern human behaviour' debate.
[430] Henshilwood *et al.* 2002:1279
[431] Henshilwood, 2007:126

At the time of writing, 13 additional engraved ochre pieces have been unearthed from Blombos Cave (Figure 4.2).[432]

Fig 4.2 Two of the more recent finds of incised ochre from Blombos, dating to c. 100,000 BP.

(Image:greatarchaeology.com)

Dating methods including Optically Stimulated Luminescence (OSL) of quartz grains from the cave's sediments and thermoluminescence dating of stone tools have dated the layers in which the ochre was found at around 99,000 BP,[433] more than 20,000 years older than the original discoveries of incised ochre.

The incising had been made with a pointed stone, with "lines arranged in apparent fan-shaped or crosshatched designs; others are etched in wavy patterns",[434] and are reported to exhibit similar crosshatch patterns to the original two pieces of ochre. For Henshilwood these discoveries will add great weight to an early emergence of symbolic behaviour in MSA Africa. In the context of this thesis, it provides affinities with the 100,000 year old incised ochre from Wonderwerk Cave.

[432] At the time of writing the new discoveries had not been published and because of the lack of verifiable data were not included in the catalogue.
[433] Balter, 2009:569
[434] Balter, 2009:569

4.4.3 Klein Kliphuis

By contrast, despite its remarkable visual resemblance to the Blombos ochre, and similarity in age, no such claims are made for an incised stone found at the site of Klein Kliphuis (KKH) (Cat.8) situated on the Western Cape of South Africa (Map 1). Dated to around 50,000-80,000 BP,[435] the stone is ground and fractured, and scored in a crosshatched manner with two horizontal and five vertical lines. The artefact has three faces, one of which is striated, another of which scored, and the third exhibits characteristics of hertzian[436] fracture.[437] The break at the right hand edge of the engraved face truncates the lower horizontals, and exhibits features indicating that it was the result of a hard hammer blow subsequent to scoring. It is possible that the break was accidental and resulted from dropping of the artefact, however, without undertaking extensive experiments, the authors consider this unlikely. Mackay and Welz suggest that the more parsimonious explanation is that the ochre was deliberately broken.[438]

In relation to its resemblance to Blombos, the authors have observed that, "like SAM-AA 8938, the KKH [Klein Kliphuis] ochre has three dominant horizontal lines. The top and bottom lines diverge from left to right, while the central horizontal line runs broadly parallel to the bottom line. All three horizontal lines are composites, the results of multiple scoring events".[439] However, unlike SAM-AA 8938, it does not appear that the face was prepared; rather it appears to have been naturally flat. Overall, the differences in line widths between the upper and lower horizontals on the one hand, and the verticals and central horizontal on the other, would appear to indicate that scoring did not occur as a single event, and that the different groups of lines were made either with a different implement, or at different times, or both. Where it is possible to ascertain the sequence of mark making of the horizontals and the verticals, the vertical lines generally appear to have been laid

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[435] Layer D2, in which the ochre was located, was assigned by Mackay (2006) to the Howiesons Poort and the early stages of the post-Howiesons Poort. Howiesons Poort assemblages commonly date to between 50,000 and 80,000 years ago.

[436] A Hertzian fracture known as a cone fracture is the cone of force that propagates through a brittle solid material from a point of impact, eventually removing a full or partial cone. An example often occurs when a small object, such as an airgun pellet, strikes a plate-glass window. This is the physical principle that explains the form and characteristics of the flakes removed from a core of tool stone during the process of lithic reduction. The phenomenon is named after the German physicist Heinrich Rudolf Hertz, who first described this type of wave-front propagation through various media. See Cotterell and Kamminga, 1987 for a fuller definition.

[437] Mackay and Welz, 2008:1523

[438] Mackay and Welz, 2008:1526

[439] Mackay and Welz, 2008:1525

down first, followed by the central horizontal, and finally the upper and lower lines.[440]

For the authors, the process through which the lines were formulated, "strongly implies an element of design"[441], regardless of whether it occurred as a single act or realised over multiple stages. They make clear that in using the term 'design', it signifies, "that the artisan(s) undertook the act(s) of scoring in order to give physical manifestation to a mental concept".[442] However, caution is exercised in interpreting this artefact as symbolic. Their suspicion is that it is likely to be symbolic in some form to its maker, but recognise the possibility that, "the motivations for engraving and breaking this particular piece were far more mundane, including testing the fragment for pigment colour and/or breaking it up into more useable pieces".[443] The prudence with which this incised stone is interpreted appears in direct contrast with Blombos, where its authors see its significance as having wide-ranging implications for human behaviour.

4.5 OSTRICH EGGSHELL

By around 55,000-75,000 BP the crosshatched patterning initially found on stone and ochre is evident on ostrich eggshell (Cat.9 -12). A rich collection of marked ostrich eggshell have been discovered at Diepkloof Rock Shelter in the Western Cape Province in South Africa.[444] In the last few years, excavators have unearthed numerous marked fragments, adding to the previously excavated sample of ostrich eggshell from this site and expanding the collection of fragments to 270 pieces.The ostrich eggshell appeared unevenly distributed across the Diepkloof shelter, but is associated with stone tool assemblages potentially identified as Howiesons Poort. Further excavation and analysis has allowed the archaeologists to propose with some confidence that there are coherent patterns in the associations between stone, bone, charcoal and ostrich eggshell, secured by a series of radiocarbon and luminescence dates.[445] The excavated level immediately above the level where 19 ostrich eggshell fragments were found has an AMS radiocarbon date

[440] Mackay and Welz, 2008:1525
[441] Mackay and Welz, 2008:1528
[442] Mackay and Welz, 2008:1528
[443] Mackay and Welz, 2008:1530
[444] Parkington *et al.* 2005; Rigaud *et al.* 2006
[445] Parkington *et al.* 2005:480.

of >55,000 BP (GifA 102381),[446] while a programme of luminescence dating[447] of sediments, has resulted in estimated of between 50-70,000 BP for the Howiesons Poort assemblages.[448] Microanalysis indicates almost all of the MSA eggshell pieces have been altered by fire (although it is not clear whether these were located near hearths) or by the chemical conditions while *in situ*,[449] so that they are coloured ochre, maroon, dark brown or black.[450]

In comparison with earlier incised markings found at Blombos, Wonderwerk and Klein Kliphuis, what is important about this large collection is the combination of variety and patterning that is manifest. Parkington *et al*. (2005) have made a number of distinctions of the eggshell at Diepkloof. First, many pieces show complex sets of seemingly randomly oriented light scratch marks, which are often short and do not cross the eggshell pieces from edge to edge. The authors do not claim these to be intentional markings, although they may result from human interactions with the eggs.[451]

More than 80 pieces of ostrich eggshell have been discovered, almost all of them less than 2.5 cm in maximum dimension,[452] which are believed to have been intentionally marked. Two kinds of marking are discernible, although within this, there is a significant diversity in marking form. There are some cases of moderately deep, U-shaped gouging of the surface leading to the removal of the uppermost ostrich eggshell layer. The edges of gouges are often marked by spalling[453] or splintering. In contrast are cases where finer V-shaped incisions have been made into the surface with little removal of material from the egg surface. These markings currently are referred to as gouges and incisions respectively. Gouges seem to have been produced by a blunter point.[454]

The marking on one fragment appears quite structured (11a), in that "diagonally intersecting incisions appear to be placed within bounded spaces above

[446] The radiocarbon GifA dates were obtained using Accelerator Mass Spectometry at the Laboratoire des sciences du climat et de l'environment (Gif-sur-Yvette, France)
[447] Luminescence dating is a Quaternary dating method used to determine the age of a sample. The method was initially developed in the 1960's for dating pottery. However, since 1979 the method has also been applied to dating geological sediments.
[448] Parkington *et al*. 2005:478
[449] In archaeological terms, 'in situ' refers to an artefact that has not been moved from its original place of deposition.
[450] Parkington *et al*. 2005:485
[451] Parkington *et al*. 2005:487
[452] Ostrich eggshell is likely to break up into small fragments due to its fragility.
[453] To break up into small chips, flakes, or splinters
[454] Parkington *et al*. 2005:487

one another".[455] Two further fragments (11b and 11c) show that the maker intended to "delineate zones or bands and then infill these spaces with hatched lines".[456] Unlike the incised ochre from Blombos, the sequence of engraving has not yet been determined. Another fragment (11d) is significant in that incisions radiate out from what is believed to have been an intentionally made water bottle mouth.[457] The polished, rounded cross-section of this fragment is very similar to that observed on LSA water flasks. Furthermore, photogrammetric[458] analysis of whole eggs demonstrates it is possible to distinguish the curvature of 'polar' (top) pieces from that of 'equatorial' (middle) pieces;[459] further detailed analysis of these fragments is in progress.[460] Intentionally marked and lightly scratched eggshell fragments come from the same excavated units in Complex 3,[461] but both marks rarely appear on the same pieces, which raises the possibility that the scratches were produced in the course of intentional marking but on different parts of the eggs,[462] or by different people, or with different tools.

The most common engraved motif consist of two long parallel lines intersected at roughly right angles by shorter, regularly spaced lines, forming a hatched band. The engraving of the motifs appears to have been standardised in that the maker began by engraving the long, parallel lines and then carefully engraving the shorter, sub-perpendicular cross lines, usually starting outside the defined band and crossing over the long parallel lines.

The most recently found sample of ostrich eggshell exhibits a set of four repetitive linear motifs in the form of a hatched band motif, a parallel to subparallel line motif, an intersecting line motif, and a cross-hatching motif. All these patterns share a common geometric concept. Because the ostruch eggshell pieces are fragmentary, it is possible that some of the geometric patterns were part of more

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[455] Parkington *et al*. 2005:487
[456] Parkington *et al*. 2005:487
[457] Parkington *et al*. 2005:487
[458] Photogrammetry is the first remote sensing technology ever developed, in which geometric properties about objects are determined from photographic images.
[459] Parkington *et al*. 2005:488
[460] Parkington *et al*. 2005:487
[461] Complex 3: is an MSA assemblage of Howiesons Poort type with numerous curved backed blades, side scrapers, notches and denticulates, end scrapers and numerous fragments of ostrich eggshell bearing marks of parallel incisions and cross hatchings.
[462] Parkington *et al*. 2005:487

complex motifs, although to date, only one pattern or motif has been found per fragment.[463]

At this stage in the analysis not all marked pieces are deemed as having once been being part of a water flask, and further research seeks to determine if whole eggs or fragments were intentionally marked. If so, this marking would then be linked with one of the "earliest demonstrable artefacts designed for storage".[464] As Parkington has argued, an egg as a foodstuff does not necessarily require a great deal of visual attention in its appearance; however, an egg as a container, as a vessel, may indeed require more visual discrimination.[465] Although debatable as to how many of the marked eggshell fragments are clearly from a flask, the patterning are varied in their 'design', perhaps intentionally making each eggshell different from each other for particular reasons of ownership.

The function of an ostrich eggshell as a water container is innovative and certainly useful as a storage container, but transporting water containers is perhaps not so pragmatic if they have to be carried. An argument could be made for the incised lines as imitating a net bag that may have been used to transport the egg around. An example located in the Pitt Rivers Museum in Oxford demonstrates this (Figure 4.3).[466]

Fig 4.3 Ostrich eggshell ornamented with beadwork and cowrie-shell fringe

(Image: Pitt Rivers Museum)

[463] Texier *et al*. 2010
[464] Parkington *et al*. 2005:489
[465] Parkington *et al*. 2005:489
[466] Collected by Donald Gunn at Fashoda, now known as Kodok, and presented to the museum in 1903, this object was said to have been originally for carrying water, and then converted into an ornament Image courtesy of Pitt Rivers Sudan Collection online. southernsudan.prm.ox.ac.uk/details/1903.16.72/

As Parkington *et al*. reflect, "The intentionally marked ostrich eggshell fragments from Diepkloof may reflect a pattern of thinking long practised on other materials or with respect to natural markings".[467] Marking materials in distinctive ways, in particular crosshatch patterning, seems to be pervasive in these earliest examples, and have been practised on stone and ochre dating back 100,000 years ago.

4.5.1 Ostrich eggshell beads

The use of ostrich eggshell as a resource develops in both form and technology; and by around 40,000 – 45,000 BP it is being exploited for personal decorative purposes, such as beads. Until this point, beads were made from naturally occurring materials such as shells, that were either naturally perforated by sea action or predators or intentionally by human agency. However, in the later Middle Stone Age, at the same period that modern humans were moving into the landscapes of Eurasia,[468] in Africa there appears to be an expansion in resource selection and exploitation. Ostrich eggshells are not only used as water containers, but also are being ground and shaped into circular beads. The methods used to produce these beads are significantly more sophisticated than any techniques used to produce the tools generally found in the Middle Stone Age.[469]

The San women of the Kalahari Desert make ostrich eggshell beads today; but their production is a long and laborious task. The first step is to break the ostrich eggshells into chips or blanks; each blank is rounded by a springbok horn or nail clippers (whichever is readily available). Next, a hole is drilled in each blank with a hand-drill and punched through with a small awl. The beads are strung, laid across a wooden board and using a whetstone, are hand polished.[470]

Manufacturing beads in this way is much more labour intensive than perforating a marine shell and signifies not only a shift in technological ability, but also a change in the way natural resources are conceptualised and potentially

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[467] Parkington *et al.*, 2005:489
[468] Genetic and fossil evidence suggests that a major dispersal of African populations occurred to both Asia and Europe at around between 60,000-50,000 BP. See Krings *et al.* 1997; Richards *et al.* 2000; Underhill *et al.* 2000; Stringer, 2002; Forster, 2004; Kivisild, 2006; Mellars, 2006; Hudjashov *et al.* 2007
[469] See Kandel and Conard 2005 for a description of the production sequences of ostrich eggshell beads of LSA people in the Geelbek Dunes, Western Cape, South Africa.
[470] http://www.womensworkbw.com/osbabout.htm

transformed, and the amount of labour expended. Interestingly, one of the exhibits in the Archaeological Museum in Cracow demonstrates the processes involved in making ostrich eggshell beads. The first step in the procedure was the incising of a crosshatch pattern on the eggshell to delineate square-shaped blanks that were then broken off and ground down into round beads. The visual parallel with the markings on the ostrich eggshell at Diepkloof is intriguing, as well as the earlier incised stone and ochre from Blombos, Wonderwerk and Klein Kliphuis; although at this stage it remains no more than an interesting observation.

Numerous bead fragments are interpreted at some sites, such as Enkapune Ya Moto (Cat.14) in Kenya, (Map 1) dating to c.40,000 BP as reflecting a high intensity of occupation.[471] As such, interpretations suggest that these are symbolic trade items exchanged between neighbouring hunter-gatherer groups, in order to maintain contacts and potential allies against famine and scarcity. Other sites where ostrich eggshell beads occur include Boomplaas (Cat.13) and Border Cave (Cat.15a,b) in South Africa (Map 1), with later sites dating to around 30,000 BP located at Kisese II, East Africa (Cat 16), Mumba (Cat.17) in Tanzania and Apollo 11 Cave in Namibia (Cat.18, Map 1). Other sites such as Loiyangalani in Tanzania provide evidence for the manufacture of ostrich eggshell beads, and while having been tentatively dated to between 40,000 – 75,000 BP, currently the dating is not secure enough to be included in the catalogue.[472]

Interestingly, although ostriches are fierce birds, the acquisition of ostrich eggs may not have been a hazardous endeavour. Ostrich breeding and egg-laying season starts in autumn (March-April) and continues until September. One female may produce as many as 13 eggs and with all the hens laying eggs in one nest, 30 to 40 may accumulate. Only about 20 eggs successfully hatch, so the rest are pushed out of the nest and destroyed.[473] This makes it a relatively easy resource to attain.

4.6 Additional artistic activity

Other artistic anomalies not previously seen in the archaeological record include a pierced stone deliberately marked with notches (Cat.15c), dating to

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[471] 593 bead fragments were discovered at Enkapune Ya Moto, but only 13 complete beads and 12 bead preforms.
[472] See Thompson *et al.* 2004
[473] Von Schirnding *et al.* 1982:5

c.40,000 BP,[474] and the now famous Lebombo Bone (Cat.15d), dated to 35,000 – 37,000 BP. Both of these objects were excavated from Border Cave, located in the Lebombo Mountains between South Africa and Swaziland, in Kwazulu Natal, South Africa (Map1)**.**

Little has been recorded on the bored stone marked with incised notches.[475] Personal observation from the images available suggests it has the appearance of being circular or curved in shape, exhibiting eight incised notches bordering the orifice, which is quite thick in appearance; it does not appear to be part of a vessel.

The so-called Lebombo bone, made from a baboon fibula,[476] is 7.7 cm in length exhibiting 29 clearly defined notches, discovered near a possible hearth. Located in the layer known as the First White Ash up to 20 cm thick, this consists of a marked and continuous white ash layer and an underlying series of white and black ash and brown sand lenses.[477] The First White Ash layer accumulated between 35,000-36,000 BC.[478] The bone is thought to resemble calendar sticks still in use today by Bushmen in Namibia.[479]

4.7 Apollo 11 Cave

One of the defining characteristics of artistic activity in the Palaeolithic is representational art. Endorsed as the hallmark of artistic production and modern human behaviour, its debut in Africa occurs at the site of Apollo 11 cave in southwestern Namibia (Map 1). Seven painted stone slabs of brown-grey quartzite depicting a variety of animals (Cat.18a), painted in charcoal, ochre and white, were

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[474] The broken bored stone with incised notches bordering the orifice, and two ostrich eggshell beads were located in the stratigraphic reference IBS,LR and IWA. Radiocarbon dates for level IBS.LR show dates of 33,000±2000 BP (top) and 38,600±1500 BP (base) and dates for IWA show 36,800±1000 (top), 36,100±900 BP (mid) and 35,700±1100 BP (base). See Beaumont, de Villiers and Vogel, 1978:412)

[475] Border Cave is an important site because of the unique preservation and the wealth of archaeological data, including remains of anatomically modern humans that indicate a cultural sequence going back more than 100,000 years. However, the quality and quantity of data means that some artefacts, such as the two notched bones and ostrich eggshell beads do not receive as much attention as they would on a less well-endowed site. Therefore, to some extent contextual information is lacking.

[476] Interestingly, another notched baboon fibula was found in 1960 by the Belgian Jean de Heinzelin de Braucourt while exploring what was then the Belgian Congo. Called The Ishango Bone, and dating to about 20,000 to 22,000 BP, the 10cm long fibula is fitted with a sharp piece of quartz on one end. See Brooks and Smith, 1987.

[477] Beaumont, 1973:42

[478] Throughout this thesis the term BP (Before Present) has been used to denote a date, however, the use of BC has been used in this context by Beaumont, who refers to van der Hammen *et al.* 1967.

[479] Beaumont, 1973:44

located in the upper levels of a MSA deposit, dating to 40,000-19,000 BP.[480] Recovered from a 'concentration', covering about 1.5m², and initially thought to be parts of an exfoliated 'frieze' which once existed somewhere on the walls or ceiling of the cave; analysis by Wendt proposes that they should be regarded as 'art mobilier'.[481]

Found in Layer E, Square A9[482], and radiocarbon dated to between 26,300 ± 400 – 28,400 ± 450 BP,[483] analysis suggests they were deliberately broken. The rock type, grey-brown quartzite, strewn in large quantities along the track in the gorge to the cave and at the base of the black limestone cliffs, reveals slabs of varying sizes and thickness.[484]

The slab consisting of two broken fragments (Cat: 18a), excavated in 1969 and 1972 respectively, bear the black drawing of a quadruped. Interpreted as feline in appearance, it is thought to depict, "a pair of obviously human legs which seem to have been drawn at a later date in place of the already faded original bent hind legs".[485] There are probably also two slightly curved horns visible, and a feature possibly representing genitals, which "add some bovine traits to this 'composition'".[486] Another fragment[487] depicts an ambiguous white, black-striped animal, interpretations such as zebra, giraffe or ostrich have been considered.[488] The most characteristic trait is a certain "stiff, long-leggedness", and in the author's opinion, despite the proportions, a zebra is the most likely interpretation.[489]

This is the oldest rock art found in Africa, and as such has invited a great deal of attention. However, what is particularly interesting here is that representational art in Africa only post-dates that found in Europe by a matter of a few thousand years. The oldest rock art in Europe is from Chauvet at 32,000 BP, while Apollo 11 dates to between 26,000 – 29,000 BP, moreover the depictions in both cases are of animals, not humans. It is an intriguing fact that representational art materialises at around the

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[480] Wendt, 1976
[481] The term refers to all works of art produced by humans that are of limited dimensions, so easily mobile. Wendt, 1975
[482] Wendt, 1972:21
[483] Laboratory sample numbers Pta-1040 (National Physical Research Laboratory), KN-I 813(Refined final KN-dates, slightly different from several already published earlier dates. Dates from KN-200 onwards are also final) and KN-2056 (Institut für Urgeschicte, Universität Köln) See Wendt, 1976:6.
[484] Masson. 2006:76
[485] Wendt, 1976:10
[486] ibid
[487] Not illustrated in the Catalogue; the only image available is not of sufficient quality to reproduce
[488] Wendt, 1976:10
[489] ibid

same time, but in very different areas of the world. Nevertheless, while the depictions at Chauvet and Apollo 11 share resemblances in the subject matter they are depicting, i.e. local animals, the ambiguity in the depictions at Apollo 11 Cave is absent at Chauvet, where depictions have a lifelike, naturalistic quality, exhibiting explicit natural history knowledge.[490]

4. 8 Summary

This chapter has presented a collection of artefacts that archaeologists recognise as evidence of the earliest symbolic activity produced by modern-type humans in Africa. By presenting the data chronologically the intention has been to demonstrate similarities and differences between artefacts, their geographical position, and any potential relationships between sites, the development [of form and technology] and the exploitation and manipulation of resources and materials. In this chapter, I have alluded to the emergence of artistic activity in MSA Africa featuring innate characteristics of the human visual system manifest in the collection and perforation of shells and mark-making on stone and ochre. The following chapter will continue the examination of artistic activity as modern humans move out of Africa, journeying to India, Papua New Guinea, Australia and the Levant.

[490] See Guthrie, 2006, a zoologist and palaeontologist who explains Upper Palaeolithic cave art in Europe from the point of view of natural history.

CHAPTER 5

Out of Africa - Presentation of Data

5.1 INTRODUCTION

As discussed in Chapter 3, genetic and fossil data suggests that modern humans migrated from east Africa somewhere around 60,000- 70,000 BP. There were two potential routes by which modern humans could leave Africa, the northern route via the Sahara and into the Levant, and the southern route, across the mouth of the Red Sea to Yemen, Oman and India, known as the Arabian Corridor Model.[491] Figure 5.1 shows the proposed northern and southern gates out of Africa and the suggested route taken via India, Papua New Guinea to Australia.

The 'first wave' of modern humans to leave Africa via the northern route occurred around 135,000-115,000 BP when the Sahara became accessible due to climate variations[492], evidenced by sites such Skhul and Qafzeh. It is proposed that this group of humans probably died out after the return of dry glacial condition causing North Africa and the Levant to return to desert conditions.[493]

Fig. 5.1 Proposed route taken out of Africa by modern humans

(Image: cogweb.ucla.edu)

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[491] Rose, 2006
[492] Oppenheimer, 2003
[493] Oppenheimer, 2003

The next migration most likely occurred via the southern gate[494] and allowed modern humans to follow the coast of the Indian Ocean to the tip of Java and then potentially island hopping to Australia.[495]

5.2 INDIA

A notable find comes from the open-air permanent settlement site of Patne, in the Deccan Trap region of Maharashtra in India (Map 2).A fragment of engraved ostrich eggshell[496] (Cat.19) raises some interesting comparisons with incised ostrich eggshell from Diepkloof. The crosshatched patterning on ostrich eggshell at Patne, radiocarbon dated to 25,000 ± 200 BP is remarkably similar in style to engraved crosshatch patterning found at Diepkloof, Klein Kliphuis, Blombos, and Wonderwerk. Also found at Patne were two unfinished ostrich eggshell beads and a shell bead.[497] While similar in design to the African examples the Patne eggshell also represents, "the first direct evidence of the Upper Palaeolithic art in India".[498] Sali suggests that the design of a trellis must have been a familiar sight for the artist to transfer it on to ostrich eggshell.

> "Can it be that he became well-familiar with this pattern while erecting his hut by trellising branches of trees? It is doubtful that Upper Palaeolithic man at Patne lived in the open without erecting some modest type of shelters such as huts made of branches and trees and leaves. Perhaps his living site was enclosed by trellising"…It is not unlikely that trellis pattern may make one think about the art of weaving, however crude it might look. The beads recovered from the levels of this culture at

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[494] Rose, 2006

[495] Oppenheimer, 2003. How modern humans arrived in Australia is subject to debate, although sea levels were 80 metres lower than today, and the current Australian land mass was connected to Tasmania and New Guinea by land (White, 2003:179)

[496] The ostrich shells from Patne belong to the genus *Struthio,* and possibly to the species *Struthio camelis.* The ostrich occurs today in Africa and Arabia, but not in India. It existed during the Upper Pleistocene in China and Mongolia, and has been noted that, "It would not be surprising if a large ostrich had existed in India at this period" (Sali, 1985:144) Other fragments of ostrich eggshell have been found at Poona, Wakankar and Bhopal, therefore, the evidence from Patne and other sites does suggest that the ostrich existed in India during the Upper Palaeolithic.(Sali, 1955)

[497] The occurrence of estuarine shell from 300km away suggests long distance contacts of Patne in this period. The beads found in Upper Palaeolithic levels at Patne represent the first and earliest examples of ornaments of the Palaeolithic so far found in India, and suggest that Upper Palaeolithic people in India used body ornaments of bone and shells contemporaneously with those seen in Europe and Western Asia.

[498] Sali, 1989:86

Patne further substantiate this view. Because they have to be put in a thread and preparation of thread is the first stage of weaving".[499]

Sali makes some insightful observations about the impetus for such patterning, suggesting that it was a design with which the maker was already visually proficient, having its roots in the cultural environment. Rather than assuming it has stand-alone symbolic and artistic signification, Sali sees the design as a derivative of processes involving hut construction and weaving practices for the suspension of beads.

The similarities in design between the African examples and Patne could be explained in one of three ways. First, as diffusion; that the artistic practice has its roots in Africa, been maintained as modern humans left the continent, and passed down from one generation to another. Second, independent innovation; that such patterning is a product of innovation and invention at different times and different places. Thirdly, as innate behaviour; that such crosshatch patterning that involves arranging lines of different orientation, is an innate characteristic of the human visual system first witnessed in the early artistic phases in Africa, and thus there is a certain expectation for its permeation into areas of cultural life.

The evidence from Africa and India is compelling for the similarities in artistic activity across sites that are geographically and temporally distant. The appearance of mark-making and personal ornamentation in the earliest phases of artistic activity develops and evolves in matters of form, pattern and technology. The developmental trajectory towards cultural complexity reveals intriguing patterns. The next chapter will apply the same considerations to the early Upper Palaeolithic of Europe, but the next section will first examine the small amount of evidence from Australia.

5.3 PAPUA NEW GUINEA

A perforated tiger shark's tooth (Cat.36) from the Buang Merabak cave, New Ireland, Papua New Guinea (Map 3), was excavated from a stratigraphic unit dated to between 28,000-39,500 BP.[500] The perforated tooth was excavated from area TPIB, equivalent to 170 cm below the current cave floor; units TP1A and TP1B contained a

[499] Sali, 1989:101
[500] Leavesley, 2006:309

total of 14 shark teeth.[501] The tiger shark is known to frequent tropical reefs, has a highly variable diet, and been described as “an opportunistic garbage can”.[502]

The tooth is 2.7 cm maximum length and 1.6 cm high, representing an animal about 4m long.[503] The tooth and perforation are partially covered with calcium carbonate,[504] but this does not obscure an partial lip on each side of the perforation (which is c.2 mm in diameter) suggesting the hole was produced by a point rotated in a 'drilling' motion alternating from side to side.[505]

The perforated tooth is from the mid-symphysis[506] region of the mandible, but showed evidence of its being well clear of the tooth socket,[507] perhaps suggesting the tooth was taken from a dead shark.[508] The presence of shark teeth in the assemblage certainly reflects the extent of the marine familiarity of the prehistoric inhabitants, and even though tiger sharks are known to frequent both the shallow waters behind reefs and the open sea their capture is clearly a dangerous activity. We can see direct comparisons here with the evidence from Blombos where deep-sea fish specimens identified from the site include, Red Stumpnose, Kob and the Black Musselcracker, a fish that is notoriously difficult to catch even today and indeed is seldom landed, “for its strength and dogged fighting ability make it a formidable adversary”.[509] Although limited in content, the evidence from Australia and neighbouring islands is that practices undertaken both in Africa and in Europe demonstrate coherency across time and space.

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[501] Leavesley, 2006:311. The teeth were identified by Noel Kemp of the Tasmanian Museum to species, which include 5x Silky Shark, 1 x Oceanic Whitetip Shark, 1 x Nervous Shark, 3 x Tiger Shark and 4 unidentified.
[502] Compagno 1988: 4
[503] Leavesley, 2006:311
[504] Calcium carbonates constitute the shells of molluscs.
[505] Leavesley, 2006:311
[506] Mandibular symphysis = the joint between the left and right mandibles at the jaw tip.
[507] Leavesley, 2006:311
[508] However, in historic times at least the shark was an item of prey. Shark catching, or 'calling', was reported as early as AD 1643 in New Ireland,[508] and still occurs today. The shark callers work in pairs and put to sea in single log outrigger canoes. Their equipment consists of a dugout canoe rattle and a float attached to a rope tied into a lasso. Once the fishermen have left the reef and paddled into the open sea the rattle is shaken in the water to encourage the sharks to swim alongside the canoe. Then the lasso is hooked around the sharks head as it swims past. The float serves to sap the shark of energy. As the shark tires the float brings it to the surface and the fishermen are able to catch up with it. Once it has been drawn alongside the boat it is beaten over the head and eyes before being lifted into the boat for transport back to shore. (See Leavesley, 2006)
[509] John Little, personal communication. http://www.3waycharters.co.za/index.htm.

5.4 AUSTRALIA

The prevailing wisdom is that modern humans entered Australia somewhere between 60,000 – 45,000 BP, with the latter date as the more likely.[510] If the date of 45,000 BP is correct for the initial settlement of Australia, then some of the earliest art is dated not long after modern humans arrived on the landmass. A fragment of painted rock (Cat.35) dated to, (at a minimum) c.40,000 BP was located at Carpenters Gap,[511] situated in the Napier Ranges, central Kimberley, in Western Australia (Map 4**).** The date from the lower levels indicates occupation of this region prior to 39,700±1000 BP.[512] This sample does not date the base of the site or the lowest stone artefacts and merely indicates a minimum age for occupation. The shelter has a date from approximately 20 cm below this of 49,700±870 BP, statistically the same age. [513] Found in a layer (Spit 47) containing burnt bone and ochre, originally the stained limestone slab was attached to either the ceiling or wall of the rockshelter, as a ledge. The ochre seems to have been applied by a method resulting in a thin even coating, possibly by blowing of wet pigment. Carpenter's Gap is important, as it is the oldest radiocarbon dated site in Australia.[514]

The practice of bead making using marine shells is also evident early in the occupation of Australia. Twenty perforated *Conus*[515] shells (Cat.37) from Mandu Mandu rock shelter in the Cape Range peninsula of Western Australia (Map 4) have produced radiocarbon dates of 35.2 ±1 - 30.9 ±0.8 ka.[516] Found in close association with one another within the rockshelter, their worn and battered appearance suggests they were probably collected as dead shells in the beach drift where they can often be found in abundance. It is suggested that the beads were made by rubbing the weakest part of the shell, the apex, against an abrasive surface.[517] Once a rough hole had been worn, the internal structure would then be broken, perhaps using a piece of bone or

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[510] See Hudjashov *et al.* 2007

[511] O'Connor, 1995; O'Connor and Fankhauser, 2001

[512] Radiocarbon dated from charcoal sample (AMS NZA 3802). O'Connor, 1995:59

[513](O'Connor, 1995:59) The two radiocarbon dates given come from samples taken at an approximate depth of 80cm and 100cm, reference numbers AMS NZ 3802 and AMS NZ 3803 respectively. Radiocarbon dating is the main dating tool for organic materials for the last 50,000 years or so (see Renfrew and Bahn, 2008. pp:141-148

[514] O'Connor, 1995:59

[515] *Conus* is a genus of medium-sized to large, predatory sea snails with the common names of *cone snails*, *cone shells* or *cones*. Live cone snails should be handled with care or not handled at all, as they are capable of 'stinging' humans with unpleasant results. The sting of very small cones is no worse than a bee sting, but the sting of a few of the larger species of tropical cone snails can be fatal to human beings. The shells of cone snails are often brightly colored and intricately patterned

[516] Morse, 1993

[517] Morse, 1993:890

stick. The edge of the top hole would be rounded and the still largely intact shell threaded on a fine string. The shell rings appear to represent a secondary modification following breakage of the last whorl, whether accidental or deliberate, during modification.[518] Estimates propose that if assembled, the strand of at least 22 beads would have had a length of 18 cm.[519]

Further evidence comes from Riwi Cave, located in The Kimberley, (Map 4**)** also in Western Australia, where ten *Dentalium*[520] shell beads (Cat.38) were unearthed. All are fragments of tusk shells or scaphopods,[521] belonging to the order *Dentaliidae* but, as none of the fragments include the posterior part of the shell, it is not possible be more specific in their classification.[522] A residue, visible to the naked eye, is present within the sinuous grooves and on rough surface areas of the shells, notably the broken ends, and microscopic analysis shows the residue is dark red/black. A Hemastix[523] test on two of these residue patches yielded positive 'small' results suggesting that there may be some blood in the residue. A fibre fragment was observed on the end of one of the beads.[524] Although scaphopods are sub-tidal they are frequently found as empty shells on the coast and wash up on the shore in huge numbers following tropical storms. Riwi is currently 300 km inland and 30,000 years ago would have been at least 500 km from the nearest sea.[525] The shell beads described here extend the age of human use of decorative ornaments in Australia to a time comparable with some of the earliest such evidence from Europe. While evidence of early art is limited in Australia, it appears that painted rock and the use of shells as beads is consistent with practices both in Africa.

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[518] Morse, 1993:890
[519] Morse, 1993:890
[520] *Dentalium* is a genus of marine scaphopod molluscs in the family *Dentaliidae*
[521] The shells of scaphopods are conical and curved in a planispiral (coiled in one plane) way, and they are usually whitish in colour. Because of these characteristics, the shell somewhat resembles a miniature elephant's tusk, hence the common name tusk shell. However, unlike an elephant's tusk, the shells of these molluscs are hollow and open at both ends; the opening at the larger end is the main or anterior aperture of the shell. The smaller opening is known as the apical aperture. Some tusk shells are minute, most are small, however, a few species reach 15cm in length.
[522] Balme and Morse, 2006:805
[523] Hemastix is a test for the indication of blood and detects the peroxide-like activity of haemoglobin in a substance, but will not detect the difference between animal and human blood.
[524] Balme and Morse, 2006:806
[525] Balme and Morse, 2006:807

5.5 LEVANT (Modern Syria, Lebanon, Israel, Turkey and Palestine)

Modern humans moved out of Africa at around 60,000 BP travelling through the Levant and reaching Europe by around 45,000 BP.[526] What is notable in this journey and in the archaeological evidence is that while there is evidence of art in both Africa, Australia (albeit limited) and Europe, the Levant region is singularly deficient in artistic activity. Why this should be so, is uncertain. It has been suggested that it could be due to large expanses of land either having not been subject to excavation, or possesses poor archaeological records that are open to debate and differing interpretations.[527] However arguably much of the Levant has been well covered and recorded archaeologically.[528] Further proposals suggest that Upper Palaeolithic societies in the Levant were foragers with a simple social organisation that is reflected in the scarcity of art, burials and the nature of their sites, and that unfavourable environmental conditions were at least in part, responsible for this pattern.[529]

A flint cortex flake engraved with a series of nested forms has been found at the site of Quenitra in the Golan Heights in south-west Syria, dating to around 54,000 BP. Microscopic examination of the piece revealed a set of four concentric semi-circles carefully carved and surrounded by angular lines that roughly follow their form, together with other vertical lines on the right hand side.[530] During this period anatomically modern humans were living in the Middle East with Neanderthals, and unlike the Skhul and Qafzeh shells that are associated with anatomically modern humans, there is no current definitive evidence which species of hominid produced this engraving, thus its exclusion from the Catalogue.

5.5.1 Üçağızlı Cave

At Üçağızlı Cave, located on the Mediterranean coast of the Hatay region of south-central Turkey (Map 5), more than a thousand shells, (Cat.22a) some of which

[526] Krings *et al.* 1997; Richards *et al*. 2000; Underhill *et al*. 2000; Stringer, 2002; Forster, 2004; Kivisild, 2006; Mellars, 2006; Hudjashov et al, 2007
[527] Pettit, 2005:152
[528] See Jelinek, 1981; Smith, 1986; Minzoni-Déroche, 1993; Kuhn, 1995; Levy, 1995; Bar-Yosef, 1998b,c; Akkermans and Schwatrz, 2003; Goring-Morris and Belfer-Cohen, 2003; Shea, 2003a,b
[529] Gilead, 1998:137
[530] See Goren-Inbar, 1990

are perforated have been unearthed spanning a time period of c.42,000 -30,000 years BP,[531] maintaining a convention practised in North Africa since c.100,000 BP. The shells comprise seven discrete assemblages assigned to different stratigraphic layers and periods.[532]

Although perforated marine shells were a continuation of an already established practice, the inhabitants of Üçağızlı were selective in their choice of shells for ornament making, preferring comparatively rare varieties either luminous white or brightly coloured shells, some with eye-catching patterns.[533] A variety of mollusc species were used as ornaments, but the same taxa predominate. Two species of marine gastropod, the carnivorous scavenger *Nassarius gibbosula*[534] and the omnivore *Columbella rustica*, together account for between 50% and 90% of the total assemblage in all layers, and are native to the eastern Mediterranean.[535] The third most abundant gastropod, *Theodoxus jordanii* inhabits fresh or brackish water, and could have been collected from the nearby Asi (Orontes) river.[536] Humans perforated most of the specimens, probably by pushing a small irregular hole through the shell wall, near the lip using some form of pointed tool, which are quite distinct from the holes bored by predatory molluscs.[537] Some of the shells were stained with red ochre. Taxonomic diversity in shell assemblages increases steadily with time at Üçağızlı, demonstrating a trend towards selection preference for shell ornaments.[538]

In addition, the only non-shell ornament comes from layer B, the terminal phalanx of a large predatory bird (*Gyps or Gypaetus*)[539], (Cat.13b), with a notch cut into its anterior proximal end probably for suspension. This layer is one of the later stratigraphic layers and is radiocarbon dated to 29,130±380 BP.[540] Interpreted as an object of ornamentation, the suspension of a claw of either a vulture or eagle would have been a visually impressive sight.

[531] Stiner, 2003:50
[532] See Catalogue entry 21a for the radiocarbon dates.
[533] Kuhn *et al.* 2001:7642
[534] Also found at Skhul Cave, Oued Djebbana and Grotte des Pigeons (see Chapter 4)
[535] Kuhn *et al.* 2003: 113
[536] The river mouth is 15 km south of the site; Kuhn *et al.*, 2003: 113
[537] Kuhn *et al.* 2003: 113
[538] Kuhn *et al*. 2009:103
[539] The specimen is probably from a vulture such as *Gypaetus barbatus* (Bearded Vulture) or *Gyps fulvus* (Griffon vulture). (Kuhn *et al*. 2009:103)
[540] Kuhn *et al*. 2009:91

5.5.2 Hayonim Cave

The only site to date that has representional artistic activity is Hayonim Cave situated in Western Galilee, Israel (Map 5). Two limestone slabs (Cat.39a,b) showing intentional incised lines were found in two different locations, D1-2 (Sq.J21) and D4 (Sq.121).[541] Radiocarbon dated to 29,000-27,000 BP,[542] the image on the first limestone slab (Cat: 39a) is clearer and the set of incised lines was probably made with a flint artefact.[543] On side 1, a line resembles an ungulate, with some indication of a head. The lines descending on the right edge outline what has been interpreted as a 'horse' head, Many lines give the impression of forelegs and rear legs. Side 2 presents fewer incised lines and suggests "some sort of a back (in a diagonal direction) and a series of descending lines".[544] The horse has no hooves, no facial features and no underbelly, the back is "merely an undifferentiated arc"[545], and the eye a simple gash. The horse was engraved first followed by a series of lines overlaying the image, which as Marshack suggests, represents the symbolically 'killing' of the animal.[546] The incised markings are not clear and the ambiguity in representation makes it difficult to come to any conclusions.

In addition, present in the Aurignacian levels[547] at Hayonim are five bead types (red deer, fox and wolf canines, horse and deer incisors); the teeth were polished after the removal of enamel.[548] However, the spatial organisation of the Aurignacian layers at Hayonim is not easy to decipher because of poor preservation of organic materials, and disturbances in depositional layers, intra and post Aurignacian activities.[549] Thus, the relationship of these artefacts to each other is unclear, and so not particularly reliable as evidence. Nevertheless, the Levant formed a major corridor for human and faunal movements between Africa and Eurasia and so the lack of artistic evidence earlier is an intriguing phenomenon.

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541 Belfer-Cohen and Bar-Yosef, 1981: 35
542 Bar-Yosef, 1997:167
543 Bar-Yosef, 1997:167
544 Bar-Yosef, 1997:36
545 Marshack, 1997:62
546 Marshack, 1997:62
547 The reference to the perforated teeth only consigns them to Aurignacian levels and does not provide any radiometric dating. (Belfer-Cohen & Bar-Yosef, 1981:31)
548 Belfer-Cohen & Bar-Yosef, 1981:31
549 Belfer-Cohen & Bar-Yosef, 1981:36

5.6 Summary

The evidence from India, Papua New Guinea, Australia, and the Levant is limited but demonstrates both continuity in object production, in that shells are collected and perforated for suspension, and fragments of rock are painted but also the emergence of new and innovative forms of artistic activity. A perforated shark's tooth from Buang Merabak in Papua New Guinea dating to 28,000-39,500 BP and the presence of five new bead types (red deer, fox and wolf canines, horse and deer incisors) at Hayonim Cave in Israel, dating to 27,000-29,000 BP demonstrates a new type of material being selected for perforation and decoration. Interestingly, the choice of new bead media found in Israel replicates those selected in Upper Palaeolithic Europe, examined in the following chapter.

CHAPTER 6

Upper Palaeolithic Europe - Presentation of Data

6.1 INTRODUCTION

This chapter resumes the journey of modern-type humans' migration into other parts of the world, focusing specifically on the evidence for artistic activity when modern humans first move into Europe at around 45,000 BP. I have selected a termination point of c.28,000 BP *a propos* the European data as it not only coincides with the African data, but also signals the end of the Aurignacian period.[550] The diversity, extent, and quantity of evidence from the "rich record"[551] after 28,000 BP are beyond the remit of this thesis, and therefore not included. However, the cultural complexity seen in the Gravettian undoubtedly develops from the preceding Aurignacian.[552]

6.2 UPPER PALAEOLITHIC EUROPE

Once modern humans migrate into Europe, artistic activity accelerates in such a way that it is termed a 'Human Revolution',[553] a 'Creative Explosion',[554] and a 'Big Bang'.[555] Such descriptive terminology explicitly conveys this period as one of upsurge and transformation, consisting of an, "increased cognitive sophistication, the manipulation of symbols, and the origin of language".[556] This is considered the time and place when we unequivocally become behaviourally modern humans. Nevertheless, the earliest evidence of artistic activity in Europe appears to be a continuation of previous practices relating to personal ornamentation but showing more variability in materials selected, possibly related to selection of animals or the physical or visual qualities of the material.

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[550] The Aurignacian is the earliest archaeological culture in Europe and defined by its stoneworking, rich bone and antler industry, and the abundance of representational objects. The name originates from the type site of Aurignac in the Haute Garonne area of France and spans the period c. 40,000 – 28,000 years ago. After this point, in Europe, cultural complexity escalates in multifarious ways. The following Gravettian culture (c. 28,000 – 22,000 BP) was characterised by significant changes in technology and artistic forms. See White, 2003, pp: 82-94

[551] Roebroeks, *et al.* 2000:1.

[552] See Roebroeks *et al*. 2000

[553] Mellars, 1989

[554] Pfeiffer, 1982

[555] Mithen, 1996

[556] McBrearty and Brooks, 2000:454

6.3 Bacho Kiro

Some of the oldest dated artefacts in Europe come from Bacho Kiro cave (Map 6) situated 5 kilometres west of the town Dryanovo, at the northern foot of the Balkan Mountains in Bulgaria. A pierced bear incisor and a pierced fox canine (Cat.20), were located in a stratigraphic layer (Layer 11)[557] represented by clearly defined hearths and traces of simple camp structures.[558] Found in the same layer was the remains of *Homo sapiens*,[559] affirming the site and the personal ornaments as the product of modern humans, and not Neanderthals.[560]

Initial radiocarbon dating of charcoal from Layer 11 dated this layer to more than 43,000 BP,[561] and research has suggested a progressive warming of the climate with subsequent increased humidity;[562] a period linked with the Heraklitsa interstadial.[563] Bone, charcoal, and dental samples from layer 11 submitted to the Oxford accelerator laboratory in 1990 produced AMS radiocarbon dates ranging from 38,500 ±1.7 BP to 33,800 ±0.9 BP.[564] Two of these dates (38,500 ±1.7 BP on bone and 37,700 ±1.5 BP on charcoal) are not significantly different from one another, but are more than two standard deviations older than the two youngest dates obtained from layer 11 (34,800 ±1.2 BP on a tooth, and 33,800 ±0.9 BP on bone). These younger dates suggest that the warmer and wetter conditions reflected in the

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557 Layer 11 at Bacho Kiro exhibits some of the earliest Aurignacian stone tool types and was designated the BachoKirian complex (Kozlowski, 1982), but in more recent publications has been called 'Pre-Aurignacian' (Kozlowski and Otte, 2000), as the technocomplex does not show any typological or technological characteristics of the European Aurignacian assemblages.

558 Kozlowski, 1982:170. Bacho Kiro shows a series of small and sharply defined individual hearths or hearth complexes located in different parts of the cave at different periods of its history. It is hypothesised that human occupants used the cave for short, intermittent occupations that involved small numbers of people, separated by long time intervals of abandonment.(Bailey and Galanidou, 2009:234)

559 See Catalogue entry 20 for further information on the human remains

560 A bone fragment exhibiting an incised zigzag pattern was found in layer 12 (Middle Palaeolithic levels) at Bacho Kiro Cave, and belongs to the Mousterian, a stone-tool making tradition, or cultural period in Europe almost exclusively associated with Neanderthals. (Kozlowski, 19822:117)

561 Layer 11, cultural level 1 (charcoal from 256-357 cm) dated to more than 43,000 BP (GrN-7545). This sample although conventionally (2-σ, within two standard deviations*)***)** only a limiting age may be given, seem to have some activity; that is using a 1-σ (within 1 standard deviation) criterion the age would be about 50,000 +9,000 -4,000 BP. (Kozlowski, 1982:168)

562 Layers 11a and 11 contain evidence of warming of the climate and of a further increase in humidity. The quantity of mountain and steppe rodents declines, and there are still few forest forms. *Pitymys subterraneus*, the European Pine Mole is more numerous than the species *Microtus arvalis*, the Common Vole, connected mainly with dry environments. In layer 11 the remains of fish were also found. The mole occurring here, *Talpa europaea*, is associated with damp meadows, and the bat *Myotis dasycneme* with water. The polar fox and ermine are still present. (Kozlowski, 1982:70)

563 Kozlowski, 1982:170**.** Also known as the Moershoofd interstadial from the Netherlands, during which the climate was relatively cool, with average July temperatures of 6–7°C

564 Hedges *et al.* 1994

layer 11 sediments correspond to the Hengelo (Podrahem) interstadial[565] rather than the Heraklitsa.[566]

Associated finds include stone tools comprising retouched flakes, end-scrapers, splintered pieces, as well as burins, truncations and notched pieces. The technique employed to perforate these teeth was one that dominated during most of the Aurignacian. It consisted not of drilling in a rotational movement, but rather of gouging the root's surface first on one side, then on the other, until an opening appeared.[567] Burins would have been particularly useful for such a procedure.

The remains of tooth crowns point to the presence of the brown bear, *Ursus arctos*. This species inhabits the forests of Eurasia, as well as North America. In the case of Bulgaria, it now appears only in the mountains, but is characterised by its considerable geographical variability, and fossil remains are known from the Pleistocene of Europe and Asia.[568] Evidence of small carnivores indicates the Red Fox, *Vulpes vulpes*. Widespread in the Palaeolithic, it appears in various environments and zones of climate and vegetation, with fossils encountered in many Pleistocene localities; including Bulgaria.[569] No microanalysis has been carried out on these perforated teeth, and little is written in the literature. The 1982 site report provides only sentence, commenting, “It is worth drawing attention to the presence in Layer 11 of ornaments made from the perforated teeth the bear and the fox; these are the earliest known products of this type in Europe”.[570]

6.4 Istallöskö Cave

A new class of objects emerges with the discovery at Istallöskö cave in the Bukk Mountains of Hungary (Map 6), of a replica of a vestigial canine of a red deer sculpted in cervid antler (Cat.21a), radiocarbon dated to 44,300 ±1900 BP.[571] This is the first example seen of the practice of copying natural objects in different materials. Such copies of natural objects, of which further examples are discussed

[565] The Hengelo interstadial was a shift from a polar desert to shrub tundra, occurring between 39,000–29,000 BP. (Churchill and Smith, 2000:62)
[566] The Heraklitsa or Loopstedt interstadial dates between ca. 50,000–43,000 BP (date based on Shotton, 1977)
[567] White, 2003:133
[568] Kozlowski, 1982:52
[569] Kozlowski, 1982:54
[570] Kozlowski, 1982:170
[571] Found in layer 9 (base) - radiocarbon reference GrN-4659 dated to 44,300 ±1900 BP. GrN is the laboratory code for Groningen Radiocarbon Laboratory (Clark and Willermet, 1997:241)

later, are termed 'facsimiles.[572] Of the 5,000 animal bones in the archaeological level at Istallosko, only five are of red deer, suggesting that the choice to represent this animal's tooth is unconnected to its dietary importance.[573]

Little information translated into English is available for this site, yet the small amount of data alludes to new modes of thinking, especially the implications of the manipulation of deer antler to make it look like a deer's tooth is a form of imitation not previously seen. In addition, a carefully perforated plate of mammoth ivory (Cat 21b) located in level nine (mid) has been radiocarbon dated to 39,800±900 BP.[574]

6.5 Kostenki

This is not actually a single site but an area on the right bank of the Don River in the region of the villages of Kostenki and Borschevo, consisting of more than twenty site locations[575] (Map 6). Radiocarbon and optically stimulated luminescence (OSL)[576] dating and magnetic stratigraphy[577] indicate Upper Palaeolithic occupation between 45,000 to 42,000 years ago. The oldest levels at Kostenki underlie a volcanic ash horizon identified as the Campanian Ignimbrite Y5 tephra, dated to about 40,000 years ago.[578] The occupation layers contain bone and ivory artefacts, including possible figurative art, and shells, the source of which is more than 500 kilometres away.

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[572] Randall White uses the term in his 2003 publication, *Prehistoric Art: The Symbolic Journey of Mankind.* I have appropriated the term in the context of this thesis to draw attention to the significance of the objects classed as facsimiles.

[573] White, 2003:134

[574] Radiocarbon reference GrN-4658 dated to 39,800±900 BP. GrN is the laboratory code for Groningen Radiocarbon Laboratory (Clark and Willermet, 1997:241)

[575] Kostenki includes 21 Early Upper Palaeolithic (EUP) open-air sites along the margins of large ravine systems on the high west bank of the Don River. Most of the sites contain active springs and comprise several occupation levels. An additional seven sites are recorded near Borschevo, several kilometres to the southeast (Anikovich et al. 2007:223). These sites appear to represent an "EUP landscape" containing (a) locations at which large mammals (chiefly horse, but also reindeer and mammoth) were killed and/or butchered, and (b) habitation areas. (Hoffecker, 2009)

[576] At Kostenki 12, sediment below the level of the ash horizon yielded optically stimulated luminescence (OSL) dates of between 52,440 ±3850 and 45,200 ± 3260 years. (Anikovich *et al.* 2007:224)

[577] By studying the direction of remaining magnetisation in thick sequences of volcanic lavas and dating when these lavas formed using radiometric dating it is possible to establish when in time different episodes of magnetic reversals took place. This is called the magnetic stratigraphy and has been very important in establishing the theory of plate tectonics.

[578] The Campanian Ignimbrite (CI) eruption, dated by $^{40}Ar/^{39}Ar$ (Argon-Argon) and various stratigraphic methods to ca. 39,000 cal BP generated a massive ash plume from its source in southern Italy across Southeastern and Eastern Europe. (Hoffecker *et al.* 2008)

The lowermost occupation level, (Layer IVb) dating to more than 40,000 years old, contained carved a piece of ivory that is thought to represent the head of an (unfinished) human figurine (Cat. 23f).[579] The image provided shows three views (top centre of the picture) of the object, which displays little, if any, carving, or facial features. However, Kostenki is well-known for its later Gravettian 'Venus' figurines and while more work needs to be done, if confirmed, this could be the oldest example of figurative art discovered to date.

The site of Kostenki 14 has unearthed four elongated beads made out of bone (Cat.23d) and three perforated shells (Cat.23e), which came from the periphery of the site, dating to c 32,000 BP.[580] The beads are considered[581] to be manufactured from the diaphyses[582] of the Polar Fox's long bone and in one case from a bird bone, although not identified to genus. The beads are encircled by deeply cut lines, in one case forming a spiral pattern, and all exhibit a strongly polished surface and smooth edges, suggestive of long periods of use.[583] The shells, identified as *Theodoxus fluviatilis Neritidae,*[584] are a mollusc adapted to both fresh and salt water, and fairly common in the present day eco-system of the River Don. Three of the shells display perforations, and smoothed edges, again indicating extensive use.[585] The perforated shells in the lowermost level at Kostenki 14 apparently are derived from a source no closer than the Black Sea, which indicates they were transported more than 500 km from source to the Kostenki site.[586] From the 2002 excavation at Kostenki 14, two drilled Polar Fox canines (Cat 23a), together with the bone beads and shells, have been suggested as possibly forming the third component of an ornamental necklace.[587]

At the site of Kostenki 17 thirty-seven perforated fox canine teeth (Cat.23a) have been uncovered, as well as ornaments made from fossilised marine animals, notably four Belemnite beads (Cat.23b, 23c). The perforated Arctic Fox teeth and Belemnite fossils produced radiocarbon dates of 32,700 (+200 -1600) BP and 36,400

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579 Anikovich *et al*. 2007:224
580 Radiocarbon dates taken from charcoal located in the ash horizon at Kostenki 14 have produced a date of 32,420±440/420 (GrA-18053) (Sinitsyn, 2003:13). GrA refers to the Groningen Accelerator Laboratory in the Netherlands.
581 Analysed by Dr I. Kuzmina from the Institute of Zoology, Russian Academy of Sciences.
582 The shaft of a long bone.
583 Sinitsyn, 2003:12
584 Identified by Professor B.I. Syrenko of the Institute of Zoology, Russian Academy of Sciences.
585 Sinitsyn, 2003:12
586 Anikovich, 2007:325
587 Sinitsyn, 2003:12

(+1700 -1400) BP respectively. More recently thermoluminescence dating of overlying volcanic ash[588] have revised the date to older than 37,000 years.[589]

Belemnites are fossilised marine animals, which are spectacularly beautiful in colour and translucence, and easily mistaken for amber. Of the four beads found, two different taxa of belemnite are represented by two examples each. The primary difference between them is the presence on one of fine transverse ripples, which produces a remarkable visual and tactile effect. Associated finds include lithic assemblages, as well as bone and ivory tools characterized by awls made on hare or arctic fox *humeri*. In addition, there are fragments of bone points and worked mammoth tusk. The only human remain is a third left molar which is anatomically modern.[590]

According to S. A. Semenov,[591] the holes in the teeth and Belemnite were produced by drilling.[592] The final form of the four Belemnite fossil beads is the result of a production sequence that began with the natural cylindrical form of the belemnites. In form, Belemnites are like mini tusks in that they are pointed distally and have a proximal cavity that is the equivalent of the pulp cavity in tusks. These natural cylinders were subdivided into segments that were then split down the centre, each half being semi-cylindrical in section.[593] Three of these segments were then perforated one end by means of fine, biconical rotational drilling. The fourth was drilled from the outside in, and the distal and proximal ends smoothed by polishing, as were the lateral margins.[594]

Kostenki also contains evidence that they were broadening their diet to include small mammals and freshwater aquatic foods, an indication, for John

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[588] The occurrence of volcanic ash in Upper Palaeolithic deposits in the central part of the Russian Plain is a remarkable phenomenon because it lies at a great distance from known areas of volcanic activity. First recognised in Central Russia during the 1930s and identified at Kostenki in the 1950s, for some time ash has been considered as resulting from the eruptions in the Caucasus, these being the nearest to the site. However, special analyses, performed at the Institute of Volcanology at the Academy of Sciences in the USSR in the 1980s links the Kostenki tephra with the volcanic system at Campi Flegrei in southern Italy where eruptions have been dated to 38,000 BP. (Sinitsyn, 2003:10) See also Melekestsev *et al*. 1984

[589] Sinitsyn and Hoffecker, 2008

[590] Chabai, 2001:77

[591] The English publication, in 1964, of S.A. Semenov's, "Prehistoric Technology", covering 30 years of investigation in the field of prehistoric tool function, had a considerable and durable impact on world Archaeology.

[592] See White, 1993 and 2007 for information on the technology of drilling in the Upper Palaeolithic.

[593] This splitting and segmenting approach is similar in principle to the technique used to make ivory beads at contemporaneous sites in Central and Western Europe. (White, 2003:135)

[594] Boriskovski *et al*. 1982:186

Hoffecker[595], that they were "remaking themselves technologically".[596] It can be argued that they were also remaking themselves socially and culturally, as the character and diversity of artistic activity attests. The capacity to live in the Kostenki environs required a unique level of adaptation and flexibility, in terms of not only climate and environment. The Kostenki sites have played a critical role in Palaeolithic archaeology providing important stratigraphic sequences and chronological frameworks. Kostenki demonstrates that modern humans existed from c 45,000 BP in one of the coldest, driest places in Europe extremely successfully. [597]

6.6 Grotte d'Isturitz

The site of Grotte d'Isturitz, located in the valley of Arberoue in the *Pyrénées-Atlantiques*, in south-west France (Map 6), has also disclosed a rich and diverse ornament assemblage. The two layers (levels 4c6 and 4d1)[598] from which these assemblages appear have yielded radiocarbon dates of 34,630± 560[599] and 36,550±610 BP.[600] Included in the level 4d Aurignacian assemblage are fifteen perforated shells of *Littorina obtusata*,[601] (Cat. 26a) a calcite[602] pendant (Cat. 26b), the overlying level yielded an amber pendant (Cat. 26c), production debris and raw chunks of amber. Level 4a yielded a perforated human lower molar (left M2 or M3), punctured by back-and-forth rotation created by a rather blunt point; and showing signs of heavy wear.[603]

Grotte d'Isturitz is about 40 km from the Atlantic Ocean, the source of the seashells. *Littorina obtusata* is highly variable in colour (from olive green to yellow to banded and chequered patterns) depending on its habitat, and while the shell

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595 A fellow of CU-Boulder's Institute of Arctic and Alpine Research and part of the excavation team at Kostenki.
596 Quote taken from news article, "Earliest evidence of modern humans in Europe discovered." PHYSorg.com. 12 Jan 2007. www.physorg.com/news87811897.html
In addition, indirect evidence of sewn clothing in the form of eyed needles is reported from Kostenki 15 at c.35,000 to 30,000 BP
597 John Hoffecker, News article "Earliest evidence of modern humans in Europe discovered." PHYSorg.com. 12 Jan 2007. www.physorg.com/news87811897.html
598 Grotte d'Isturitz has revealed multiple Aurignacian stratigraphic units, beginning with Archaic Aurignacian (levels 4d and 4c) at the base and ending with Early Aurignacian (levels 4b through to 3) on top. Level 4d is bracketed top and bottom by two dates 34,630±560 (Gif-98237) and 36,550±610 (Gif-98238). (White, 2007a:290)
599 Gif-98237. Gif refers to the radiocarbon laboratory code and represents Gif-sur-Yvette in France.
600 Gif-98238
601 The common flat periwinkle
602 Calcite is one of the most common minerals, comprising about 4% by weight of the Earth's crust and is formed in many different geological environments.
603 White, 2007a:294

appears smooth, upon closer inspection has a finely interwoven appearance.[604] The amber pendant from this site is the oldest known evidence for amber jewellery in the world, the source of which is the Cretaceous fossil-bearing deposits located in the Pyrenean foothills.[605] The use of human teeth modified for perforation is a rare occurrence in the Aurignacian, but also occur at Grotte des Hyènes at Brassempouy, discussed below.

6.7 Abri Castanet

By 32,000 BP, the evidence for numerous art forms across Europe demonstrates the maturation of the so-called 'Human Revolution'. Abri Castanet, a rockshelter by the Vézère River in the Dordogne region of France (Map 6)**,** has yielded hundreds of perforated shells (Cat. 24a) as well as a large portion of the collapsed shelter ceiling bearing engraved and painted imagery (Cat. 24b). AMS dates from Abri Castanet yielded dates ranging from 34,320±520 - 31,430±390 BP.[606] Recent excavations at the site substantiate the "impression of intense bead production, with the presence of as many bi-products as beads",[607] giving the impression of a small workshop. Excavations are ongoing at Abri Castanet and the stratigraphy initially proposed by Peyrony in 1935 is proving to be much more complicated; more dates are currently being processed.

A significant aspect of the Vézère Valley, in which Abri Castanet is located, is the number of sites in close proximity (Figure 6.1); the Vézère valley contains 147 prehistoric sites dating from the Palaeolithic and 25 decorated caves.[608]

604 Pizzolla, 2008
605 White, 2007a:300
606 Valladas et al, 2007
607 White, 2007a:295
608 The valley has been designated a UNESCO World Heritage site. http://whc.unesco.org/en/list/85

Fig 6.1 Abri Castanet and adjacent Palaeolithic sites in the Vallon de Castel-Merle, Sergeac, France

1) Abri des Merveilles,
2) Abri Blanchard II,
3) Abri Sous-le-Roc,
4) Abri Blanchard I,
5) Abri Castanet, old sector,
6) Abri Castanet, new sector,
7) Abri Reverdit,
8) Abri du Roc d'Acier,
9) Abri Labattut,
10) La Souquette

(Image: Randall White http://www.nyu.edu/gsas/dept/anthro/programs/csho/whiteimages.html)

Technological variability of the early stages of the Aurignacian in southwest France and the western Mediterranean has been noted,[609] but there was also a great deal of group mobility in this location during the Aurignacian.[610] Material evidence of

[609] See Bon, 2002
[610] Blades, 1999a 1999b

Aurignacian social complexity is manifested by the early Aurignacian in the lower Vézère Valley, and some of the study assemblage indicates intragroup and intergroup social relations.[611]

6.8 Grotte des Hyènes

The artefact variability observed at Grotte d'Isturitz has its counterpart in the Grotte des Hyènes, in the Aquitaine Basin, at Brassempouy, France (Map 6)**.** This site has produced an important collection of pierced teeth, including fox, wolf, and deer, as well as perforated shells, further examples of 'facsimiles' in the form of cervid canines (one in ivory, the other in stone), and four perforated human teeth (Cat.27).[612] A series of radiocarbon dates obtained for the Aurignacian sequence at Grotte des Hyènes range in dates from 33,600±240[613] - 26,870± 500 BP[614] with an anomaly of 17,970± 150.[615]

The beads and pendants from Grotte des Hyènes were made from ivory, chlorite, talc, calcite, bone, hematite and lignite. Brassempouy's location close to the Pyrenean talc sources likely results in much higher percentages of talc beads, however, Isturitz is even closer to the talc sources yet most beads are made from ivory, contradicting claims of a classic down-the-line distance pattern.[616]

Four techniques are present in the Grotte des Hyènes ensemble with respect to the modification of objects for suspension: perforation by bifacial gouging, by demi-rotation, by pressure or indirect percussion, and by basal circumcision (also known as *Rainurage*), a technique used on the four human teeth.[617] A small amount of fabrication debris and some unfinished beads and pierced teeth indicate on-site manufacture of at least some of the basket-shaped beads and pierced teeth at both

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[611] Blades, 1993a:93
[612] With regard to the human teeth, it has been argued that given the total lack of Aurignacian burials the teeth, may indicate Aurignacian mortuary practices that did not involve burial. (White *et al.* 2003; 2006; Henry-Gambier *et al.* 2004)
[613] From stratigraphic layer Couche 2DE, Gif/LSM-11034. Gif = Gif sur Yvette, France. White, 2007a:289
[614] From stratigraphic layer Couche 2E, GifA-9032. Gif = Gif sur Yvette, France. White, 2007a:289
[615] From stratigraphic layer Couche 2E, GifA-8570. Gif = Gif sur Yvette, France. White, 2007a:289. See Catalogue entry 26 for a full list of dates.
[616] White, 2007a:294. The down-the-line exchange network was developed in the 1960s by Colin Renfrew using distribution studies of obsidian found at early Neolithic sites in the Near East. The system is characterised by the way a commodity travels across successive territories through successive exchanges, revealing a pattern of exponential fall-off as the commodity moves further from its source. (see Cann, Dixon and Renfrew, 1968)
[617] White, 2007a:289

Castanet and Brassempouy.[618] While at Grotte de Hyènes, a wolf canine shows distinct stigmata (hacking, scraping, gouging) of preparation for perforation, but seems to have been abandoned or lost before perforation occurred, implying on-site production of at least some tooth-ornaments.[619]

Analysis of finished bead-to-production debris at Grotte des Hyènes, Abri Castanet and Grotte d'Isturitz has led to the identification of a massive production signature at Castanet, an ornament maintenance signature at Hyènes, and a "no-production-whatsoever signature" at Isturitz.[620] This has led White to develop a model or ornament fabrication within a regional system of movement and site function, focusing on ornament production, use and discard in Aurignacian cultural landscapes, reinforcing the importance between the social environment and cultural production.

6.9 Abri de la Souquette

As previously mentioned, a particularly intriguing addition to the repertoire of artefacts seen in early Upper Palaeolithic Europe is those designated as facsimiles. This new genre of object is very limited in the archaeological record, and currently is only attributable to three sites. Istallosko cave (Cat. 21a) in Hungary dated to >43,000 BP, Grotte des Hyènes at 33,000 BP, (Cat. 27) in the Aquitaine Basin, France, and the Aurignacian site of Abri de la Souquette (Cat. 25) in the Dordogne, France.

Little information about Abri de la Souquette is available and so while it has a catalogue entry it is more for its significance as a new class of object, and for the fact that a particularly good image exists, enabling a good visual analysis. Dated to the Aurignacian layers, at present there is no published radiometric dating or contextual information. Sculpted in mammoth ivory, and measuring 2 cm – 2.5 cm in length,[621] these replicas are pierced for suspension, and quite interestingly, although imitating a shell in form, the position of the piercing does not replicate the same position in which a real shell would be pierced, which may simply be a pragmatic consideration. Nevertheless, these facsimiles are remarkable in their likeness to a shell, most notably in the rendering of the surface, revealing a keen eye for detail.

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[618] White, 2007a:289
[619] White, 2007a:295
[620] White, 2007a:300
[621] White, 2003:71

Moreover, at only 2 – 2.5 cm in length demonstrate a technical proficiency on a small scale.

6.10 REPRESENTATIONAL ART

The development towards cultural complexity is observable most explicitly in the emergence of representational art in the archaeological record. Notwithstanding the possible but unsubstantiated carved human head from Kostenki discussed above, clear evidence emerges at around 32,000 – 35,000 BP. Manifest in two quite distinctive techniques; parietal or cave art and mobiliary or portable art, the sites at which representational art occurs are located in France, Italy and Germany and Austria. France and Italy provide evidence of cave art, while four sites in the Swabian Jura in southern Germany and the site of Galgenberg in Austria have collectively yielded a number of sculpted animals and two female figurines. The first site examined will be parietal art from Fumane Cave in Italy followed by Chauvet Cave in the Ardèche region in France. After the parietal art, the focus will move to mobiliary art from four cave sites in the Swabian Jura in southern Germany and the site of Galgenberg in Austria.

6.11 Fumane Cave

Several fragments of stone bearing painted depictions (Cat. 29 a-e) were found at Fumane Cave, located in the Lessini Mountains, near Verona, northern Italy (Map 6)**,** dating to c.35,000-32,000 BP.[622] In addition to the parietal art, the Aurignacian deposit has yielded a considerable number of ornamental objects, four red deer incisors with a groove at the root level and 723 seashells from 58 different species,[623] gathered on the Mediterranean coast (about 120 km away) and brought to the site.[624] Although unable to find available images for these artefacts, it has been observed that, “a preferential selection of the smallest, very visibly decorated forms seems to have been made”.[625] Among the shells, nearly half have at least one drill hole, but is unclear whether these are natural perforations or the result of human

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[622] Radiocarbon dates taken from charred wood in the Aurignacian layers range from 30,650±250 (OxA-11347) to 36,500±600 (UtC-2048).OxA refers to the Oxford Radiocarbon Accelerator Unit and UtC is the laboratory code for Utrecht van der Graaf Laboratorium.
[623] See Vanhaeren and d’Errico, 2006:1110 for a list of the shell species
[624] Broglio *et al*. 2006
[625] Broglio *et al*. 2006

modification. In addition, a rib from a small herbivore was found, decorated with two series of finely incised transversal lines.[626]

Archaeological evidence indicates that Fumane cave was a habitation site for the Aurignacian people of the Lessini Mountains, demonstrated by well-defined hearths, post-holes, piles of waste and concentrations of ochre in the sediment, distributed between the central and frontal areas of the cave. In the central area, around 150 cm under the ceiling, is the oldest hearth, while in the area in front of the entrance, there is a larger hearth, surrounded by horizontal slabs, with four post-holes nearby, interpreted as a structure protected by an artificial shelter backed onto the rock wall.[627]

The first fragment of painted stone (Cat. 29a) was discovered at the base of Section D3, in contact with Section A2,[628] under the entry porch of the cave. This stone is 30 cm long and has a convex face on which is painted a quadruped in red ochre. The image has been described as, “the profile of a four-legged animal, without a tail, with a slender body, a long neck and a relatively small (but incomplete) head. Two rear legs and one front leg are visible, but a detached flake seems to have amputated the area where the fourth leg should have been”.[629] The image provided however, does look as if the animal has a tail that stretches out behind. The body and neck appear quite long, but the neck I would argue looks quite wide. The head looks in proportion to the body, but any facial features or species characteristics are absent.

The second rock fragment (Cat. 29b) comes from Section D5. This stratigraphic layer consists of a heap of clastic[630] stones, which formed at the cave entrance near the left-hand wall. After cleaning the layer of calcite, which completely covered its face, this fragment shows the front view of an erect bipedal form. The axis of the body is painted along the length of a small ridge, and the 18 cm high figure is thought to display, “two horns on its head (or a mask?)”.[631] However, this is such an ambiguous figure that the motif on the top of the head is highly questionable. Under the neck, the arms are spread out and the right hand holds an object hanging

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626 Broglio & Gurioli, 2003
627 Broglio *et al*. 2006
628 See Catalogue entry for details of context
629 Broglio *et al*. 2006
630 Clastic sedimentary rocks are rocks composed predominantly of broken pieces or *clasts* of older weathered and eroded rocks.
631 Broglio *et al.* 2006

downwards, interpreted as “a ritual object?”[632] On each side of the torso, at the level of the navel there are two small lateral non-symmetrical reliefs. The lower part of the body is enlarged, perhaps relating to the stomach, to which are attached short bowed legs. Due to the flaking of the stone, the image is interrupted along the length of the right side of the body.

Four other fragments (Cat. 29c,d,e), for which three images are available here show figures, or parts of figures, which are difficult to interpret. Fragment 29c, found in Square 51/61, section D3, has maximum dimensions of 20 cm x 17 cm x 12 cm and depicts an unidentifiable quadruped; 29d is from Square 107e, section D1d, with dimensions of 14 cm x 7 cm x 5 cm showing an image that is difficult to interpret. The last fragment here, 29e found in Square 117c + f, section D3a + b is 35 cm x 20 cm x 8 cm displays some form of ring motif. The majority of these images appear incomplete, as the painting seems to continue beyond the point where the rock broke.[633]

The depictions at Fumane are difficult to identify to species level, and while ambiguous, they do seem to have been part of a larger wall painting that has flaked off, rather than individual representations. Thus, the images potentially had some relationship with each other when originally painted. The practice of depicting interrelated imagery on cave walls is seen most explicitly in the cave painting from Chauvet Cave, located in southern France, which has taken centre stage in archaeological debates due to its antiquity[634] and impressively lifelike renditions.

6.12 Chauvet Cave

Discovered in 1994, Chauvet Cave, near Vallon Pont d’Arc in the Ardèche gorge, in southern France (Map 6) has provided some visually engaging and unprecedented representational imagery painted deep into the cave system (Cat. 28a-c). The earliest radiocarbon dates range from 30,230 ± 530 BP - 32,410 ± 720 BP.[635] Chauvet Cave is situated on the Ardèche, a 125 km long river in south-central

[632] Broglio *et al.* 2006
[633] Broglio *et al.* 2006
[634] The early dating of the art in Chauvet is problematic and Pettit and Bahn (2003) warn that the radiocarbon dates need better validation.
[635] The radiocarbon Gifa dates were obtained using Accelerator Mass Spectometry at the Laboratoire des sciences du climat et de l'environment (Gif-sur-Yvette, France). The results, expressed in years before present (BP) are uncalibrated so do not respond to calendar ages. The associated standard deviation is at one sigma that is 67% chance of being in the correct time span. (Clottes, 2003:33)

France, the source of which lies in the Massif Central.[636] The region is one of exceptional landscapes, where the horizontal plateaux of the Bas-Vivarais[637] contrast with the vertical gorges cut by the Ardèche.[638] The entrance to the gorges is dominated by the Pont d'Arc (Figure 6.2)**,** a unique geological phenomenon. The study of sediments deposited by the Ardèche during the Quaternary[639] indicates that the Pont d'Arc already existed in the Upper Palaeolithic, and is situated at a possible river crossing point for seasonal migrating animals.[640]

Fig 6.2 Pont d'Arc, near Chauvet Cave, Ardèche River, France

(Image: Helen Anderson, 2008)

The morphology of Chauvet cave is quite complex and the location of the decorated wall surfaces difficult to describe; therefore, Figure 6.3 shows the general plan of the cave with the names of the main 'chambers' and 'galleries' as provided by Clottes in his 2003 excavation report.

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[636] The Massif Central is an elevated region in south-central France, consisting of mountains and plateaus. The region acted as high-level summer pastures for reindeer that migrated in winter to the more low-lying pastures of winter plain. The Massif Central has produced abundant reindeer remains covering a period from 34,000- 20,000 BP. See Geist 1998

[637] The Bas-Vivarais is one of five natural regions of the Ardèche. This Karst region is formed of calcareous limestone, where the streams flow in steep-sided valleys separated by sharp crests. With a generally low altitude the Bas-Vivarais enjoys a warm, and dry, almost Mediterranean climate

[638] Clottes, 2003:16

[639] The Quaternary Period is the geologic time period spanning 1.805 +/- 0.005 million years ago to the present.

[640] Clottes, 2003:17

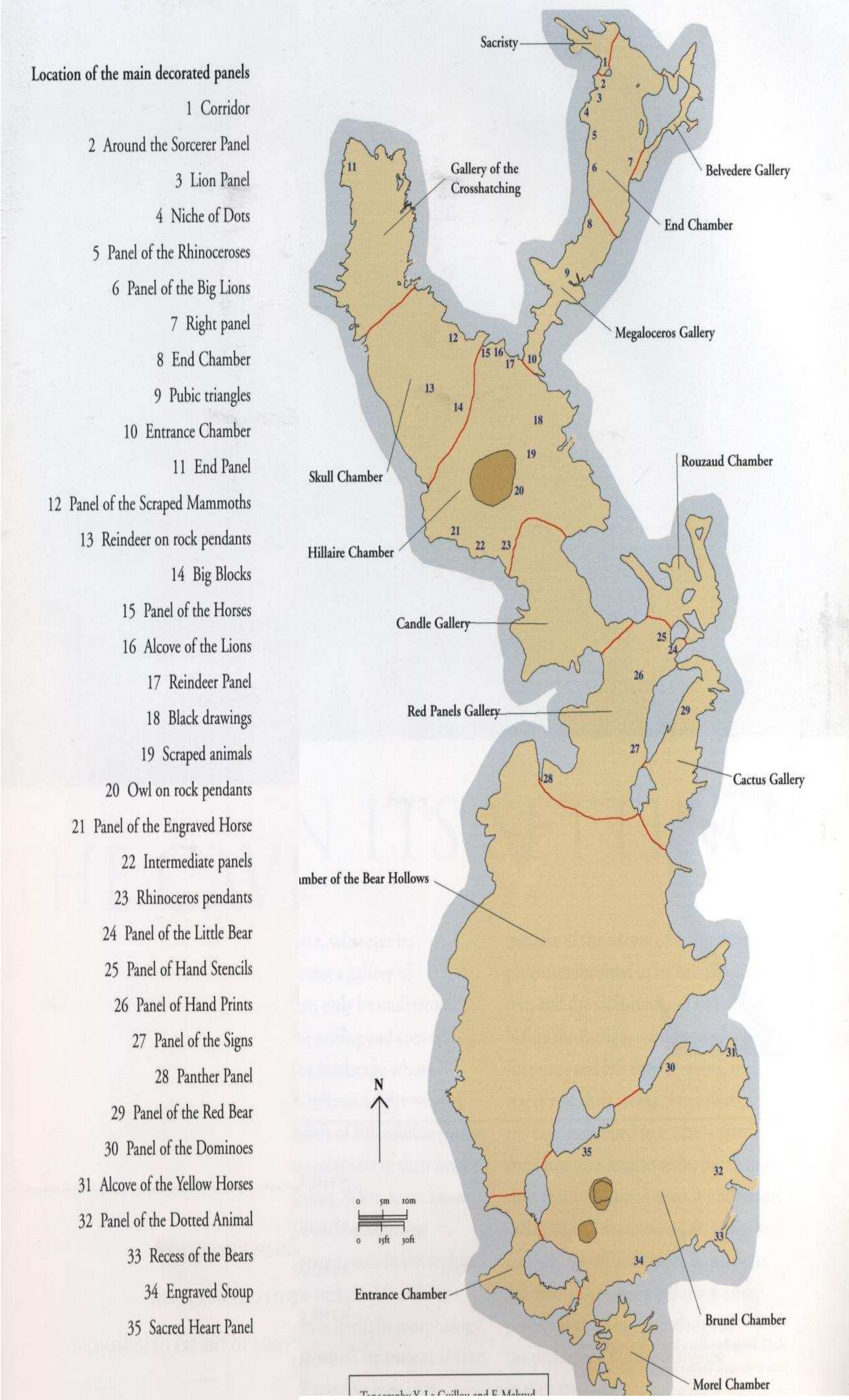

Fig 6.3 Plan of Chauvet Cave

(Image: Clottes, 2003:13)

The present day entrance is not the one known during the Aurignacian, because that entrance is now blocked by scree (an accumulation of broken rock fragments). The modern entrance is via a side passage cut through by the retreat of the cliff. This passage has been widened by the excavation team, and leads into the real cave through a ten-metre shaft.[641]

The terminology used by Clottes in his designation of wall spaces displaying painted imagery is very particular, employing terms such as ‘Panels’ to describe areas of wall space that display imagery and ‘Chambers’ and ‘Galleries’ to denote areas of the cave system that designate these zones of imagery. A’ panel’ located within a ‘gallery’ or ‘chamber’ is very biased terminology, and intrinsically conveys artistically motivated and even religious connotations. Therefore, to clarify my position, while I will use Clottes designated names of the areas in the cave for ease of location on the map; I recognise the biased nature of his terminology and thus aim to be as neutral and objective as possible in my descriptive analysis.

It is not my intention to examine the entire imagery in the cave, space constraints would not allow for such an endeavour. Instead, I will focus on those sections of the cave that have been radiocarbon dated, and provide evidence for some of the oldest representational art (Cat.28 a –c).

6.12.1 Techniques

A broad range of graphic techniques was employed in Chauvet, but in general, two types of procedure can be distinguished. One consists of removing material from the rocky support of varying degrees of hardness, the characteristic of which would dictate the choice of tool used, such as engraving, scraping or finger tracing. The other involved applying pigment to the wall either by spraying or by direct contact such as drawing with a finger, brush, charcoal or crayon.[642] Certain figures combine several of these techniques, but according to recent counts, half of the animal figures belong to the first category (removal of material), which include a variety of procedures during production.[643] This concept of preparing the required section of the wall prior to drawing is a practice rarely seen in other caves,[644] but in

[641] Clottes, 2003:17. For a full description of the morphology of Chauvet see Clottes, 2003:17-23
[642] Clottes, 2003:152
[643] Clottes, 2003:152
[644] The only other two examples are of Magdalenian date (.c18,000-10,000 BP); Altxerri cave, Guipúzcoa, northern Spain; and Covaciella, Asurias, northern Spain. (Clottes, 2003:152)

this context was undertaken to abrade the surface, which brought out a white graphic space, and eliminated bear claw marks.[645] In Chauvet, bacterial and chemical decomposition have created a soft surface layer, termed mondmilch (or 'moon milk'), comprising a soft texture and a dazzling whiteness.[646] This natural phenomenon, frequent in very humid caves, transforms the limestone into a very malleable material, easily incised with fingers,[647] but the hard rock surface is only a few millimetres below the surface.[648] The people depicting animals in this cave had noticed this property and while it has its drawbacks in that lines are blurred and imprecise, contrasts and colours can be manipulated with little effort. By smearing charcoal on ochre clay, the mixture produces a palette of sepias or browns, and if applied to the white mondmilch, it yields shades of grey.[649]

The pigments used in Chauvet are black charcoal and red ochre, which would have demanded the required preparation requiring the right texture appropriate for the surface. The ochre would have needed to be ground down to make a powder and on occasion mixed with a binder.[650] Sometimes the pigment was applied with fingers, whole hands or on the panel in the Alcove of the Yellow Horses (not described here), the imprint of plant fibres remain visible and animal hairs that are sticky with coloured paste lie close by.[651]

Analysis of the charcoal on the Panel of the Horses and in the Megaloceros Gallery reveals that charcoal was used like a crayon, with sketches being retouched with the finger to improve the outline and fill in any gaps.[652] By mixing the charcoal with clay on the surface of the limestone (known as stumping), it gave the impression of volume, through the numerous shades of greys, browns or sepias.[653] As studies proceed, analysis will determine the composition of the charcoal; solely of vegetal origin, or if the artists occasionally resorted to burnt bone (possibly reduced to powder beforehand).[654] Further research will determine if pigment and clay were

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[645] Clottes, 2003:154. Bears are thought to have used Chauvet cave during the same period that humans were paintings on the walls. See Bocherens *et al.* 2006
[646] Clottes, 2003:112
[647] Finger flutings made in the moonmilk surface can be seen in Koonalda Cave, Nullarbor Plain in Australia, dating to 20,000 BP.
[648] Clottes, 2003:112
[649] Clottes, 2003:112
[650] Clottes, 2003:157
[651] Clottes, 2003:157
[652] Clottes, 2003:157
[653] Clottes, 2003:157
[654] Clottes, 2003:157

mixed directly on the wall (as initial observations record) or if there was a previous stage of preparation.[655]

The morphology of the cave walls were also frequently exploited in the depictions of animals. Niches and recesses were used in helping to position figures, edges represented ground lines, and fissures and irregularities in the rocks often were integrated into depictions, becoming natural back lines or horns, suggesting body shape and turning drawings into 3-dimensional images.[656] The incorporation of the rock face in the depictions is visually very effective and this practice, while used in other caves, in Chauvet contributes to "conveying reality".[657]

6.12.2 'The Bison Panel'

The first section under discussion here is the so-called 'Bison Panel' (Cat. 28a), located in the End Chamber of the cave. A sample taken directly from the central bison (of three depicted) gave a radiocarbon date of 30,340±570 BP.[658] The entrance to the End Chamber is about 5m wide and is marked by a major drop in floor level, where a succession of irregular terraces have formed, some of which exhibit enormous hollows created by bears.[659] The End Chamber comprises three main parts, where ceiling heights range from 5 and 6 metres to 12 metres in height.

The Bison Panel consists of an enormous descending rock 3 - 4 metres (9¾ - 13 feet) wide, which develops perpendicular to the left wall, and is very visible upon entering the End Chamber.[660] The vast panel is covered in bear claw marks, as well as areas of corrosion that predate the drawings, and all the depictions are made in black charcoal. The panel comprises three large bison and the cervico-dorsal[661] line of a mammal, allegedly "engraved at arm's length",[662] although an explanation of this deduction is not offered. Two bison are facing in one direction (towards the left wall of the End Chamber), positioned above a single bison facing in the opposite direction. Among various other lines and scrapings, three horse heads are detectable,

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655 Clottes, 2003:157
656 Clottes, 2003:157
657 Clottes, 2003:158
658 Gifa 95128 - Clottes, 2003:33
659 Clottes, 2003:128. The existence of bear hollows and the presence of cave bear bones show that the cave was often used as a shelter by these animals. A cave bear skull was intentionally moved and placed on a rock in the Skull Chamber; another was marked with black lines. Not far from the entrance, two *humeri* may possibly have been stuck into the floor.
660 Clottes, 2003:144
661 Outline depicting neck and back
662 Clottes, 2003:144

as well as a large feline facing left; a fossil (unidentified) present in the wall was used as the eye for one of the horses.[663] Clottes suggests that these depictions were created prior to the Bison, although no dating or technical information is provided to support this theory and so the basis for the supposition is unclear.

The location of the Bison panel occurs to the right of the left wall of the End Chamber, known as the Big Panel. This is one of the most iconic panels in Chauvet because of its depictions of animals, almost procession-like, facing for the most part, in the same direction, and portrayed as if moving over the recess in the wall.[664]

Between the Bison Panel and Big Panel sits the so-called Sorcerer pendant,[665] a protrusion of rock that descends vertically to end in a point 1.2 metres from the floor. The panel has four faces, one is marked with red colouring, and one showing the so-called Sorcerer, comprising the forequarters of a bison on top of, what has been interpreted as, human legs.[666] What is striking is that the animals depicted on the Bison Panel, the Sorcerer pendant and Big Panel all face in the same direction, as if moving in unison.

Careful examination indicates that the chamber was not subject to frequent visits. A fire was made in front of the so-called Sorcerer pendant, and perfectly preserved fragments of charcoal are scattered all over the floor; a heap of charcoal can be seen in a small recess of the Big Panel.[667] If many people had followed each other into the End Chamber, it is highly unlikely the remains would have survived intact in the way they do.

6.12.3 'Panel of the Horses'

The second radiocarbon dated panel relates to images of two confronted rhinoceroses (Cat 28b), located on the Panel of the Horses in the Hillaire Chamber, dating to 30,790±600 BP -32,410±720 BP.[668] The Hillaire Chamber measures about 30 metres in diameter (100 feet) with a ceiling height of up to 17 metres. Three

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[663] Clottes, 2003:144
[664] This wall has been the subject of intense discussion and in the context of a neural approach has been analysed particularly skilfully by Onians (2005).
[665] The Sorcerer pendant is so-called because the image depicted is the forequarters of a bison on top of what has been interpreted as human legs, and thus perceived as a composite creature, half-bison for the top of the body and half-human for its general stance and bottom of the body.(Clottes, 2003:142)
[666] Clottes, 2003:140-142
[667] Clottes, 2003:148
[668] Radiocarbon date taken from confronted rhinoceroses (left) = 30,940±610 (Gifa 95126); confronted rhinoceroses (right) =32,410±720 and 30,790±600 BP (Gifa 95132 and 95133 respectively)

chambers and galleries converge here, the Candle Gallery, the Skull Chamber and the Megaloceros Gallery. Humans left some trace of their visits here, especially near the entrance, such as wood charcoal, a block brought to serve as a step and others piled up further on.[669] The Horse Sector is located more than 190 metres from the present entrance and is situated within the field of vision of any visitor moving towards the back of the cave, whether towards the End Chamber or the Gallery of the Crosshatching.

The Panel of the Horses consist of twenty animals grouped on a surface area of about four square metres (about 43 square feet) most of them facing left in the direction of the nearby Skull Chamber.[670] This section has been the subject of some in-depth analysis and the exceptional state of preservation has made it possible to reconstruct the chronology of events in creating this area of imagery (Figure 6.4).

The two confronted rhinoceros were created during the third phase of construction of this panel of images, and are situated in the lower part of the panel at an average of 60 cm (24 inches) from the present floor.[671]

The image depicts two rhinoceroses facing each other, an ambiguous scene, as it is unclear whether the rhinoceroses are two males confronting each other or the prelude to a pairing between male and female; both types of behaviour exist in present-day rhinoceroses.[672] Clottes' describes this pair of rhinoceroses, thus[673]

"In this duo, the left rhinoceros has a grey-sepia middle stripe, obtained by rubbing with fingers and mixing the surface clay of the virgin rock with the black line of the head of a pre-existing figure, that of a rhinoceros in profile – other surviving parts of it include the curved extremity of the long nasal horn, the back, the jaw and the chest. The animals' thigh and belly, drawn with a finger, are barely visible".[674]

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669 Clottes, 2003:88
670 Clottes, 2003:111
671 Fritz and Tosello, 2000
672 Clottes, 2003:114
673 In 1998, Jean Clottes headed the research team that appraised Chauvet Cave
674 Clottes, 2003:114

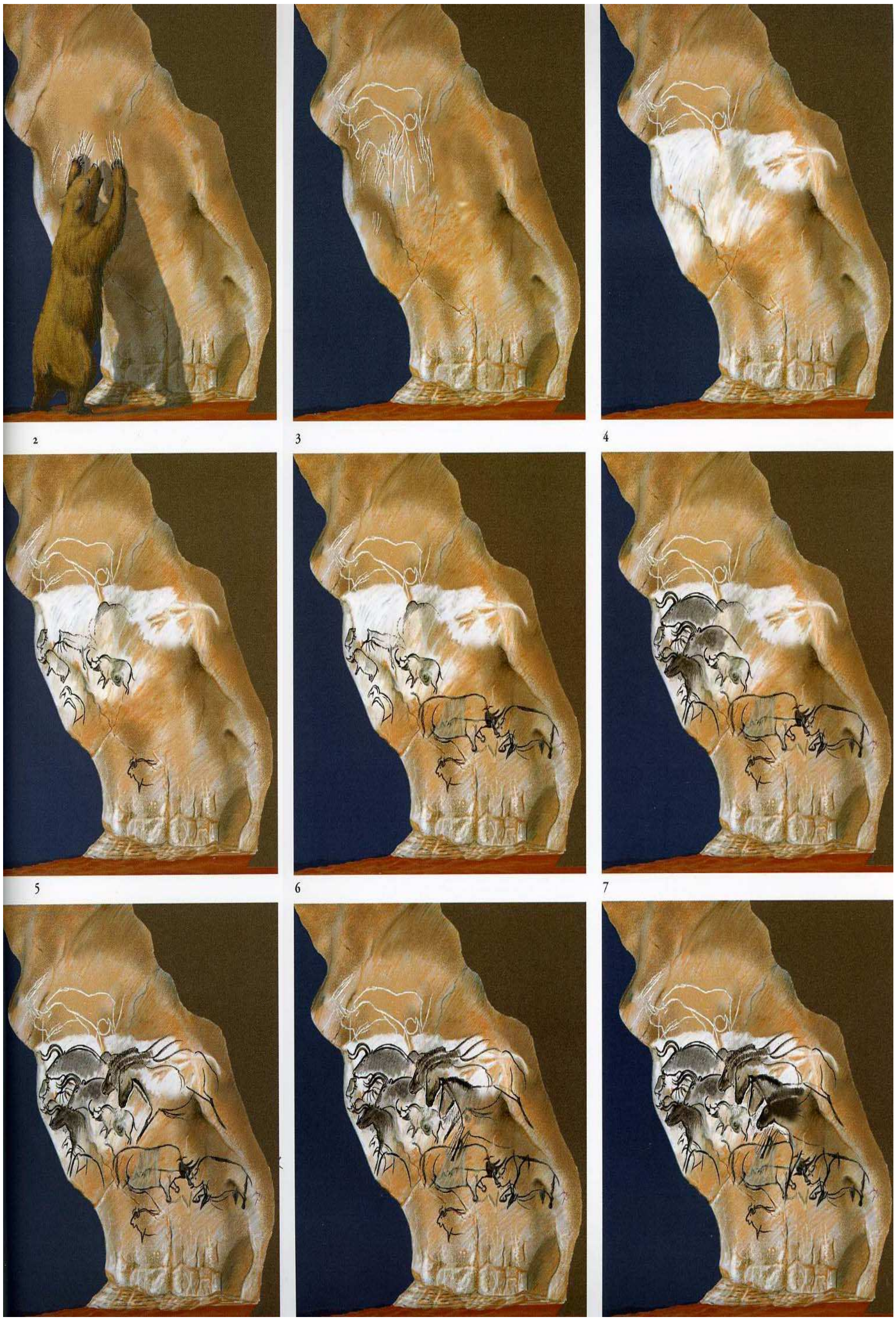

Fig 6.4 Panel of the Horses; reconstruction of a possible sequence

(Image: Clottes, 2003:116. Ill.111)

The rhinoceros on the left is positioned on a portion of wall that is flat, while the hindquarters and limbs of the rhinoceros on the right are drawn on what is termed a "cradle-shaped"[675] section of wall. Essentially, the back section of the rhinoceros is situated in the same place as a cavity in the wall and so depending on one's viewpoint the hollow in the cave wall has the effect of distorting the view of the animal. The least distorted view is obtained by sitting at the foot of the panel, which is the suggested position of the artist.[676] The right hand rhinoceros is almost identical to the left except that it is a much clearer depiction, and does not show any blurring of lines in the same way as the animal on the left. Clottes suggests that this was an "evident wish"[677] on the part of the artist to make the left-hand rhinoceros disappear, and may be interpreted as an initial sketch for the right-hand image.[678] Alternatively, he suggests that the scene may have been conceived only after depicting the initial rhinoceros and thus, the composition was modified to incorporate another into the drawing.[679] Whatever the motivation, and clearly it is precarious to assume an "evident wish" on behalf of the makers of these images, the depictions assume accurate and realistic renditions.

As mentioned previously, the chronology of the creation of the paintings on this wall has been analysed carefully. It is likely, in comparison to nearby panels, that before any human intervention occurred a fine film of yellow clay, probably scored by bear claw marks, overlay the original limestone surface of the wall.[680] The next phase of this panel is the vigorous scraping of the wall, eliminating initial traces of engravings and claw marks. The third phase corresponds to the production of the fighting rhinoceroses in the lower part of the panel.[681] The panel's fourth chronological stage corresponds to the drawing of the aurochs in the upper left corner. The three heads display clear similarities in orientation, size and graphic conventions; the flowing, curving horns projecting forwards are a good example of this. Analysis of the superimpositions suggests the central aurochs was the last to be drawn. The four horses mark the last important phase on this panel.[682]

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[675] Clottes, 2003:114
[676] Clottes, 2003:114
[677] Clottes, 2003:114
[678] Clottes, 2003:114
[679] Clottes, 2003:114
[680] Clottes, 2003:112
[681] See Fritz and Tosello, 2000
[682] See Fritz and Tosello, 2000

6.12.4 'Megaloceros Gallery'

The final image discussed in the context of Chauvet cave is the drawing of the Megaloceros[683] (Cat. 28c) located in the Megaloceros Gallery. This section of the cave leads on from the Hillaire Chamber to the End Chamber, and the image has been radiocarbon dated to 31,350 ± 620 BP.[684]

The Megaloceros Panel is one of two decorated panels that face each other at the entrance to this gallery. The Megaloceros is on the right and on the left the forequarters and the cervico-dorsal line of two mammoths. This gallery is the only one in the cave where human traces on the floor are preserved enough to be directly linked to the art on the walls. Alignments of hearths, lit and maintained, blackened or dirtied the walls in different parts of the corridor, and were probably used for producing charcoal as much as for illumination and warmth. Large pieces of wood charcoal, located in alcoves along the walls directly below the paintings seem to act as places of storage.[685]

In the central section of the right hand panel is the charcoal drawing of the Megaloceros. About 50 cm (24 inches) in length it faces right. Some of the lines of the silhouette are doubled and relatively broad, though they become finer at the ends. Anatomically this example conforms to other known Megaloceros images; small head, supple neck, short tail and legs. The Megaloceros disappeared more than 10,000 years ago and had impressive antlers, although they are not represented in this drawing, only some short outgrowths emanate from the top of the head.[686] A crescent-shaped line surrounds the groin region while the body has a broad sweeping line running across it from the dorsal hump, which is suggested as an attempt to depict the different colour of the hide.[687] Such a delineation is also found on a Megaloceros drawing at the back of the gallery as well as those in Cougnac[688] which

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683 The deer of the genus *Megaloceros* - literally 'Great Horn' were found throughout Eurasia from the late Pliocene to the Late Pleistocene, and were important herbivores during the Ice Ages. Most members of the genus were extremely large animals that favoured meadows or open woodlands, with most species averaging slightly below 2 meters at the withers. Lister *et al*. 2005

684 Gifa 96063

685 Clottes, 2003:118

686 Clottes, 2003:122

687 Clottes, 2003:123

688 The caves of Cougnac are located on the commune of Payrignac, close to Gourdon, in the department of the Lot (the Midi-Pyrenees, France).

are believed to date to the Solutrean[689] or Early Magdalenian.[690] The colour was made by crushing the pigment and mixing with the limestone, which forms flat tints of grey.[691]

Above the rump of the Megaloceros an incomplete rhinoceros, limited to the horns, forehead and cervico-dorsal line facing upwards on the left of the panel is visible. The outline was drawn as a continuous line with a crumbly piece of charcoal of unequal hardness. Some small charcoal particles can be seen on both sides of the line, inside which are fine vertical striations.[692]

Figurative art is seen as a crucial threshold in the cognitive evolution of modern humans; the next section will focus on representational art in sculptural form from four sites in southern Germany, located in close proximity to each other, dating to between 36,000 – 32,000 BP, and the site of Galgenberg in Austria, dating to around 30,000 BP.

6.13 SWABIAN JURA

The Swabian Jura[693] of southwestern Germany has been a major centre of Palaeolithic research.[694] Particularly renowned are the Aurignacian sites in the Ach and Lone Valleys, namely Vogelherd, Höhlenstein-Stadel, Geissenklösterle, and

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[689] An archaeological culture defined by its masterful bifacial stoneworking, rich bone and antler industry, and abundance of representational objects. It spans the period of 22,000 – 18,000 years ago and is restricted for the most part to Europe west of the Rhône. (White, 2003:230)

[690] An archaeological culture defined by its bifacial stoneworking, rich bone and antler industry, and abundance of representational objects, and decorated caves. It spans the period from 18,000 – 11,000 years ago and covers most of Western and Central Europe. Approximately 80% of all Palaeolithic representations are attributable to the Magdalenian. (White, 2003:228)

[691] Clottes, 2003:123

[692] Clottes, 2003:125

[693] The Swabian Jura is a plateau in the German state of Baden-Württemberg in southwest Germany. The most prominent topographic feature is the low Jurassic-aged, limestone mountains and plateaus referred to in German as the Schwäbische Alb. The Upper Danube Valley is located along the southern and eastern edge of the Swabian Jura, and the Neckar Valley helps to define the western border of the region.

[694] The Swabian Jura has played an important role in the debate regarding the appearance and spread of anatomically modern humans and culturally modern behaviour in Europe. Two models developed at Tübingen University in connection with the sites of the Swabian Jura are the Danube Corridor and *Kulturpumpe* Hypotheses. (Conard, 2002a,b; Conard and Floss, 2000; Conard *et al.* 1999). The Danube Corridor hypothesis argues that the early presence of modern humans in the region can be accounted for by a relatively fast migration along the Danube into Central Europe. The early appearance of Upper Palaeolithic innovations in technology and symbolic communication form the basis of the *Kulturpumpe* hypotheses, wherein climatic change on the northern margin of the Alps, independent cultural evolution and competition between archaic and modern hominins are viewed as the driving forces for cultural innovation in the Upper Danube region. These factors combine to establish the Aurignacian by around 40,000 BP.

Höhle Fels (Map 6). These sites have yielded some of the oldest accepted figurative art and musical instruments in the world.[695] Vogelherd and Höhlenstein-Stadel are located in the Lone Valley, and Höhle Fels and Geissenklösterle are located in the Ach Valley. One of the most iconic pieces of figurative art from this region, dating to the Aurignacian comes from Höhlenstein-Stadel.

6.13.1 Höhlenstein-Stadel

The site of Höhlenstein-Stadel is located in the Lone valley in Baden-Wurttemberg, southwest Germany, about halfway between Vogelherd and Bockstein.[696] Only one piece of figurative art has been found in this cave, but has received much attention for its interpretation as a hybrid figure; half-man, and half-lion (Cat.30). Originally found in more than 200 pieces,[697] the figure has been carefully reconstructed. Located in deposits at the back of the cave, radiocarbon dates from the layer in which the fragments were found date to between 31,750+1150/-650 – 32,270+270/-260 BP.[698]

Carved in mammoth ivory, the figure stands 28.1 cm high, 5.6 cm wide and 5.9 cm deep, and is the largest of the artefacts from the four sites discussed here. The reconstructed figure displays the head of a lion, the facial features of which clearly exhibit eyes, a nose and a squarely defined jaw line, with incised mouth. Small ears sit alert on top of the head, and in the anatomically correct position for a lion. The torso is elongated and smooth with no morphological features evident. Only one of the legs is complete, but they both appear quite muscular; however, they are not designed for the figurine to stand upright independently. The arms hang down by the sides, showing muscular shoulders, with seven parallel, horizontal lines incised on the upper left arm.

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[695] Conard and Floss, 2000; Hahn, 1986; Hahn and Münzel, 1995; Müller-Beck *et al*. 2001

[696] Actually, Höhlenstein-Stadel consists of three prehistoric cave sites in a group: the Stadel proper, the Kleine Scheuer and the Bärenhöhle

[697] The figurine was found in nearly 200 fragments in 1939, but due to the outbreak of World War II was stored in Ulmer Museum and forgotten until 1969, when Professor Joachim Hahn from the University of Tübingen succeeded in fitting the fragments together.

[698] Radiocarbon dates from 20m, spit 6 = H 3800-3025 – mixed bone sample, 31,750+1150/-650; ETH-2877 – reindeer ulna and wolf astagalus, 32,000±550; KIA 13077 – reindeer radius, 32,270+270/-260. See Conard and Bolus, 2003:336

The processes involved in manufacture were “complex and arduous”,[699] given the limitations of technology available. Splitting and wedging of desiccated mammoth ivory was followed by scraping, gouging, incising, grinding and polishing.[700] The polishing was achieved with powdered hematite,[701] a very effective metallic abrasive, still used today by contemporary carvers.[702]

While other figures have been found in the Swabian Jura that deemed to possess lion/human attributes, the figurine from Höhlenstein-Stadel is by far the largest, standing at 28.1 cm tall, in comparison with two others from Vogelherd (Cat.31j) and Höhle Fels (Cat.32a) standing 6.9 cm and 2.5 cm respectively (described below). In fact, all other figurines found across the four cave sites in this area do not nearly match the dimensions of the Höhlenstein-Stadel *Löwenmensch*. No other figurines have been found from the cave at Höhlenstein-Stadel.

6.13.2 Vogelherd

The Aurignacian site with the most abundant finds excavated to date in southern Germany is Vogelherd cave,[703] located approximately 1 km northwest of Stetten in the Lone Valley (Map 6). The cave is positioned 18 m above the valley floor, is up to 7 metres wide, 3.8 metres in height and 39 metres long.[704] Located in an inconspicuous limestone spur of the Upper Jurassic, it has three entrances, south, southwest and north-oriented.[705] Two distinct ecosystems flank the Lone Valley, the drier plateau to the north, probably a steppic [706] landscape during much of the valley’s hominin occupation, and the expansive flatlands with marshes to the south stretching to the Danube. Herds of grazing animals would have moved seasonally in and out of these ranges, using the natural routes dissecting the Lone Valley.[707]

Riek (1934) defined nine cultural horizons within the cave, although more recently some adjustments have been made to Riek’s original names for the cultural

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[699] White, 2003:71. See White 2007b for an account of the complexities of sculpting mammoth ivory with Aurignacian tools.
[700] White, 1996:29-38
[701] Hematite is the mineral form Iron Oxide. Many Aurignacian beads show traces of hematite and much experimental work undertaken by Randall White at NYU has demonstrated the use of hematite in ivory working. See White 2007b
[702] White, 2003:71.
[703] Initially excavated by Gustave Riek (1934)
[704] See Catalogue
[705] Dept. of Prehistory, Tubingen University website - www.urgeschichte.uni-tuebingen.de
[706] In physical geography, a steppe landscape is a grassland plain without trees
[707] Niven, 2007:363

layers, which he based on stone-tool typology.[708] The figurines have come from the Aurignacian deposits, layers IV and V, recently dated to between 31,000-36,000 BP.[709]

The most important Aurignacian finds from Vogelherd are more than a dozen figurative pieces carved from mammoth ivory. I have included 12 items in the catalogue for which images were available, five of the pieces are new and at the time of writing were unpublished. (Cat. 31a-l) The figurines examined here comprise one horse, four examples of mammoths, two bovid, four felines and one human form. In addition, three further unidentified figurines and a fragment of a mammoth figurine were recovered form the same stratigraphic layers; no images are available.

The horse, (Cat. 31a) carved from mammoth ivory, is 4.8 cm long, 2.5 cm high and 0.7 cm in width. It exhibits a remarkably high, arched and quite thick set neck with a long downward-looking face; although difficult to detect, it may show evidence of a forelock. The ears, mouth and nostrils and eyes are visible. The body of the horse is well-defined showing a curvilinear back and low belly. Due to the flaking of external ivory layers, the width has been reduced and the legs have broken off just above the knee. Engraved cross marks and angular signs are visible on the back of the neck, as well as on the back and the left chest.[710] The figurine shows evidence of a small tail, which may have broken off. Using only Aurignacian tools and techniques[711], it took the late German archaeologist Joachim Hahn twenty-seven hours to reproduce experimentally the small ivory horse from Vogelherd.[712]

Of the four mammoth sculptures, only two are complete (Cat.31b). The first described here is a sculpture in the round of an adult mammoth, found in stratigraphic layer V. The trunk was broken from the sculpture while it was still in use and before it became interred, and the legs are missing. Nevertheless, the

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[708] The Roman-numeral designations are retained today and are as follows: I ¼ Neolithic; II and III ¼ Magdalenian; IV and V =Aurignacian; VI-IX = Middle Palaeolithic. The Aurignacian horizons yielded the majority of cultural material, making up more than 90% of finds overall.

[709] For a list of the 26 AMS and radiocarbon dates for Vogelherd, see Catalogue entry 30, from Conard, Niven and Stuart, 2003

[710] Taken from the official Alb-Donau-Kreis website, the district of district in Baden-Württemberg, where the four cave sites are located. http://www.ice-age-art.de

[711] The Aurignacian tool-kit is characterised by the presence of many burins, a sharp transverse chisel-like working edge, traditionally regarded as an engraving tool and used to work bone, ivory, antler, soft stone and wood. In addition long blades, carinated (steep-ended) scrapers and split-based bone points were also typical. See White, 2002, 2004, 2007b for more information on Aurignacian stone tool working techniques.

[712] White, 2003:71. Although White has cited this experimental archaeology undertaken by Hahn, I can find no literary reference to it.

miniature has been interpreted as a male mammoth because of the elaborate carving of its bulky head.[713] The fore and hind extremities are perforated. These perforations are not polished, so it may be that the figure was not worn as a pendant, but instead was sewn to a garment. The mammoth shows numerous notched cross marks along the top of the back, the underbelly, and a series of five vertical cross marks from the centre of the top of the back to the underbelly. In addition, the figurine is described as exhibiting lines of dots and notches,[714] although this is not evident from the image. In profile, the torso appears very realistically rendered.

The bas-relief[715] of a mammoth (Cat 31c) is a unique find, since the carving is made of bone rather than ivory, probably the pelvic bone of a large animal.[716] It is 6.9 cm in length, 3.6 cm wide and stands 2.9 cm high. Its surface is roughly sketched with the bas-relief of a mammoth, which displays three diagonal notches.[717] The perforation broke while the pendant was still in use. On the reverse side, there are red/yellow coloured traces of ochre (ferric oxide).[718]

The figurine (Cat. 31d) showing only the tail end and hind legs of an animal is interpreted as representing a mammoth due to the physiognomy of the back and the legs; the remains were broken off while it was still use.[719] The reconstruction of this sculpture gives an original length of approx. 10 cm and a height of approx. 7.5 cm in which case it would be the largest sculpture from the Vogelherd.[720] Rows of notches and cross-marks are engraved on the oval soles of the sculpture's feet, and horizontal lines are incised on the legs. Like most other figurines, this one is carved from mammoth ivory; however, it does not appear to have been fashioned with as much care as other figurines, which might have something to do with its original size.

Of the two bovids, only the right half of the body of this first sculpture (Cat. 31e) remains, and the entire head is missing. It is 7.2 cm in length, 5.25 cm tall and

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713 Taken from the official Alb-Donau-Kreis website, the district of district in Baden-Württemberg, where the four cave sites are located. http://www.ice-age-art.de

714 http://www.ice-age-art.de

715 A bas-relief, French for "low relief", is where the overall depth of a projecting image is shallow. The background is very compressed or completely flat, as on most coins, on which all images are in low-relief.

716 Taken from the official Alb-Donau-Kreis website, the district of district in Baden-Württemberg, where the four cave sites are located. http://www.ice-age-art.de

717 http://www.ice-age-art.de

718 http://www.ice-age-art.de

719 http://www.ice-age-art.de

720 http://www.ice-age-art.de

1.35 cm wide. The sculpture is remarkably rotund, but in profile is quite distinctively bison-like, notably due to the hump on the shoulders, and the apparent mane depicted by cross marks from its shoulders down its back. The surface is scored with numerous dots and lines, with four diagonal lines incised on its belly. The legs finish at the knee joint. The other bovid (Cat.31f), is more difficult to identify as the shape is not so distinctive, and the head is missing. This bovid is 5.8 cm long, 2.4 cm in height and 1.4 cm wide. Gustav Riek, the initial excavator of Vogelherd cave, believed that the sculpture represented a bear, due to the low withers and the strong haunches, but it was later suggested that it might represent a rhinoceros.[721] In comparison to other figurines from Vogelherd (and other cave sites in southwest Germany discussed here), this animal shows only a small number of dots and line notches.

The sculpture of the lion (Cat. 31g) is 8.8 cm in length, 5.25 cm high and 1.35 cm wide. It shows a solid, heavy body with strong muscular shoulders. The head is bowed and the ears lay back, displaying some behavioural pose, although difficult to identify. The body and head are covered with numerous rows of dots, and on the side of the torso, a crosshatch pattern made up of four diagonal lines in one direction and six on the other is apparent. Either the legs were not part of the original carving, or have since broken off. Just after its discovery, traces of red ochre (ferric oxide) were observed on the surface.[722]

Unfortunately, only the head is preserved from a once complete and accurately finished cave lion carving, (Cat. 31h) found after the excavation in a spoil heap. It is 2.5 cm in length, 1.8 cm high and 0.6 cm wide. The nose and mouth are well-defined and accurately depicted, while the eyes are only depicted as slits, they appear much more defined due to the way the cheek bone has been carved. The ears are precisely positioned and faithfully depicted. There appears to be horizontal notches incised from the nose up to the top of the head, as well as cross hatch lines that start from just underneath the ear and moves round the neck which may indicate fur or a mane. The head bears a similarity with the lion-man of Höhlenstein-Stadel, discussed above.

The ivory figure thought to be a snow leopard (Cat. 31i), found in layer IV, is 6.8 cm long, 2.4 cm high and 1.45 cm wide. Its species classification is based on its

[721] http://www.ice-age-art.de
[722] http://www.ice-age-art.de

slender shape.[723] The head slightly bowed and the ears lay back on the head, giving the impression of stalking or lying in wait.[724] Part of the back haunches is missing on one side and the legs either have broken off or were not carved, they finish just above the knee joint. There is no evidence of a tail. Numerous dots mark the torso, perhaps indicating the patterning of the spotted fur or perhaps signifying the woolliness of a winter coat; incised lines are evident down the back of the neck.

The only sculpture considered human in form (Cat. 31j) is also carved from mammoth ivory. Found in layer IV, 20 meters deep inside this tunnel-shaped cave, it is 6.9 cm high, 1.9 cm wide and 1.05 cm thick. Although interpreted as a human representation, this figurine is difficult to identify securely. The head stands out distinctly from the body, although there is no evidence of any facial or cranial features. The torso is long and cylindrical shaped. The legs terminate just below the thighs, and the body is covered with indented rows of dots.

Two recent finds from Vogelherd in 2007 include a mammoth and a lion (Cat. 31k and 31l) and come from the same sediment layer as the previous finds. The mammoth (Cat. 31k) is 3.7 cm long and weights 7.5 grams, and is the first to be recovered in a complete state.[725] This figurine is slim and exhibits a lean and refined form, yet the powerful legs and tall shoulders give the mammoth a robust and forceful appearance. Uniquely it has a pointed tail, and the trunk is intact and hangs down to the mammoth's feet. The top of the head displays six short horizontal incisions, and the soles of the mammoth's feet show a criss-cross pattern.

The lion is 5.6 cm long and has a long torso with an outstretched neck. The head is small and round and the only facial characteristics that seem apparent are holes depicting the eyes; the head appears incomplete and crudely carved. The legs are completely missing and this may be due to damage before or after deposition. A small stump demonstrates evidence of a tail. One of the most striking visual qualities of this figurine are about 30 finely incised crosses along its spine,[726] starting at the top of the head and terminating at the tail.

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[723] Weighing up to 165 lbs, the snow leopard falls into the gray area in between 'big cats' and 'small cats', and is slender in comparison to the cave lion (which would have been 5-10% bigger than a modern lion).
[724] http://www.ice-age-art.de
[725] Conard *et al*. 2007
[726] Conard *et al*. 2007

6.13.3 Höhle Fels

Höhle Fels is located in the Ach Valley near the town of Schelklingen, 20 km southwest of Ulm (Map 6), and about 2 km from Geissenklösterle cave. The first excavation took place in 1870, and intermittently excavated since 1958.[727] In 1999, the excavation team[728] reached the Aurignacian deposits, which, in addition to numerous lithics and organic artefacts, yielded three mammoth ivory figurines. Comprising an upright figure, a water bird and a horse's head (Cat 32a-c), they date to more than 30,000 BP.[729] The horse head dates to between 29,560 +240/-230 and 31,140 +250/-240,[730] the two other figurines from stratigraphic layer IV date to 31,100 ±600 and 33,090 +260/-250 BP.[731]

The upright figurine (Cat.32a) stands 2.55 cm high and was recovered from layer AH IV in 2002.[732] The figurine is difficult to identify, it may be human, animal or a hybrid figure. The legs of the figurine are missing, but the remaining fragment includes the head, torso, arm, shoulder and buttocks of an upright figure. The shoulder is angular and the posture rigid. A subtly carved ear is visible high on the head and the nose and mouth are visible. The arm is short and tapered with an incised vertical line. It is interpreted as having a mixture of felid and human traits, "showing marked similarities to the *Löwenmensch* from Höhlenstein-Stadel",[733] although only 1/11th of its size. The similarities to the figurine from Höhlenstein-Stadel are based on the form and posturing of the head, the shape of the cranium is similar, and despite the Höhle Fels facial features being undefined, they appear similar to

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[727] Excavated in 1870 by Prof. Oskar Fraas and J. Hartmann .Excavated from 1958-60 by Gustave Riek. From 1987-96 excavations took place under Prof. Joachim Hahn and since 1997 under Prof. N.J.Conard and H-P Uerpmann.

[728] Excavations led by Prof. Nicholas Conard, University of Tübingen.

[729] Conard and Bolus, 2003

[730] Archaeological horizon IId (base) provides two AMS radiocarbon dates of 29,560 +240/-230 (KIA 8964 - mammoth/rhino rib) and 30,010 ±220 (KIA 8965 - reindeer antler). IIe provided a date of 30,640 ±190 (KIA 16040 - horse pelvis). The underlying layer IIIa provided 5 AMS radiocarbon dates of (KIA 16038 - Reindeer femur) 29,840±10; (KIA 18877 - Pinus charcoal) 30,170 +250/-240; (OxA-4601 – Bone) 30,550 ±550; (KIA 18876 - Pinus charcoal) 31,010 +600/-560; (KIA 16039 - Small ungulate femur) 31,140 +250/-240. see Conard, 2003

[731] Archaeological horizon IV has yielded three AMS radiocarbon dates; (OxA-4600 - Reindeer metapodial) 31,100 ±600; (KIA 18879 - Unidentified charcoal) 31,160 +1,530/-1280; (KIA 16036 - Horse femur Tool (retoucher)) 33,090 +260/-250. See Conard, 2003.

[732] Archaeological horizon IV is the richest of the Aurignacian deposits at Höhle Fels and, although only 9m² have been excavated, the deposit has provided a rich assemblage of lithic and organic artefacts, including diverse forms of finely carved ivory ornaments and much ivory working debris. Conard, 2003:830

[733] Conard, 2003:830

Höhlenstein-Stadel. In addition, the way in which the head is slightly raised is similar to the much taller *Löwenmensch*.

The body of the waterbird was discovered in 2001 from layer AH IV near the bottom of the Aurignacian sequence. In 2002, the head and neck of the figurine were recovered from the same stratigraphic layer, confirming suspicions that the sculpture depicted an aquatic bird. This is a small figurine; its dimensions are 4.7 cm in length, 1.3 cm high and 0.9 cm wide. The neck appears extended and the wings are sculpted close to the body, appearing to be in flight or perhaps diving. The eyes are visible and the beak is more pointed than those commonly seen on ducks. The legs are short with no indications of feet and the tail extends below the legs and depicted as a "finely carved flat splint".[734] Incised lines on the back of the bird are thought to represent feathers. The representation exhibits "a morphology similar to that of a diver, cormorant or duck".[735]

In 1999, the largest part of a carving of an animal's head was discovered (Cat. 32c), in the transition between archaeological horizons (AH) IId and IIe, fitting to a piece of the animal's cheek from the underlying layer AH IIIa.[736] It strongly resembles the head of a horse, although it could possibly represent a bear or another animal. The head is 3.6 cm in length, 0.7 cm wide and 1.5 cm high. The sides of the face and underside of the jaw show fine, regular crosshatching and parallel lines. The mouth, nostrils and eyes of the animal are clearly engraved,[737] and the physiognomy of the cranium is very equine in appearance. The remainder of the figurine may be missing or potentially the head was the only fragment produced. If there are further remains of this figurine, the finished product would have been one of the larger objects produced in this area.

In addition, and at the time of writing, a new and previously unseen find was unearthed in the Aurignacian deposits. Termed the 'Venus' of Höhle Fels (Cat. 32d) this is the oldest definitive human figurine found to date, and is a significant find in adding a new piece to the jigsaw of artistic development. It is termed a Venus figurine because of its similarities with a number of female figurines found from Gravettian contexts, exhibiting common attributes of large buttocks, stomachs and

[734] Conard, 2003:830
[735] Conard, 2003:830
[736] Conard, 2003:830
[737] Conard, 2003:830

pendulous breasts; however, this Aurignacian example pre-dates the Gravettian figurines by around 7,000 years.[738] Carved from mammoth ivory, it is 5.97 cm in height, has a width of 3.46 cm, 3.13 cm thick and weighs 33.3 g, and dimensionally is similar to the other figurines found at Höhle Fels. Found in six pieces, only the left arm and shoulder are missing.[739]

One of the most noticeable features of the figurine is the absence of a head; instead, an off-centre ring is located above the broad shoulders. This loop preserves evidence of polish, indicating that it was probably suspended.[740] Because of the significance of this figurine, a comprehensive visual analysis has been carried out by Conard (2009), detailed below.

"The shape of the preserved part of the figurine is asymmetrical, with the right shoulder elevated above the left side of the figurine. Beneath the shoulders, which are roughly as thick as they are wide, large breasts project forwards. The figurine has two short arms with two carefully carved hands resting on the upper part of the stomach below the breasts. Each hand has precisely carved fingers, with five clearly visible on the left hand and four on the right hand. The navel is visible and correctly placed anatomically. The Venus has a short, squat form with a waist slightly narrower than the broad shoulders and wide hips. Multiple, deeply incised horizontal lines cover the abdomen from the area below the breasts to the pubic triangle. Several of these horizontal lines extend to the back of the figurine… Microscopic images show that these incisions were created by repeatedly cutting along the same lines with sharp stone tools. Such deep cuts into ivory are only possible with the application of significant force.

The legs of the Venus are short, pointed and asymmetrical, with the left leg noticeably shorter than the right leg. The buttocks and genitals are depicted in more detail. The split between the two halves of the buttocks is deep and continues without interruption to the front of the figurine, where the vulva with pronounced labia majora is visible between the open legs… In addition to the many carefully depicted anatomical features, the surface of the Venus preserves numerous lines and markings.

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[738] For further information about Venus figurines see Bisson & Bolduce, 1984; Delporte 1993; Duhard, 1993; Dobres, 1996; McDermott, 1996; Iakovleva, 2000; Mussi, Cinq-Mars and Bolduc, 2000; Soffer *et al*. 2000; White, 2006a

[739] Conard, 2009:248

[740] Conard, 2009:250

The top of the Venus shows a series of U-shaped incisions on the roughly flat surface formed by the top of the breasts and the shoulders. The shoulders preserve multiple markings, with the short, deep, vertically incised lines along the back side of the figurine being the most pronounced. The breasts and arms also have multiple short, deeply incised lines that add to the three dimensionality of the sculpture. These markings are reminiscent of the various incisions found on other examples of ivory figurines from the Swabian Aurignacian, but, as is true of the others, this depiction is unique. The Venus shows no signs of having been covered with pigments.[741]

The significance of this figurine is its antiquity in comparison to other known figurines of this type and, its first definitive representation of a human form. In addition, it bears the same incised markings as those on the animal figurines, generating greater ambiguity to their meaning, yet a reassuring familiarity.

6.13.4 Geissenklösterle

The fourth and final site in this cluster is the Geissenklösterle cave, which lies in the Ach Valley at Blaubeuren, about 2 km northeast of Höhle Fels (Map 6). The west-oriented cave is part of a limestone rock formation, which rises 60 metres above the valley floor.[742] Geissenklösterle has an extensive sequence of settlement phases, providing a stratigraphic sequence from at least 43,000 up to 10,000 BP.[743] The deepest layer exposed so far contains finds from the Middle Palaeolithic (layer IV), stratified above this is a Lower Aurignacian (layer III) layer, AMS radiocarbon dated to c.38,400 BP and c. 40,200 BP by thermoluminescence (TL),[744] followed by the Upper Aurignacian (layer II), which was AMS radiocarbon dated to c. 33,500 BP and with TL to c. 37,000 BP.[745] The Aurignacian can be subdivided into a lower and an upper Aurignacian. The 33 radiocarbon dates from archaeological materials from

741 Conard, 2009:250
742 Münzel, 2001:448
743 Fieldwork was carried out in Geissenklösterle cave by Joachim Hahn and others between 1973 and 1991. It has been continued since 2000 by Nicholas Conard and colleagues. These excavations uncovered a long stratigraphy comprising layers from the Middle Palaeolithic to the Mesolithic, as well as other Holocene material, thus providing the best studied sequence in the Swabian Jura. While the Middle Palaeolithic yielded only few tools, the Gravettian and Aurignacian layers were especially rich in finds.
744 Richter *et al.* 2000
745 Richter *et al.* 2000

the Aurignacian of Geissenklösterle fall almost entirely between 30,000 – 40,000 BP.[746]

The Upper Aurignacian layer (AH II) has produced four carved ivory figurines depicting a human form carved in relief, a mammoth, a bear and a bison (Cat. 33a-d). Five ^{14}C-AMS[747] dates for AH II range from 32,300±700 – 36,800±1000 BP.[748]

The figurine of the purported standing bear (Cat. 33a) is 5 cm in length, 2.1 cm tall and 1.9 cm wide. Found in layer AH IIa and reconstructed from 11 pieces of ivory, its posture shows the animal's arms outstretched and its head raised, tilting upwards with the mouth slightly opened; the body is covered with incised lines and notches.[749]

The mammoth sculpture (Cat.33b) measures 6.7 cm long, 3.8 cm high and 2.9 cm wide, and was pieced together and reconstructed from more than 40 single fragments, found in layer IIA.[750] Unfortunately, the lower parts of the head and trunk are missing, and no facial features are distinguishable. The shape of the body is thought clearly to indicate a mammoth, however, in comparison to the mammoth figurines located at Vogelherd, this is less accurately depicted and therefore less easy to identify. The surface of the body is incised with horizontal lines covering the length of the body, between which are obliquely oriented lines, almost like a herringbone pattern.

Discovered in stratum AH IIb, (an ashy bone layer near a possible hearth), the anthropomorphic relief (Cat.33c) measures 3.8 cm long, 1.4 cm tall and 0.45 cm wide. Unfortunately, the surface of this small flat segment of mammoth ivory is in very poor condition, but is regarded as depicting the bas-relief of a human being with raised arms. The image shows an obverse bipedal upright form, with limbs raised, the right of which show five horizontal lines. All facial features are missing, including any physiological characteristics that may determine if this depiction is human or animal. The torso is quite long and the thighs and legs appear reasonably muscular and robust. There appears to be a protrusion hanging down between the

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[746] Conard & Bolus, 2003:60
[747] Radiocarbon – Accelerator Mass Spectometry dating
[748] OxA-5160 = 33,700±1100 (Hare, IIa); OxA-5707 = 33,200±500 (Horse, IIa); OxA-4594 = 36,800±1000 (Reindeer, IIa); OxA-5708 = 32,300±700 (Mammoth, IIb); OxA-5162, 33,200±1100 (indeterminate bone, IIb). Richter *et al.* 2000:75
[749] http://www.ice-age-art.de
[750] Ivory grows in layers, so fossil ivory very often disintegrates into single flakes.

legs, but this may be a consequence of flaking of the material, rather than an intentional feature. There are a series of notches (possibly 8 on each side) located down each side of the ivory segment. On the reverse are four vertical rows of dots, the first row comprises 12 dots, the second, 10 dots, and the last 2 rows also 12 dots. The significance of this is unknown. Traces of manganese and red ochre (ferric oxide) were found on the back.[751]

The Bison (Cat.33d) is 2.55 cm in length, 1.45 cm high, and 0.6cm wide, and was also located in layer IIb; it is carved in small bas-relief.[752] The shape of the body and the high shoulders is suggestive of a bison. The facial features are not very clear, but analysis proposes there are faint hints of a beard and a horn.[753] There are six vertical incised lines along the torso and small incisions run along the length of the neck and backbone to the back of the haunches.

6.13.5 Personal Ornamentation from Swabian Jura

In conjunction with the figurative art, the lower Aurignacian deposits yielded a diverse array of personal ornamentation. At Geissenklösterle, in AH III, ten pendants in total were unearthed; elongated and tear-shaped pieces made of ivory, as well as perforated fox canines.[754] Most pieces had been found near the fireplace or in the fireplace itself. In AH II nearly a dozen double perforated ivory beads, as well as some perforated fish vertebrae coloured red.[755] At Höhle Fels objects of personal ornamentation, among them double perforated ivory beads similar to those from Geissenklösterle were also found.[756] At Vogelherd, examples of personal body adornment came in the form of incised pendants made from the incisors of red deer and brown bear (one each),[757] and more than two dozen ivory rods, pencil-thin and sometimes split lengthwise, might have been intended for bead production, as has been inferred for identical pieces at several French and Belgian Palaeolithic sites.[758]

Until the recent find of the so-called 'Venus' from Höhle Fels, the final object in this chapter was regarded as the earliest definitive representation of a

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[751] http://www.ice-age-art.de
[752] See Glossary of terms
[753] http://www.ice-age-art.de
[754] Bolus, 2003:155
[755] Bolus, 2003:155
[756] Bolus, 2003:159
[757] Niven, 2007:364
[758] Niven, 2007:365. See White 1989 and Otte, 1997 for information of French and Belgian Palaeolithic sites.

human and the first in a series of representations classified as ‘Venus figurines’.[759] The discovery at Höhle Fels has now situated the ‘Venus’ of Galgenberg within an early sequence of human representations.

6.14 Galgenberg

The figurine from Galgenberg, (Cat. 34) near Stratzing (Lower Austria) (Map 6), is one of the oldest well-dated and identifiable human sculptures made by modern humans in Europe. Discovered during excavations in 1988, the figurine is 7.2 cm high, and because of its posture has been dubbed the ‘Dancing Venus of Galgenberg’.[760] Charcoal samples from the same stratigraphic layer in which the figurine was found have produced radiocarbon dates of 29,200 – 31,900 BP.[761] Originally found broken in eight pieces near a campfire on an open-air habitation site, it is made from blackish green amphibolite.[762] The material is local to the site and evidence of waste material provides proof that the figurine was made in the same area.[763]

The figurine depicts a standing human form; the thickened limbs are conjoined at the base, supporting the statue. There are no features on the cranium or face, and the absence of any overt sexual organs makes this an ambiguous figure in comparison to the Höhle Fels figurine. However, the pose has been interpreted as causing, “the left breast to be depicted almost in profile, while the right is in very low relief because of the stone’s flatness”.[764]

The right arm rests on the upper right thigh, but the left arm is ambiguous in its positioning, although it is interpreted as if, “folded back at the elbow”.[765] However, the pose can also be read as if holding something aloft. The body weight appears to be supported predominantly on the left leg, while the right is slightly bent

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[759] Venus figurines is an umbrella term for a number of statuettes of women sharing common attributes (many depicted with enlarged buttocks, breast and belly) from the Aurignacian or Gravettian period of the Upper Palaeolithic, found from Western Europe to Siberia.

[760] The figurine is also known as ‘Fanny, after the famous Viennese dancer Fanny Elssler. One of the most famous images of Elssler shows her in a pose that is directly comparable to the figurine.

[761] Bahn, 1989:345

[762] A class of metamorphic rock with one of the amphibole minerals as the dominant constituent. Most of the amphibolites are dark green to black crystalline rocks that occur as extensive layers widely distributed in mountain belts and deeply eroded shield areas of the continental crust. Amphibolite is the main country rock that has been intruded by the large granite masses found in most mountain ranges, with small and large masses of amphibolite present also as inclusions in granites

[763] http://www.aeiou.at/aeiou.encyclop.v/v132616.htm

[764] Bahn, 1989:345

[765] Bahn, 1989:345

at the knee. Flattish in appearance, rather than sculpted in the round, this may due to the characteristics of the stone used, which often occurs in slabs.[766] There are no defined morphological attributes such as facial features, fingers, hair, or sexual organs. Although termed the 'Dancing Venus', it does not conform to other Venus figurines that exhibit clear and oversized sexual organs, such as Höhle Fels. In addition, while its appellation is historically and socially contingent, in reality the pose is difficult to ascertain.

6.15 Summary

This chapter has presented the data from Europe as a continuation of the artistic activity witnessed first in MSA Africa. As modern humans enter and colonise Europe two features are notable; materiality becomes more diverse in ornamentation production, and the quantities of produced objects increase. In addition, evidence shows that depictions of mostly animals and some humans, in both painted and sculptural forms, were an early phenomenon.

The first evidence we have of representational paintings occurs at c. 35,000-32,000 BP in Fumane Cave, northern Italy; c. 32,000 BP in Chauvet Cave, southern France and c. 28,000 -26,000 in Apollo 11 Cave in Namibia, Africa. While the differences in artistic styles vary enormously between Chauvet and Fumane, the two sites are about 800 km apart, a week's walk, and therefore any similarities could feasibly be attributed to cultural diffusion. However, Apollo 11 Cave is the anomaly in the theory, and raises some challenging questions concerning how representational art emerges, and what mechanisms trigger its occurrence across vast distances, broadly speaking contemporaneously.

The early Upper Palaeolithic in Europe was constructed of different groups of modern humans who adapted to different environments, developing new ways of living, economic systems, and probably different social organisations and cultures. Despite the relatively modest amount of discoveries from early Upper Palaeolithic Europe[767], there is considerable variability, but also substantial consistency with earlier artistic production elsewhere.

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[766] Bahn, 1989:345

[767] Approximately 80% of all Palaeolithic representations are attributed to the Magdalenian (18,000 – 11,000 BP)

The following chapter will address these similarities, differences and correspondences in a more statistical format. Chapter 7 analyses all the data from Africa and Europe with the purpose of observing the spatial and chronological distribution of artistic activity, examining the patterns that emerge.

The final two chapters, 8 and 9, focus on the types of mental processes involved in the production of the objects presented in this and the preceding two chapters. The neurological concepts and theories outlined in Chapter 3 will act as the foundation for understanding the possible manner in which art emerges and develops. Neural and visual plasticity, mirror neurons and Environmental Enrichment studies are discussed in light of the emergence of art in Africa and its enrichment and complexity as modern humans' journey into Europe. In this way, the modern human brain and modern human behaviour are inextricably linked, allowing for tentative working models that associate environment, experience and culture.

CHAPTER 7

Descriptive Statistics

7.1 INTRODUCTION

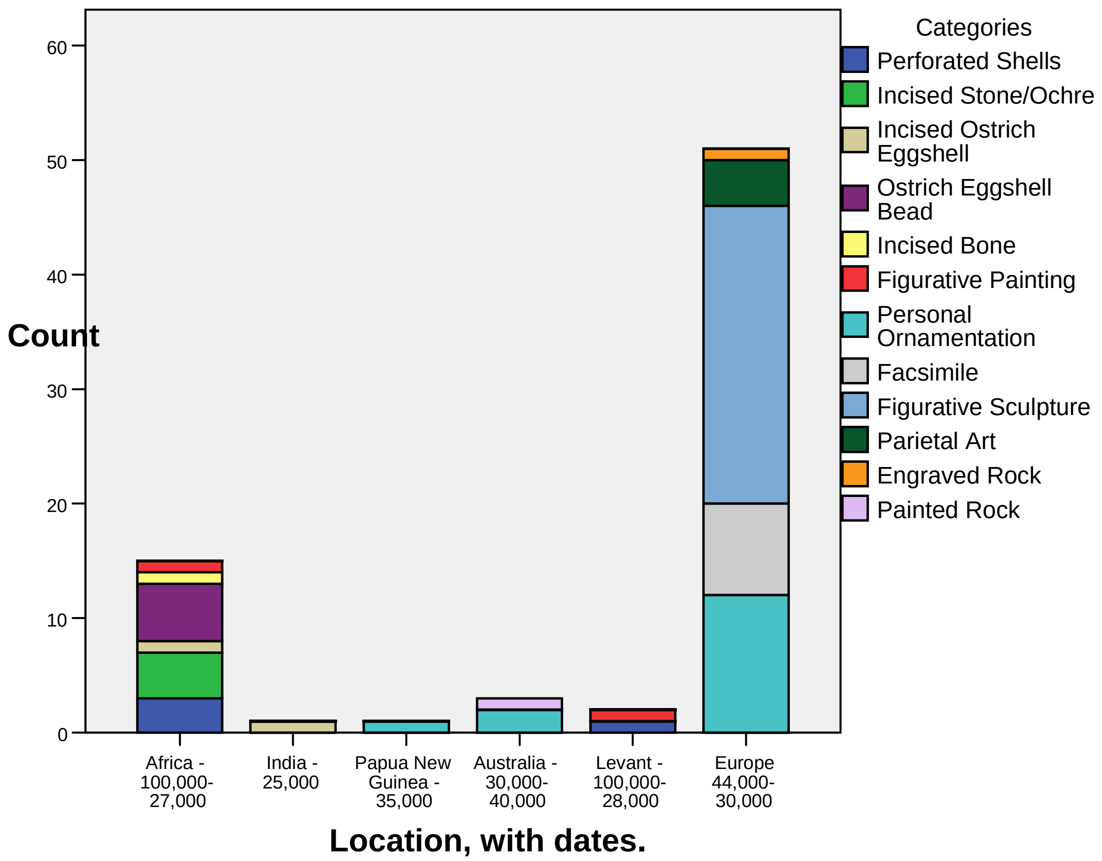
A statistical analysis allows an alternative method of summarising and describing the collection of data taken from Chapters 4, 5 and 6. This type of descriptive statistics can be useful to communicate patterns in the data from which inferences may be drawn about processes. The data used in the tables below relate to location, object type and materials, occurring in Africa, Australia, Papua New Guinea, India the Levant and Europe, dating within the period 100,000 – 28,000 BP.

For ease of analysis, rather than being site specific, the data have been categorised into geographical countries/continents, as divided in the preceding chapters. The object types have been classified in two ways; Graph 7.1 shows a larger set of categories, while Graph 7.2 presents a more condensed version of categories. This is discussed in more detail below. The data are also divided into materials, to indicate the types of resources being used in art production across time and space

Admittedly, the data set available is very limited in some cases, but the aim is not to create subjective chronological or spatial boundaries in the data set; rather it is to examine the distribution of the different categories of the sample. Nevertheless, any observations made recognise the biased nature of the archaeological record and its sampling, notably in relation to the preservation of some materials and not others (perishable materials such as wood, skin etc that likely demonstrated imitative making behaviours). This has clear consequences for the representativeness of the data set and any commentary made.

7.2 Categories

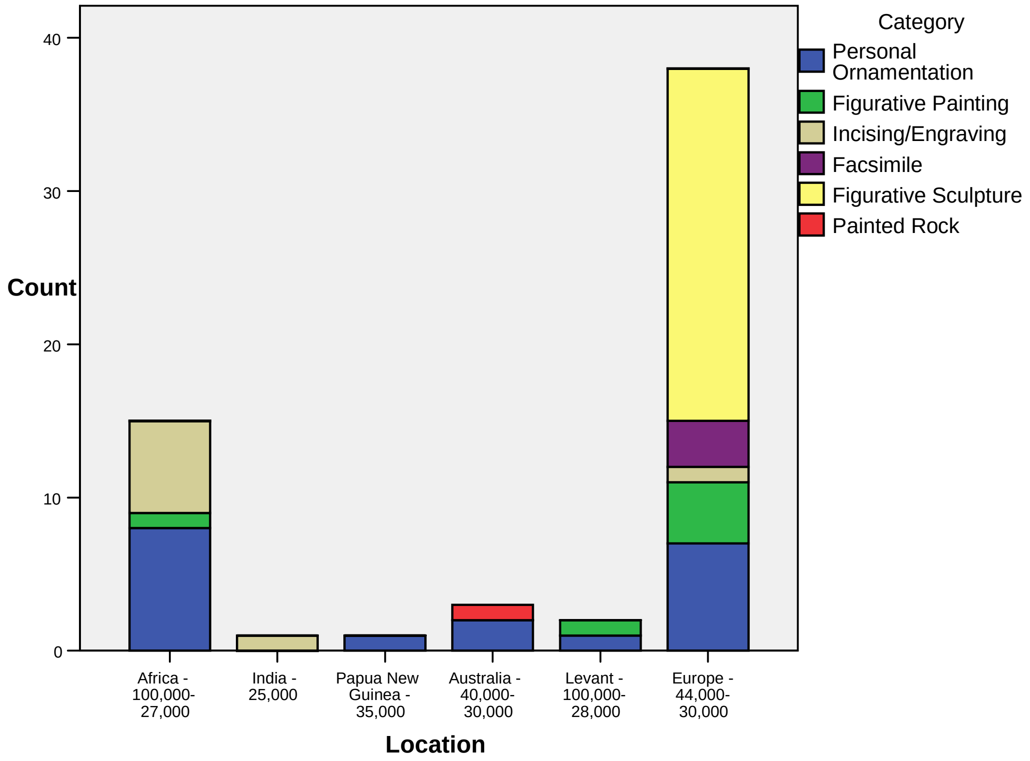
Graph 7.1 shows the different locations and dates with the different categories of objects found in each area. The categories in this graph show a certain degree of specificity; for example in Africa, there are six categories of objects which include figurative painting, incised bone, ostrich eggshell beads, incised ostrich eggshell, incised stone/ochre and perforated shells. In Europe, there are also six categories, classified as engraved rock, parietal art, figurative sculpture, facsimile and personal ornamentation.



Graph 7.1 Geographical locations showing the types of categories of objects found.

The categorisation of objects, however, is not always easy to resolve. For example, objects such as perforated shells found in Africa can also be classified as personal ornamentation. The reason it has not been categorised in this way in Graph 7.1 is that it is arguable whether a perforated shell dating to 100,000 BP is evidence of personal ornamentation; although, it is probably likely that ostrich eggshell beads were used as items of personal ornamentation. In addition, the figurative painting at Apollo 11 cave in Africa certainly has parallels with parietal art in Europe, and so potentially can be considered as belonging to the same category. Moreover, the practice of incising or engraving natural materials, such as ostrich eggshell, rocks, stone or ochre is an activity that is witnessed both in Africa and Europe.

Graph 7.2 presents the re-classification of categories to include perforated shells and ostrich eggshell beads into the category of personal ornamentation, figurative painting into parietal art and incised ochre and eggshell into the more encompassing category of incising and engraving.



Graph 7.2 Geographical locations showing re-classification of categories of objects.

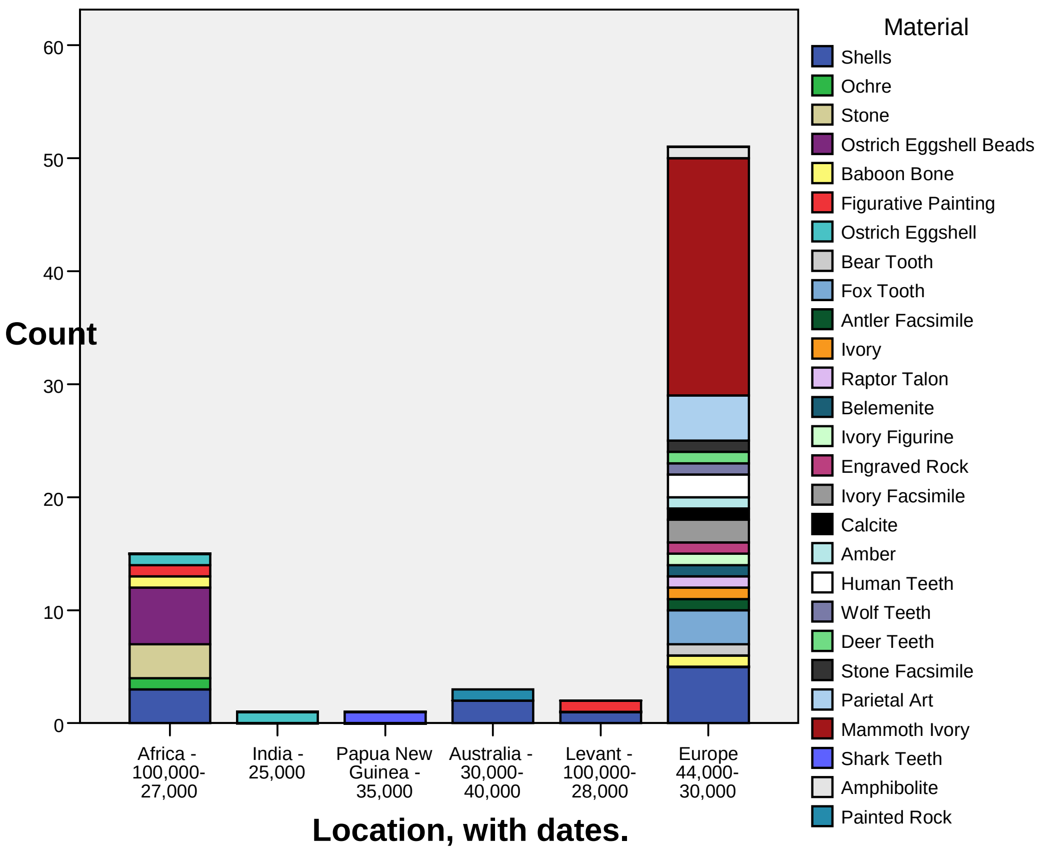
Reclassifying the objects, as shown in Graph 7.2 demonstrates that while Africa presents fewer categories of objects, there are now 3, those same three categories continue as a practice into Europe. In effect there is parity with Europe in terms of a continuation of practice in personal ornamentation, figurative painting and the incising or engraving of objects; the emergence of figurative sculpture in Europe is a significant development. In addition, the appearance of facsimiles is a new class of object.

The variety of objects, however they are classified and divided, demonstrates that the types of objects found in both Africa and Europe are very similar in production and/or execution. In addition, the evidence from India, Papua New Guinea, Australia and the Levant all demonstrate a continuation of practices that first emerge in Africa. It seems from the graph that the artistic activities that emerge in Africa are expanded upon and acquire more cultural complexity in Europe, yet the charts do not seem to reveal an 'explosion' a 'revolution' or a big bang', as has been advocated. Interestingly, the 'revolution' may instead lie in the exploitation of resources (see Graph 7.3). However, such a reading would assume continuity in preservation which is not viable. For example, if materials such as bone, antler, or wood were used and deposited within exposed or acidic contexts then their preservation is unlikely and therefore distorts the perspective.

7.3 Materials

If we examine the types of materials that are being used within these categories, it is very clear that the difference between Africa and Europe is significant. In Africa, seven different types of materials are exploited and used in artistic production, while in Europe it amounts to twenty different materials. What can we infer from this increase? It is unlikely that the increase in materials in Europe is simply based on an increased availability of resources to exploit, and that in comparison; the environments in Africa are limited in available resources. Many sites in Africa, particularly South Africa, reveal a range of settled landscapes demonstrating a variety of resources being skilfully exploited, so accessibility does not seem a feasible explanation.

If the increase in the types of materials used is not based on availability, then there must have been some other reason for a preference for these materials. As discussed in Chapter 3, one of the findings of an exposure to an Enriched Environment is that the number of excitatory synapses per neuron in the visual cortex increases, and the number of inhibitory neurons are decreased, anticipating that neurons in the cortex of enriched animals may be more reactive to visual stimulation. If this prediction is correct then we may speculate that the diversity in materials seen in Upper Palaeolithic Europe may be the result of an alteration in neural networks of the visual cortex becoming more responsive. Indeed, the types of materials chosen possess particular visual qualities, such as amber, calcite and Belemnite that may have contributed to their selection. Nonetheless, once again caution must be applied regarding the biases of archaeological preservation and sampling at work.



Graph 7.3 Geographical locations showing the variety of materials used in each area.

If, as has been suggested, that the visual responsiveness of modern humans alters in some way in Upper Palaeolithic Europe, then how does this become transmitted from one generation to another? Processes of learning and transmission have been in operation for millennia. We only have to examine the ways in which stone tool technology was past down from one generation to another to understand how cultural processes operate. However, in the post 40,000 BP world it appears that there are regional differences in the kinds of art-like activity and the intensity of art-like production. While a novel environment may go some way to explaining its neurological influence in the production of material forms, it would not explain why, when *Homo sapiens* moved into novel environments within Africa and expanded across Anatolia, southeast and eastern Europe, we do not witness the same diversity in choice of materials. Therefore, an explanation based on visual resources alone is insufficient, and must also involve cultural factors at work. It is by Upper

Palaeolithic Europe that Gamble[768] identifies a new and different kind of social networking that begins to appear, discernible in the way that materials and artefacts were exchanged over long distances for the first time. It should also be emphasised that figural representation that begins to appear post-40,000 BP are qualitatively different from the incised patterns on stone and ochre and the perforated marine shells of earlier periods. In short, post-40,000 BP modern humans are producing and encountering different methods of representation, supported by new kinds of social networking and cultural modes of transmission.

7.4 Summary

In attempting to make simple statistical observations, a significant problem is in how to categorise some objects. Despite the problems with classification, we can observe that there are particular elements of production, such as the collection and perforation of natural objects that emerge in Africa and continue as a practice wherever modern-type humans settle, demonstrating some continuity in practices, if not techniques used.

Most interesting is the diversity of materials that are exploited as humans move out of Africa. For example, in terms of the shell evidence, this develops from the same genus of shells being collected at four sites in MSA Africa to the selection of more diverse shells, such as the periwinkle at Isturitz, a shell known for its variability in colour and reticulated appearance, while at Üçağızlı, visually colourful and eye-catching shells were selected. Similarly incised stone and ochre emerges in MSA Africa exhibiting crosshatch patterns, developing into such objects as the Lebombo bone, the incised eggshell at Diepkloof and Patne and crosshatch designs present on the figurative art in the Swabian Jura. The modification or manipulation of ostrich eggshells is first seen in Africa, but by the time modern-type humans reach Europe, the selection of other natural materials exhibits increasing diversity comprising pierced animal teeth, a pierced raptor talon, amber, calcite, ivory, and even human teeth. Comprising distinctive visual qualities, the implications involved in acquisition makes their use highly intriguing.

The category of facsimiles is also intriguing. It involves the complex modification of one material to mimic (in some cases) an unrelated object; yet the

[768] Gamble 2002; Gamble *et al.* 2004

processes involved in mimicking natural objects may have its roots in MSA Africa, where modern humans may have perforated shells to mimic naturally occurring perforated shells. Representational art is manifest in the form of parietal and mobiliary, the significance of which is that painting on rock occurs in Africa and Europe broadly contemporaneously. While is it clear that cultural objects acquire increasingly complexity in production and reception, that complexity is most evident in the materials sourced for their production. While we may speculate about the choices made in the types of materials used in artistic production, what seems less tentative is that the practices of perforating natural objects and making abstract and/ore representative markings on stone is a practice that has been transmitted and communicated across time and space. Based on the data set here, the early systems of art-like activities seen in MSA Africa develop into similar but more diverse activities by Upper Palaeolithic Europe, presumably by systems of cultural transmission and learning, probably enhanced or facilitated by neural processes.

The following two chapters discuss in more detail what neural processes might have been involved in the production of the objects discussed in Chapters 4, 5 and 6. It will examine how we might account for the type of materials selected for the production of objects presented here, and the possible rationale for their symbolic significance.

CHAPTER 8

Discussion – Middle Stone Age Africa

8.1 INTRODUCTION

Having reviewed the data on artistic activity from 100,000 – 28,000 BP in Africa, India, Papua New Guinea, Australia and Europe, this chronological and geographical pursuit was to observe in what forms and contexts artistic activity emerged and developed. The endeavour in this and the following chapter is to consider what mental processes might have led to the making of these objects, taking into consideration principles such as those discussed in Chapter 3: neural and especially visual plasticity, mirror neurons and Environmental Enrichment studies.

The importance of neural plasticity is that it means that our brains are liable to change according to biological principles. Throughout our lifetime the brain has the capacity to alter its system of networks in response to all our experiences, and especially in response to our environment, and the motor and sensory experiences through which we relate to it. An interesting experiment in adult neural plasticity has been carried out by Steven Mithen on himself in terms of intensive exposure to music.[769] In this experiment, Mithen undertook a brain scan before and after singing lessons of a year's duration. The results demonstrated how the activity in neural circuitry had been modified in conjunction with the learning of this cultural skill. In this trial , the authors show how the modern human brain can respond structurally to intense (cultural) exposure. In this paper, the brain is described in terms of it being a 'cultural artefact', that is, it can be both unintentionally influenced by the cultural context in which it has evolved and that it can be deliberately manipulated and moulded by cultural context. This paper is important in the context of this thesis not only because it demonstrates the process of neural plasticity, but additionally that the brain does not simply provide us with the capacity for culture, but it shows the impact of cultural behaviour on the brain. Understanding the brain as a 'cultural artefact', that it shapes and is shaped by culture is an important factor.

Plasticity of the visual system and visual experiences are likely the most important for the understanding of the earliest art. The visual cortex on which we

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[769] Mithen and Parsons, 2008

rely for these experiences contains banks of cells that are genetically programmed to respond to lines of orientation and categories of objects and this response can be reinforced or modified as a result of experience. In this process the brain makes associations between objects. Cells that respond to objects that share similar properties cluster together, which helps us to understand why some objects remind us of others. With this in mind, if we know to what sort of environments (physical and cultural) people have been exposed, we have some foundations for inferring how that environment may have influenced their behaviour. This is particularly significant when thinking about the earliest art and is at the basis of this thesis. To be able to make such connections helps us to understand why art may look the way it does in certain places and at certain times. Additionally, it may support current explanatory frameworks relating to why certain artefacts, patterns, or activities may have attained symbolic significance.

Mirror neurons also help us in learning, especially in learning how to communicate, imitate, and understand the actions and emotions of others. We can reflect upon how the mirror neuron system may have promoted successful interaction between small groups of people in Middle Stone Age Africa, how it may have facilitated inter- and intra-group dynamics and the diffusion of ideas, and as demographic populations increased in Upper Palaeolithic Europe, subsequently developed into a sophisticated system of communication and imitation. Moreover, the recent direct findings of mirror neurons in humans reveal they are active in areas not only devoted to motor actions, but in areas processing vision and memory. In addition, the human mirror neuron system helps us understand the actions of not only conspecifics, but any other animals with which we share the same motor actions. This may be an important issue when we consider the role of animals in relation to personal ornamentation, as well as the first representational imagery.

Knowledge of such mental processes is important when thinking about the earliest art because it adds a new dimension in our understanding. Until now it has been assumed that finds of perforated shells and animal teeth, incised patterns on stone and ochre, ostrich eggshell beads, carved or painted depictions of animals all functioned as symbols, proving the existence of complex communicative systems,[770] as far back as 100,000 BP. Such artefacts are thought to reflect the influence of

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[770] Henshilwood 2006, 2008; Henshilwood *et al*. 2002, 2004; Henshilwood & d'Errico, 2005; Henshilwood & Marean, 2006

language and symbolic thought. There is no certain knowledge about the chronology of the development of language and symbolic thought, although modern language is believed to have existed for 50,000 – 100,000 years. The dilemma for archaeologists is to identify behaviours in the archaeological record that may indicate language abilities, and often, as Henshilwood admits archaeologists are "desperately looking for proxies [because] we don't have a great deal of theoretical background".[771] Art and symbolic thought are considered proof of linguistic abilities.

However, identifying symbolic thought in the archaeological record, especially in terms of the earliest art, is not a straightforward task and rarely well-defined. Should we consider a doodle to be symbolic, or is the stringing of a naturally perforated shell symbolic? And is symbolic thought measurable; are there degrees or levels of symbolism? Such questions are very difficult to resolve, but thinking about the problem in neurobiological terms might help. Considering why an object, pattern, or activity might acquire a symbolic significance because of the way in which the brain interacts with its external environment may inform our thinking on these issues. Moreover, we need to take into consideration the cultural processes of transmission and learning in operation that results in the emergence of artistic activity in MSA Africa and its development towards greater cultural complexity by Upper Palaeolithic Europe. Such cultural processes presumably have been in operation for a very long time, which would explain how complex sequences of technical operations, such as in the making of stone tools, have been learned and transmitted spatially and temporally.

Based on current knowledge, artistic activity appears first in the archaeological record in Middle Stone Age Africa as simple practices in the forms of perforated shells and incised stone and ochre, and by the time modern humans reach Europe in the Upper Palaeolithic (c.40,000 BP), artistic practices include more complex techniques such as 2D and 3D representational art, increased diversity in personal ornamentation and facsimiles.

Conceivably, the earliest art from Middle Stone Age Africa may be considered as an early stage in symbolic thought, where cultural artefacts and their meaning have greater resonance with the physical environment. As these first forays into artistic activity are learned and transmitted through time, and as humans become

[771] Henshilwood, 2006b

engaged with activities that are culturally and socially more complex, the brain is affected by, and affects, its cultural environment as much as the physical. Cultural traits may be inherited and/or the process of enculturation ensures that succeeding generations further contribute to the extension of cultural environments. Therefore, by Upper Palaeolithic Europe, the cultural complexity we see in the archaeological record may be a result of people responding to visual images encountered in cultural contexts, as much, if not more than the physical environment.

The symbolic significance of objects that we are focusing on here may then lie in the ways in which external environmental stimuli are stored in the visual brain and how the brain makes connections between objects, patterns, activities to make something meaningful. Moreover, the greater the knowledge of shapes and objects the brain has to manage, the more connections will be made between objects and shapes and the more multifarious the impact on culture. My aim is to consider what neural processes might be involved in the production of art objects, and how the environment (physical, social and cultural) in which they were produced may have influenced their production. The arguments made here, while framed within known biological processes, I recognise are speculative. My intention is to make my case as plausible as possible, acknowledging that at present it is unable to be made more concrete. While other scholars are more interested in identifying the earliest time and place when modern humans had the capacity for symbolic thought, my enquiry assigns more focus on why particular artefacts may have acquired symbolic status, and considers this in neurological terms.

8.2 MIDDLE STONE AGE AFRICA

Middle Stone Age Africa sees the emergence of art-like activities at around 100,000 – 75,000 BP in two very particular forms; the incisions of markings on stone and ochre of what we recognise as crosshatch patterns, and the perforation of shells. Incised patterning on ostrich eggshell occurs at around 60,000 BP and by around 40,000 BP ostrich eggshell is used to create beads. By 28,000 BP the first representational art appears, broadly contemporaneous with the emergence of representational art in Europe.

8.3 MARK-MAKING

The first data set of objects to be examined is the practice of making incised marks on stone and ochre. There are three sites in South Africa where this occurs, Wonderwerk Cave, in the northern Cape (stone), Blombos Cave, in the southern Cape, (ochre) and Klein Kliphuis, in the western Cape (ochre), dating to 100,000 BP, 77,000 BP, and between 50,000-80,000 BP respectively. It is particularly significant that the first markings made on natural materials share similarities in design across sites, more specifically all examples exhibit what we distinguish as a crosshatched pattern.

All the incised fragments were found in cave contexts. The Wonderwerk example was found in association with clusters of small rounded quartz and chalcedony pebbles, the nearest known source of which is the Kuruman River over 45 km away; the same layers at the back of the cave yielded mainly quartz crystals, known to occur more than 20 km to the northeast. The discovery of other incised stones from earlier deposits, it has been suggested, may indicate an engraving tradition extending back up to 500,000 years.[772] The Blombos ochres were located adjacent to a small hearth, in a matrix of undisturbed and consolidated mixed ash and sand. More than 39 *Nassarius kraussianus* shells, a few bone tools and an engraved bone also came from this phase. The engraved ochre from Klein Kliphuis was found in association with Howiesons Poort and post-Howiesons Poort lithic technology.

The objects are art-like in that the marks are made by humans and likely are not the result of chance movements. Indeed Henshilwood considers that the incised ochre at Blombos are not “a one-off ‘doodle’ or the idle ‘scratching’ of a bored individual”;[773] in essence, he considers there is an intentionality behind the design. An interesting trait of these designs revealed by detailed study of the *chaîne opératoire* on both the Blombos and the Klein Kliphuis ochre is the similarity in the order involved in producing the crosshatch patterning. Both examples appear to have been the result of comparable operational sequences, in that vertical and oblique lines were made first, followed by the horizontal lines. The significance of this is not simple to resolve, but may simply be the result of best practice for the outcome desired (Figures 8.1 and 8.2). However, if these cross-hatch patterns are representative of something more tangible within their framework of reference, then

[772] Beaumont & Vogel, 2006
[773] Henshilwood & d’Errico, 2005:261

the sequence in which the lines are incised may not be random. Analysis of the Klein Kliphuis fragment indicates that scoring was not a single event, and that the different groups of lines were made either with a different tool, at different times or indeed, both. Where it is possible to ascertain the sequence, the vertical lines appear to have been incised first followed by the central horizontal and the upper and lower horizontals.

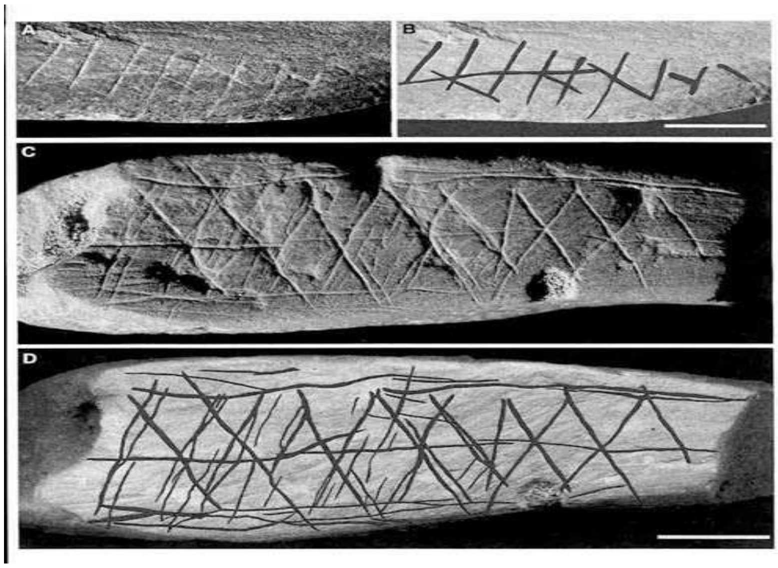

Fig. 8.1 Photos and tracings of the engraved ochres from Blombos Cave

(Image: Henshilwood, 2005:258, Fig.14.6)

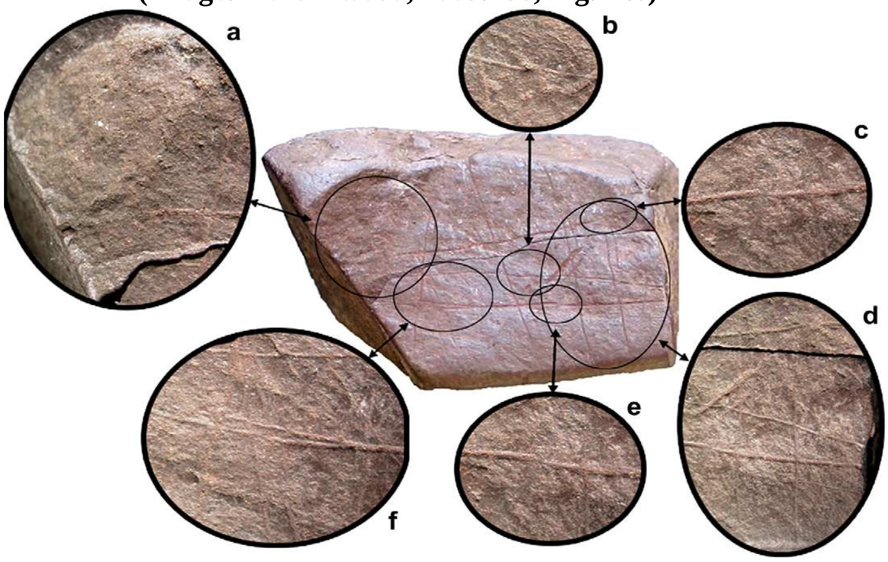

Fig. 8.2 Specific features of the scored face of Klein Kliphuis stone:

(Image: Mackay and Welz, 2008:1526, Fig.7)

Another concern relates to the issue of scale of the incised stone and ochre. The archaeological literature provides the dimensions of the stone and ochre, and in all instances they are small fragments, the smallest of which from Wonderwerk and Klein Kliphuis are only 2 cm and 2.9 cm in length respectively, with the Blombos ochre at 5.36 cm and 7.58 cm long. The fragments from Blombos and Klein Kliphuis show evidence of being ground, and Klein Kliphuis also shows evidence of a fracture that truncates the lower horizontal lines; no such observations have been made for the Wonderwerk stone. Of course, we cannot rule out that these fragments were originally larger and were reduced after incision through use wear; apart from the Klein Kliphuis stone, no such analysis has been proposed. In particular, Klein Kliphuis and Wonderwerk are very small pieces of raw material on which to incise a pattern; the selection of larger pieces would have made the process of incising an easier task. The same comparison can be made for the perforation of *Nassarius* shells that are very small to manipulate. To date no observations or considerations concerning size are explored in any depth, but close work may point towards the capacity for a particular intensity of visual acuity.[774] The fact that the perforated shells and incised ochre are, for the most part, from contexts in which hearths are located may contribute to a notion of enhanced visual perception. Perforating a shell or incising a small piece of ochre in the dim recesses of a cave or by firelight is visually demanding.[775] However, even if the manufacturing sequence was carried out in daylight, scale remains an interesting issue.

Despite the similarities in design, the differences between the materials are notable, namely between stone and ochre, which present different properties and functions. It should be noted that the properties of ochre go beyond its use as a pigment; it can be used in hafting tools and as an insect repellent. Numerous fragments of ochre are found in the MSA levels at both Blombos (8,500 pieces) and Klein Kliphuis (919 pieces). Unlike the incised stone from Wonderwerk, fragments of ochre from Blombos Cave show evidence of being rubbed or ground. This is not surprising, as ochre has to be ground to produce the pigment powder. The grinding of the surface creates natural striations. In the case of Klein Kliphuis, Figure 8.3 demonstrates the types of vertical and oblique lines that occur as a result of testing the pigment. Bearing in mind the quantity of the mineral at each site, the sight of

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[774] One's visual acuity is an indication of the clarity or clearness of one's vision. It is a measurement of how well a person sees. The word "acuity" comes from the Latin *acuitas*, which means sharpness
[775] Moreover, visual acuity is affected by the size of the pupil; optical aberrations of the eye that decrease visual acuity are at a maximum when the pupil is largest (about 8 mm), which occurs in low-light conditions.

ochre displaying incised lines of different orientation may have been common, as a result of testing pigment. We may speculate that this visual familiarity of incised marks and striations on ochre made from testing the pigment potentially contributed to the marking of the objects at Blombos and Klein Kliphuis. The sight of incised ochre was a familiar one and may have been reproduced or enhanced on the ochre at Blombos and/or Klein Kliphuis.

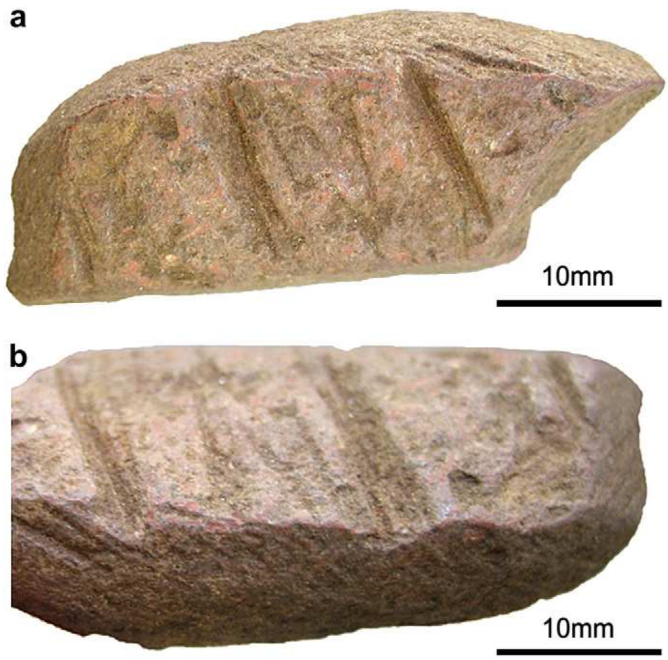

Fig. 8.3 Deeply incised ochre fragment: (a) plan view; (b) oblique view

(Image: Mackay & Welz, 2008:1528)

Yet, what may have been the visual preference or stimulus for the stone from Wonderwerk? The earliest occupation of Wonderwerk cave has been estimated up to one million years ago, with more recent dates related to the San at 2,000 years ago.[776] One of the interesting features of this site is that rocks comprising spaced parallel lines appear in much older MSA levels than 100,000 years ago. Indeed, it may indicate an engraving tradition that dates back up to 500,000 years.[777] As mentioned previously, more recent levels have yielded numerous small rounded quartz and chalcedony pebbles, the nearest known source of which is the Kuruman River over

[776] Beaumont & Vogel, 2008
[777] Beaumont & Vogel, 2008

45 km away; the same levels at the back of the cave yielded mainly quartz crystals, known to occur more than 20 km to the northeast. The importance of this is that a practice of engraving stone and collecting pebbles and rocks precedes the cross-hatch stone dating to 100,000 BP.

A key related question is why this crosshatch pattern should occur at these three particular sites. If we consider the way in which our visual system effectively builds up a catalogue of shapes in response to the environment in which we live, then what particular features of the environments might influence the visual preferences of those living at Wonderwerk, Blombos and Klein Kliphuis to make crosshatch patterns? These sites are located in the northern, southern and western cape regions of South Africa respectively. The relevance of their similarities to each other potentially is rooted in the similarities of environments. South Africa is renowned for its “unique geology”[778] due to the continental drift, plate tectonics and major volcanic events that have left a record of deep earth processes dating back 3.5 billion years. The most conspicuous examples of fine-grained intrusive rocks in South Africa are vertical, or nearly vertical, dykes and horizontal sills of Karoo dolerite found from the beaches of the Cape Peninsula to the northern corners of the country.[779]

Wonderwerk Cave is located on the eastern flank of the Kuruman Hills in the Northern Cape, part of the Asbestos Hill Subgroup; the dominant geological group in the area is known as the Ghaap Plateau.[780] The Kuruman Banded Iron Formation, of which the Kuruman Hills are comprised extend north to south more or less continually for over 400 km.[781] The Kuruman Hills are made up of well-laminated fine-grained rocks including shaly layers, reddish cherty and hematite iron oxide,[782] and exhibit excellent exposures of weathered fine layered rocks (Figure 8.4).[783]

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[778] Norman & Whitfield, 2006:9
[779] Norman & Whitfield, 2006:15
[780] Harding, 2009:4
[781] Norman & Whitfield, 2006:212
[782] Norman & Whitfield, 2006: 206
[783] Norman & Whitfield, 2006: 206

Fig. 8.4 Kuruman Hills

(Image: Norman & Whitfield, 2006:260)

Klein Kliphuis is located in the Western Cape, in the foothills of the Cedarberg Mountains, part of the Table Mountain Group. The Cedarberg range are gently folded showing magnificent exposures of sharply defined sandstone and shale formations that result in well-defined horizontal and vertical fracture and jointing patterns in the rock.[784] The area is well known for its weathered sandstone rock formations (Figure 8.5).

Fig. 8.5 Table Mountain sandstones are an excellent example of cross-bedding.

(Image: Norman & Whitfield, 2006:128)

[784] Norman & Whitfield, 2006: 206

The coastline adjacent to Blombos Cave comprises the Cape Supergroup, part of the Table Mountain Group,[785] and from Cape Town to Port Elizabeth the landscape shows a particularly distinctive rocky coastline. The folds and faults in the shaley rocks of the Table Mountain Group are generally highly cleaved.[786] The rock formations all along the coast present two quite important features, their colour, and their natural striations**.** There is a distinctive reddish hue to the rocks; indeed even the hills are ochre-coloured; and the rocks are marked with parallel, oblique, and slanting grooves and ridges. More significantly, the rock formations located right on the beach and in the immediate vicinity of Blombos Cave possess these natural criss-cross patterns (Figures 8.6 and 8.7).

Fig. 8.6 Rocks on the approach to Blombos Cave

(Image: Steven Mithen, pers. comm. 2006)

[785] Norman & Whitfield, 2006:126
[786] Norman & Whitfield, 2006:126

Fig. 8.7 Rocks on the approach to Blombos Cave

(Image: Steven Mithen, pers. comm.2006)

The particular geological formations that occur at these three sites above all have one thing in common, and that is the unusual rock formations that comprise horizontal, vertical and diagonal folds, cracks or striations in the rock surfaces. Based on what we know of the capacity of the visual cortex to change as a result of experience, especially relating to orientation tuning, the visual experiences of these environments may have heightened the sensitivity, and visually nourished orientation cells in V1 to respond more strongly to lines of particular orientation. Interestingly, the phenomenon of cross-hatching appears stronger at Blombos than anywhere else. Its proximity to the coast, where there would have been more exposure to rock is more likely to have enhanced the visual predisposition. But what other elements might have been influential?

Consideration of subsistence strategies may provide a clue. In particular, more than 1200 fish bones have been recovered from the Middle Stone Age deposits, meaning that people living at Blombos had probably started fishing at least 100,000 years ago.[787] Fishing is thought to be a much later innovation, so the question at Blombos is whether these fish were caught, or scavenged. If people were picking up dead fish from the shore, we would expect to see random species represented, if bone preservation for all species can be considered equal. However, only a few recurring species from the site are identified. These include deep-sea fish, such as Red Stumpnose, Kob and the Black Musselcracker. No equipment directly associated with fishing has been found at Blombos, however Henshilwood has suggested that fish may have been lured close to shore by chumming with local bait, which may have been thrown into the water to attract fish that were then netted or speared.[788]

Specific details about fishing practices are often difficult to reconstruct from archaeological evidence alone but, we know from sites such as Katanda, in the Democratic Republic of Congo that bone harpoons were produced to spear spawning catfish by around 90,000 years ago.[789] Netting may have been an option as Henshilwood suggests, or possibly some form of wooden fish trap or kraal. In coastal and estuarine waters, fish tend to move up the estuaries on the flood tide and drift back down with the ebbing tide, attracted by feeding in the shallow water and by the nutrients in freshwater streams and rivers moving into the estuary. Indeed, anglers in the Goukou River frequently sight large Kob even today.[790]

Fish traps consist of several large stakes lodged into the riverbed at intervals with a latticework frame attached to the bottom stakes. They work by trapping fish behind the fence walls as the tide recedes. Once trapped, they would have been relatively easy to spear**.** Fish such as the Kob, Red Stumpnose and Black Musselcracker still inhabit the coastal waters from Cape Town to Maputo. Even today, at Kosi Bay in KwaZulu Natal, South Africa is particularly famous for their traditional fish traps, (Figure 8.8) built to trap fish moving in and out of the estuary with the tide.[791] Either fish traps or netting is plausible, but in each case the construction of both would have ensured that a cross-hatch pattern is likely to have been a visually familiar one that may have found its way being replicated.

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[787] Official Blombos website - http://www.svf.uib.no/sfu/blombos/
[788] Official Blombos website - http://www.svf.uib.no/sfu/blombos/
[789] Yellen *et al*. 1995
[790] Little, 2006
[791] www.kosibay.net

Fig. 8.8 The lakes at Kosi Bay are criss-crossed with a maze of fish traps

(Image: The Nedbank Green Trust project www.nedbank.co.za)

In addition, people from Blombos were travelling up to 20 km to catch these large fish and collect shells; conceivably they may have required some form of container to transport them back to the cave. Microscopic analysis of the tick shells from Blombos (discussed later in this chapter) apparently reveals a distinct use-wear pattern consistent with suspension. Thus, people from Blombos were making robust twine on which to thread the shells, perhaps from the estuarine grasses. The production and use of some form of basketry made from woven natural fibres to collect and transport their produce are possible. For a neural explanation of the visual interest of our objects this could be of crucial importance. The cross-hatched designs on the ochre blocks may have activated the same neural equipment as that involved in looking at the equipment on which they depended. They could thus have worked on two distinct, but related and potentially reinforcing levels. We may speculate that the repetitive forms of fish traps or netting and woven fibres, and the visual cues of lines of similar configurations stimulated neural processes. Based on what we know of neurons responding to complex and comparable shapes**,** we may suggest that neurons in the temporal lobe potentially modified their preferred stimuli to fire maximally to the shapes and colours provoked by netting, woven basketry, and distinctively coloured and ridged rock formations. The variety of visual sources of which lines of different orientation may have been observed may indicate why Blombos shows a stronger incidence of the practice. Therefore this cross-hatch design or pattern may have been mutually reinforcing, and its replication on ochre may reflect these influences.

8.3.1 Interpretations

Currently there has been no synthesis or comparison of the three sites. The literature on the incised stone from Klein Kliphuis,[792] found in 2008, makes reference to the Blombos ochre, but is cautious in making any suggestions of shared conventions. While the authors do not rule out the possibility of the ochre being symbolic, neither can they exclude “more mundane”[793] motivations for its appearance, such as testing the ochre for pigment colour. Although regarded as a more ordinary explanation, it may be the routine practice of causing striations caused by pigment testing that potentially acted as a visual trigger.

Henshilwood, on the other hand, is more committed to the notion that the Blombos ochres are “intentionally symbolic images”,[794] relying on “syntactical language”[795] to transmit their meaning as the designs are too complex for imitation alone. But it may not be necessary to go as far as Henshilwood in his interpretations. This case study suggests that the production of such a pattern might be explained by referring to the predispositions of the local visual system enhanced by natural and cultural factors. Such a reading has implications relating to intentionality, meaning they could be the result of purposeful design, but they do not have to be. Responding to Henshilwood’s argument that they could simply be the “idle ‘scratching’ of a bored individual”,[796] possibly an individual whose visual system has learned to respond more sensitively to lines of different orientation as a result of environment and experience.

8.3.2 Summary

This rationalisation for the occurrence of cross-hatch markings made on ochre and stone is compatible with the principles of the human visual system. Positive associations with environment and experience and objects in the environment potentially acted upon a visual system reinforcing an innate predisposition and visually nourishing areas of the brain. The potential range and diversity of sources at Blombos may explain why it is more prevalent here than at other sites.

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[792] See Mackay and Welz, 2008
[793] Mackay & Welz, 2008:1530
[794] Henshilwood & d’Errico, 2005:256
[795] Henshilwood & d’Errico, 2005:256
[796] Henshilwood & d’Errico, 2005:261

8.4 SHELLS

In terms of the early shell evidence, the most significant feature is that they are found at five sites distanced by time and space. The sites are Skhul and Qafzeh in Israel, Grotte des Pigeons in Morocco, Blombos Cave in South Africa and Oued Djebanna in Algeria, and date to 100,000, 92,000, 82,500, 77,000 and 75,000 years ago respectively. At Skhul and Oued Djebanna the incidence of shells is very low, only two and one found respectively. Until very recently Blombos had yielded the most perforated shells at 41, but in 2009 another 47 were added to the existing 13 found at Grotte des Pigeons; moreover, they were in even older levels, dating up to 110,000 years ago. Thus, the concentrations of perforated shells are in the most northerly and southerly ends of Africa.

The shell evidence is slightly different from the incised stone and ochre discussed above because the context of their finds is more directly associated with modern humans. The shells were most likely intentionally selected and in some cases drilled and stained with ochre, although some were collected already with naturally occurring perforations. The two shells from Skhul were located in the same stratigraphic layer as ten individuals, some apparently intentionally buried, confirmed as anatomically modern humans. Similarly, ten shells from Qafzeh were found in the layers that have yielded burials attributed to anatomically modern humans. The shells do not seem directly associated with the burials, but rather appeared scattered more or less randomly throughout the deposit. The proximity of Skhul and Qafzeh spatially (a few metres apart) and temporally (about 8,000 years) indicate a recurring experience of shell collecting, piercing and use, and the association with burials provides a greater indication that the preference for marine shells was a shared experience. The shells from Grotte des Pigeons and Oued Djebanna were found in contexts near hearths, perhaps also indicating they were part of a shared activity. Those from Blombos were found near the rear of the cave, but in clusters of between 2- 12 shells. It is widely believed that they were used as items of personal ornamentation or as expressions of group or individual identity.[797] Despite the spatial separation of the sites, (a distance of about 8000 km between Oued Djebanna and Blombos), the shell evidence presents some very intriguing

[797] D’Errico, 2003:51

correspondences, suggesting some homogeneity in the early phases of artistic activity by modern humans.

The fact that modern humans are collecting and piercing exactly the same genus of shells, at sites that are geographically distant across Africa and broadly contemporaneously, is an intriguing coincidence. The explanation for such similarities, in general, is attributable to the movement of people across the landscape engaging in forms of trade and exchange, and thus they are the products of cultural diffusion. Cultural diffusion as an explanation is easier to resolve in terms of the spatial distance of some of the sites than it is for the temporal separation; these sites cover a period of 25,000 years.

However, we may refer to Gamble's[798] work on long-distance social exchange networks in Upper Palaeolithic Europe as a model for explaining how the construction of social landscapes led to the elaboration of culture to carry the novel social representations in symbolic form. The social landscape allowed for a "stretching of social systems across time and space".[799] It seems conceivable that social networks could have been in operation between Grotte des Pigeons in Morocco and Oued Djebanna in Algeria, and certainly between Qafzeh and Skhul. The proximity of these sites to each other could account for the similarities in practice and may explain why the same genus of shells is selected. At present the evidence is too sparse and too widely spread in space and time to make any definitive judgements, and it is worth noting that all the finds in the catalogue are very recent discoveries.

Fundamentally, the anomaly here is Blombos Cave, separated by 8,000 km and up to 25,000 years. If the perforated shells from Blombos Cave are not the result of long-distance social and/or exchange networks, what other explanations can we infer? How credible is it that the selection and collection of marine shells, and their subsequent perforation and suspension, is a spontaneous practice? If we are to doubt the usefulness of the extended networks and exchange hypothesis in relation to Blombos what alternative may lead from the embedding of a predilection for certain visual images/motifs in the neural networks of an individual visual cortex to the production of certain kinds of artefacts?

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[798] 1998, 2002
[799] Gamble, 1998:442

The selection, collection and use of shells may be easier to explain from coastal sites in the same way that the incised ochre from Blombos is easier to explain from a site potentially more exposed to incised rocks. Oued Djebanna seems at variance in terms of its location, being the farthest from the sea. The other sites are linked by their proximity to the sea and estuarine environments that provide the opportunities to experience different shells and their characteristics. Of course, future discoveries may indeed reveal a practice of shell collecting and perforation in southern Africa that would bridge the gap in terms of distance between sites and demonstrate a cultural and social explanation for similar practices. For the time being, if cultural diffusion is less likely for Blombos Cave, we may need to invoke other explanations.

One of the first problems to address is why they chose this genus of shell in the first instance. We cannot know for certain why the same types of shells were selected; it may simply be a matter of availability. *N. kraussianus* and *N. gibbosulus* shells, while location-dependent, are ubiquitous along the African coast.[800] Even today, *Nassarius* shells are common. An image displayed on the Blombos website (Figure 8.9) showing a modern collection of *N. kraussianus* shells demonstrates that naturally occurring perforated shells are not difficult to find, several in this image display a natural perforation similar to the archaeological specimens.

Fig. 8.9 Modern collection of Nassarius kraussianus shells

(Image: Blombos Website http://www.svf.uib.no/sfu/blombos/)

[800] Branch *et al.* 2008

The very act of collecting shells of this size requires a certain intensity of focused looking. This may have involved either looking for intact shells, or shells that already possessed a naturally occurring hole. The more we look at something with any attention, the more connections will form between the specific neurons involved, thus strengthening our preference for looking at that thing. This means that if we have been previously exposed to an object, we will see it more easily and have a preference for looking at objects with which it shares similar properties. Therefore, the intentional perforation of shells may simply be the result of observing already naturally perforated shells in the environment. In this sense, the intentional piercing of a shell may be an act of familiarity and replication. The drilling of a shell may simply be an act of replicating a naturally perforated shell, seen in estuarine or coastal environments, or possibly emulating collecting naturally perforated shells and stringing them together consecutively.

Based on what we know of neurons responding to comparable shapes and objects, one potential factor for the collection of *Nassarius* shells that has been proposed is that they bear a visual resemblance to human teeth.[801] Once shells are strung onto twine and if indeed these were worn on the body, especially as a necklace, then the associations made with teeth would have been even stronger (Figure 8.10).[802] Of course this is speculative and does not explain their collection at all of the sites. Nevertheless, if we think about them in terms of resemblances (in the same way that cross-hatch patterns may resemble other artefacts), then their symbolic value might have been founded in this quality of similitude. It may also go some way to thinking about later practices as modern humans move out of Africa when animal teeth are sought out for collecting and perforating for suspension.

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[801] Onians, 2009, personal communication

[802] The eminent art historian E.R. Gombrich made a similar argument in his publication *Art and Illusion.* Gombrich argued that the use of cowrie shells on a skull from Jericho, dating to 6000 BC was because the shape of the shells were so similar to human eyes, they were used as a visual metaphor. As Gombrich states, “Eye-like objects can take the place of eyes”.

Fig. 8.10 Recently made Nassarius shell necklace

(Image:http://www.svf.uib.no/sfu/blombos/Artefact_Review2.html)

8.4.1 Interpretations

Most explanations for similarities in object production assume that they result from the movement of people across the landscape engaging in forms of trade and exchange. According to this view they are the products of cultural diffusion. Mackay & Welz (2008) in their examination of the incised ochre at Klein Kliphuis also refer to the shell evidence and think the likelihood of perforated shells from the four sites being the product of a shared convention, "tenuous, given the 10,000 years and 8000 km which separate their occurrence in Morocco and South Africa.".[803]

Another factor in the feasibility of the diffusion proposal is the failure to explain why certain items were not the result of diffusion. While it is proposed that shells were transported over long distances, and social and/or exchange networks were functioning throughout even greater geographical areas,[804] the "documented lithic raw-material procurement patterning in the African MSA and the Levantine Mousterian only exceptionally exceeds 100 km, and generally is much lower".[805] Seemingly, while shell networks are argued to be operating over vast distances, lithic networks were not, "because at least three of the four sites where similar bead types

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[803] Mackay and Welz, 2008:1529

[804] Bouzouggar *et al.* (2007) suggests that the transport of shells over distances up to 200 km (Oued Djebanna) and of more than 40 km, in the case of the shells from Taforalt, may "suggest the existence, already at this early stage, of previously unrecorded interlinking exchange systems or of long-distance social networks". (Bouzouggar *et al.* 2007:9969)

[805] Bouzouggar *et al.* 2007:9969

were found can be attributed to a different technocomplex (Taforalt and Oued Djebanna: Aterian;[806] Blombos: Still Bay;[807] and Skhul: Levantine Mousterian[808]).”[809] The lithic evidence then mitigates arguments over the notion of long-distance exchange. This anomaly is most notable in relation to Blombos Cave.

The state of preservation of the Skhul and Oued Djebanna shells is such that a definite conclusion cannot be reached as to the human origin of the wear. The argument made for their symbolic use is based on the remoteness from the sea, their low nutritional value, and the presence of unusual perforations.[810] These shells are used as evidence to support the hypothesis that a long-lasting and widespread beadworking tradition existed in Africa and the Levant well before the arrival of anatomically modern humans in Europe. In addition, Bouzouggar *et al.* (2007) suggests that Grotte des Pigeons, along with other sites, indicates that the choice, transport, colouring, and long-term wearing of these items were part of a deliberate, shared, and transmitted non-utilitarian behaviour. They argue that to be conveyed from one generation to another over a very wide geographic area, such behaviour must have implied “powerful conventions”[811] that could not have survived if they were not intended to record some form of meaning. With regard to Blombos Cave, Henshilwood[812] argues that taphonomic, morphometric and microscopic analysis of modified *N. kraussianus* shells provides clear evidence that the shells were deliberately perforated and worn as personal ornaments. He suggests a bead-making tradition was integral to the material culture of these people, and an unambiguous marker of symbolically mediated behaviour. Moreover, the symbolic meaning of these beads must have been shared and transmitted through syntactical language.

The two main issues here relate to the capacity for syntactical language and the attribution of symbolic intention to perforated shells. The issue of when and how language emerges is an area of huge debate and it is not my intention to engage in the

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[806] See Glossary
[807] Still Bay might represent a short-lived local style of stone tool manufacture, but further dating of the handful of sites with stratified Still Bay assemblages is needed before this can be stated with certainty. The Blombos Still Bay Industry has an age of more than 70,000 years. See Wadley, 2007.
[808] In recent years, the Levantine Mousterian has been the subject of major controversy, but with the advent of more sophisticated dating techniques, together with the stratigraphic evidence the Levantine Mousterian lasted from about 270,000 – 47-45,000 BP. See Bar-Yosef, 1998b:110-124; Rink *et al.* 2004; Mercier *et al.* 2007
[809] Bouzouggar *et al*. 2007:9967
[810] Vanhaeren *et al.* 2006
[811] Bouzouggar *et al*. 2007:9969
[812] In d’Errico *et al*. 2005

complexities of it here. Suffice to say that a recent conference entitled '*The Cradle of Language* (2006) held in South Africa, highlighted the complexities and an absence of a definitive understanding between syntactical language and symbolic thought. In fact, during the proceedings Jim Hurford,[813] suggested that the beads from Blombos are not mediated by syntactical language, and while the incised ochre from Blombos shows evidence of features reminiscent of syntax (controlled repetition with a lasting product), it cannot necessarily be used as a marker of linguistic capacity. Jean-Marie Hombert[814] emphasised the polygenesis of languages, and that while modern humans had the cognitive potential for language when they left Africa, they did not have language at that time.

In addition, Malafouris (2008) has argued against the idea that the Blombos beads necessarily indicate symbolic thought and language, simply because they function as personal ornamentation. Rather, he uses cognitive neuroscience to focus on a relatively unexplored dimension of these artefacts, exploring their possible role in the emergence of self-awareness. Malafouris argues that material culture and its active nature can be understood at the level of the human brain, most notably, "in the dynamic interaction between neural growth mechanisms and environmentally derived neural activity". [815]

The uncertainty in the relationship between art, symbolic thought and language drives this enquiry into another direction, which thinks about why shells may been considered some form of symbol. The evidence is too sparse at present to argue for shared symbolic conventions established across time and space, but rather we may consider that the selection, collection and perforation of shells are the first markers in what subsequently becomes a system of shared representations.

If we adopt a neural constructivist approach to this problem then we may understand the collection of marine shells (both naturally perforated and initially intact to be subsequently perforated) as the result of the interaction between agents, their environments and their neural architecture. The symbolic status of marine shells may have developed because of an increasing representational flexibility that allows environmental factors to shape the human brain's structure and function.

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[813] Linguist based at Edinburgh University
[814] Linguist and director of CNRS, Department of Humanities and Social Sciences. France
[815] Malafouris, 2008:401

8.4.2 Summary

The collection and perforation of shells at these five sites are further evidence of a very early practice of art-like activities in MSA Africa. While the shell evidence is perhaps more complex to deal with, we do not have to go as far as thinking about them in terms of symbolic behaviour, language or as objects of long-distance exchange. The 'powerful conventions' spoken of may relate instead to neurological principles. The act of looking intently at *Nassarius* shells, both intact and naturally perforated may have been sufficient visual trigger for imitation.

In truth, the quantity of evidence is scarce and its significance arguable; the evidence amounts to a few examples of incised or engraved stone and ochre and less than a hundred pierced shells over a period of 25,000-30,000 years. In archaeological terms there is, admittedly, an imperfect database. Nevertheless, what we do have are the early stages of artistic activity in modern humans, and what we can say is that there are discernible resemblances and similarities in these first forays, which in and of itself provides some observable adjacencies of some significance. The explanation proposed here is that if these objects were symbolic to their makers, and possibly involved in a shared convention, that their status as objects of meaning may rest on characteristics of the human visual brain, and the way neural networks and neural architecture are influenced by environment and experience.

8.5 OSTRICH EGGSHELL

The first employment of ostrich eggshell in art-like activities appears a little later in the archaeological record. The earliest uses are incised fragments found at Diepkloof in the western Cape, South Africa, dating to between 55,000 – 70,000 BP. These fragments exhibit very similar, although more complex, markings to those found on the stone and ochre from Wonderwerk, Klein Kliphuis and Blombos. Ostrich eggshell beads emerge later at the following sites; Boomplaas, South Africa at 44,000 BP; Border Cave in South Africa at 40,000 BP; Enkapune Ya Moto in Kenya at 37,000 – 39,000 BP; Kisese II in East Africa at 31,500 BP; Mumba in Tanzania at 29,000 – 33,000 BP and Apollo 11 Cave in southwest Namibia at 26,000 -28,000 BP.

The greater complexity in terms of production and the impetus for the markings seen at Diepkloof and the emergence of ostrich eggshell beads makes it difficult to choose a particular explanation. However, Diepkloof is located near Elands Bay, only about 50 km east of Klein Kliphuis, and so modern-type humans would have experienced similar geologically-based visual experiences as those at Klein Kliphuis. Furthermore, as argued in the case of Blombos, the coastal environment would have ensured a greater exposure to rock, strengthening the visual preference for linear configurations. Indeed, whatever else the production of the incised ostrich eggshell at Diepkloof was influenced by, there are similarities with Klein Kliphuis. In addition, the time frame within which the Diepkloof and Klein Kliphuis artefacts range are 55,000-70,000 BP and 50,000 – 80,000 BP respectively. Taking into consideration the proximity of the sites in space and time, we may speculate that there may have been some contact between groups that allowed for the transmission of the design (either from Diepkloof to Klein Kliphuis or vice versa).

Some of the eggshells from Diepkloof show evidence that they were once used intact, and may have functioned as water carriers. Water is an important resource, and if indeed the shells were used as water carriers, then the object that gives you the capacity to carry water around would have stimulated positive associations in the brain. In addition, the possible use of nets or bags to carry around the egg (as discussed in Chapter 4) may have strengthened those associations. Thus, the combination of networks of lines and ostrich eggshells provides positive mutual reinforcements.

The way in which ostrich eggshell beads are created, has been discussed in Chapter 4, but essentially a cross-hatch pattern is incised onto the eggshell and the square or diamond shaped pieces that are produced by such patterning are broken off. These fragments act as pre-forms, later to be ground down into a circle, which is drilled. It is therefore relatively easy to understand how the process of creating pre-forms may have derived from the original practice of incising eggshell. The difference between the selection of ostrich eggshell and the use of marine shells is that a new form has to be envisaged (a circular bead) out of an existing resource (eggshell). Therefore the use of ostrich eggs in personal ornamentation is quite distinctive from the shells in technology and rationale.

In terms of the brain's response to ostrich eggshell beads, what we may say is that as a material, ostrich eggshell likely already had positive associations in the brain. It may have been connected with its use as a food resource, but also with its ability to carry water, two of the basic requirements for survival. In addition, as proposed earlier for the selection of shells, the brain makes associations with comparable shapes and objects. Therefore, if strung shells had the potential to be reminiscent of a row of teeth, we may speculate the same visual predilection for ostrich eggshell, which visually shares many properties with shells, as well as with teeth (Fig. 8.11). This visual similarity may have been further reinforced when the eggshell is regularly shaped, strung onto twine and hanging around the neck. We may also consider the visual response to a necklace made from ostrich eggshell beads (or any other material or that matter). The primary visual cortex (or V1) is the first stage in visual processing and is highly specialised for processing information about objects, but more specifically it is especially proficient in pattern recognition. Indeed the brain is wired in such a way as to seek out patterns, such as recurring events or objects. The capacity for pattern recognition, to repeat in a predictable manner, may underpin some of the earliest examples of artistic activity, such as marine shells and ostrich eggshell beads strung onto twine, and even cross-hatch patterning.

Fig. 8.11

(Left) Ostrich eggshell beads (Image: Pitt Rivers Museum, 1921.75.93)

(Right) *Nassarius* shell necklace (Image: http://www.svf.uib.no/sfu/blombos/)

8.6 Later Mark-making

Two other objects, found at Border cave in Kwazulu Natal, South Africa need consideration. One is a fragment of bored stone with incised notches adjacent to the orifice, dating to 40,000 BP, the other is a baboon fibula marked with 29 clearly defined notches, dating to 35,000 – 37,000 BP. The bored stone is an ambiguous artefact and difficult to interpret, but the baboon fibula has been compared to calendar sticks used by San Bushmen today. The notched bone taken together with the emergence of eggshell beads brings to mind concepts of counting. Estimating how many ostrich eggshell beads one requires, or how many beads can be produced from one eggshell, or indeed recording incised lines to act as a counting device, is potentially some of the first evidence of the use of numbers and quantity in prehistory.[816] The implication for the evidence of counting is important when we consider its relation to language abilities. Recent research has shown that the intraparietal sulcus (IPS) – the area known to be involved in processing number information in fact has two very separate, specific functions.[817] One function is more specific and responsible for counting 'how many' things are present, and the other is more general and responsible for assessing quantity.

Dehaene *et al.* (1999) demonstrated that exact calculation is language dependent, whereas approximation relies on nonverbal visuo-spatial neural networks. Mathematical abilities may result from the interplay of these two areas. Calculating exact arithmetic relies on an area of the brain in the left inferior frontal circuit also used for generating associations between words. In contrast, the approximation of numbers shows no dependence on language and relies primarily on the visuo-spatial network of the left and right parietal lobes.[818] These results may indicate that our capacity for assessing approximation of numerical quantity has a long evolutionary history, but that "symbolic arithmetic is a cultural invention specific to humans".[819]

The important element then is to identify evidence for assessing quantity and evidence of the ability for exact calculation; the implication of which is that evidence

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[816] The concept of quantity is likely to been understood in hominins for many hundreds of thousands of years in terms of food collection, but more tangible evidence in early modern humans is scarce. Alexander Marshack has suggested that notches and lines carved on certain Upper Palaeolithic bone plaques were in fact notation systems, specifically lunar calendars notating the passage of time. (Marshack 1964, 1972, 1997)

[817] Castelli *et al.* 2006

[818] Dehaene *et al.* 1999

[819] Dehaene *et al.* 1999:973

for counting indicates syntactical language. As well as language, the ability to count adds another cognitive leap in the development of modern humans. Unfortunately, the evidence presented here is not conclusive either way, but is an intriguing area of research.[820]

8.7 REPRESENTATIONAL ART

The appearance of representational art at Apollo 11 Cave in Namibia, dating to around 28,000 BP is particularly interesting. Firstly, it is the oldest representational art in MSA Africa, but also it broadly coincides in both depictions and timing with the emergence of cave art at Chauvet in France and Fumane Cave in Italy, dating to 32,000 and 36,000 BP respectively. How we account for representational art at these particular sites raises some difficult questions, because in light of the current evidence, it does so at sites that have no obvious connections to each other.[821] When the data set is so small, as in the case of Apollo 11, it is difficult to develop an argument as such, but, expanding the data set and including the European examples may help.

The depiction of a figurative image that stands for something perceptible and recognisable in the environment is a tangible record of particular type of mental activity. More significantly, we do not draw what we do not notice; or rather we do not draw what the visual system does not detect. Just as elements of the environment may have contributed to the particular incised crosshatch markings earlier in MSA Africa, different elements and intensity of experiences may have contributed to the reasons where the earliest depictions of animals occur.

To the north of the gorge where Apollo 11 Cave is located, is an extensive plain fringing the escarpment of the Huns Mountains. To the south is a network of ridges and valleys, leading down to the Orange River about 40 km away.[822] Geological analysis demonstrates that the gorge was subjected to successive wetter

[820] Anthropological research on the Pirahă group of the Amazon jungle may shed some light on how one might address such an issue. The Pirahă have become famous for having an absence of syntax in their language, but in addition, they can only approximate number, they are unable to count, or learn to count even when taught. See Everett, 2005, 2008

[821] In addition, the first evidence of representational art in Australia, which in some cases has proved difficult to date securely, certainly dates to around 10,000 BP but may even be up to 25,000 BP Layton, 1992; Chippindale & Taçon , 1998; Taçon, 2000; Brumm & Moore, 2005

[822] Masson, 2006:76

and drier periods in prehistory, occurring throughout the Quaternary.[823] The wetter episodes, although short and of varying intensity, made prehistoric occupation possible in an “otherwise predominantly inhospitable environment”.[824] Currently, it is a parched landscape, where the flora and fauna are sustained by occasional late summer thunderstorms that may create short-lived flash floods in the gorge, restoring the semi-permanent springs.[825] The timing of the representational art from Apollo 11 Cave coincides with Marine Isotope Stage 2, which includes one of the coldest periods, the last glacial maximum. Conditions became very arid and the Namib Desert expanded as far north as 12˚ south.[826] Water is the most important survival resource, but under the increasingly arid conditions during MIS 2, the intermittent springs in the gorge and the nearby Orange River may have intensified the resource for both humans and animals alike. Two scenarios can be drawn on here; animals would have exploited the times when the gorge was flooded with water due to thunderstorms, but in addition in the onset of the Last Glacial Maximum the competition for water may have led to a greater intensity of observing animals who were seeking out the same resource. This intensity in experiences as a result of the environment may have resulted in neural networks more attuned to searching for animals, either as a food resource or as competition.

8.8 SUMMARY OF MIDDLE STONE AGE AFRICA

Support for the emergence of art in Africa prior to 40,000 BP divides archaeological thinking. In general, substantiation rests on whether we can identify artefacts as demonstrating symbolism. Yet how we interpret and identify symbolic thought is not well-defined. If we are to take the view that the earliest art in MSA Africa is evidence of symbolic thought, I have attempted here to think about why that might be the case. If we consider artefacts as the result of its maker and its maker’s place within the environment (physical and cultural environment) then this may contribute to our understanding of symbolic thought. Why an artefact should be meaningful to its maker is an important consideration, and often in prehistory can be very difficult if not impossible to realise. The focus here has been to place an artefact

[823] Masson, 2006:77
[824] Masson, 2006:76
[825] Masson, 2006
[826] Dupont *et al.* 2000:119

in the context of its maker and the environment in which it was produced, thereby making a relationship between the brain and the physical, social and cultural environment in which it functions. Although these are speculative observations, they are grounded within known biological frameworks and the aim is not to make definitive statements but to provide an alternative framework within which we can consider why the earliest forms of art may have been meaningful.

The following chapter is a continuation of this discussion focusing on the artistic activities as modern humans migrate out of Africa, subsequently arriving in Europe.

CHAPTER 9

Discussion – Out of Africa to Europe

9.1 INTRODUCTION

This discussion chapter is a continuation of the previous chapter, but will focus on artistic activity as modern humans migrate out of Africa, to include India, Papua New Guinea, Australia, the Levant and Europe.

9.2 INDIA

The evidence we have from Upper Palaeolithic[827] India is a fragment of ostrich eggshell from Patne bearing a crosshatch design, one finished and two unfinished beads of ostrich eggshell, and a shell, dating to 25,000 BP. This limited data set stands in contrast to the number of identified archaeological sites in India. Archaeological evidence clearly indicates Later Pleistocene occupation throughout the subcontinent, including the settlement of both coastal and estuarine environments.[828] Nevertheless, there is very little in the way of early evidence of art-like activities.

It has been suggested in the previous chapter that the rationale behind the earliest evidence of crosshatch patterning seen in Africa was potentially rooted in exposure to particular visual experiences, which nourished areas of the occipital lobe that respond to lines of different orientation, stimulating their firing and response. The incised fragment from Patne is reminiscent of incised ostrich eggshell from Diepkloof, South Africa dating to around 55,000 – 70,000 BP, and the crosshatch design is similar to the incised stone and ochre from Wonderwerk, Klein Kliphuis and Blombos Cave in South Africa (dated to between 100,000 – 75,000 BP).

The similarities between the Patne design and the incised ochre from Blombos have been acknowledged by others.[829]. The site's excavator has suggested that the patterning on the eggshell may have been visually influenced by the trellising

[827] The terms Lower, Middle and Upper Palaeolithic, although it is important to note that the prehistoric culture of India do not present a similar succession of technological and chronological stages of Europe. The Upper Palaeolithic of west Asia evolved c 40,000 BP.
[828] James & Petraglia, 2005:S4
[829] Mellars, 2006

of branches while erecting a hut, and that this trellis pattern may have made one think about weaving.[830] This observation is similar to those made here for Blombos, that there may be various environmental and cultural factors involved in the explanation of the design, strengthened by our knowledge that visual preferences develop as a result of distinct environmental exposures. A similar line of reasoning could be made for the more recent incised ostrich eggshell found at Diepkloof.

The absence of art-like activities in the Indian sub-continent, despite the numerous archaeological sites, is an interesting problem. Differential survival of artefacts may play a role in the anomaly, but given the considerable archaeological research undertaken in South Asia, the discrepancy needs further investigation.

9.3 AUSTRALIA AND PAPUA NEW GUINEA

The data set from Papua New Guinea and Australia dating to the Pleistocene[831] is again limited in its quantity. The site of Buang Merabak in Papua New Guinea has yielded 14 shark teeth, of which one is perforated, dating to between 39,500 and 28,000 BP. The evidence from Australia includes a fragment of rock stained with ochre thought to have originally come from the rockshelter roof or wall, dating to around 40,000 BP, and located at Carpenter’s Gap, Western Australia. In addition, 22 *Conus* shells, dating to c. 32,000 BP come from Mandu Mandu rockshelter, Western Australia, and *dentalium* shell from Riwi Cave, Western Australia dating to 30,000 BP.

The selection and collection of shells in Australia are significant, because they support the importance of the African data. The early practice of collecting and perforating shells seen in Africa is continued in Australia, albeit with different species of shells. A question that arises relates to the importance of shells. These are unlikely to have been collected as a food resource,[832] certainly in the case of Mandu Mandu rockshelter, though edible, many *Conus* shells are venomous and they are not

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[830] Sali, 1989:101

[831] Following Soffer and Conkey (1997), the term ‘Pleistocene’ is used instead of ‘Palaeolithic’ because ‘Palaeolithic’ in a large sense refers to the archaeological record from 2.5 million to 10,000 years ago. In a sense it is a cultural term that is not used in Australia. The ‘Pleistocene’ is a geological term and dates from 1.75 million to 10,000 years ago. However, in practical terms its temporal span is more limited in Australia as widely accepted cultural artefacts do not predate the arrival of modern-type humans after c 60,000 BP.

[832] Henshilwood collected 100 living shells from the Goukou and Duiwenhoeks estuaries in South Africa, which yielded a dry soft tissue mass of 0.814 g; hardly sufficient to warrant their collection as food. http://www.svf.uib.no/sfu/blombos/

generally considered to be a dietary species. In addition, the *Dentalium* shell from Riwi cave had been transported up to 500km for the coast, possibly the result of trade and exchange. The location of Riwi so far from the source of the shell may certainly have placed an added value or importance to the resource. It is interesting to note that at Buang Merabak teeth seem to now take on importance as a resource.

As mentioned at the outset, there is a spectrum of reasons why someone should like something or wish to collect something, and this is liable to change depending on different environments and cultural contexts. The introduction of teeth in the archaeological record is notable. Teeth may be considered as constituting a row of tools, and especially visually, rows of straight white teeth constitute a strong, reliable set of tools. Teeth are also a defensive feature, so possession of a row of teeth beads may have provided its owner with additional reassurance. Therefore the discovery of 14 shark's teeth, from Buang Merabak in Papua New Guinea is important because it indicates the appeal of animal teeth.[833] Certainly, once modern-type humans migrate into Europe, teeth become much more frequent in the archaeological record.[834]

In addition, Carpenter's Gap in Western Australia has yielded an ochre stained fragment of rock, originally attached to the roof or wall of the rockshelter. There is not a great deal that can be argued for the painted rock fragment, against other comparable sites, except perhaps in relation to the pindan-stained sand. Typically red in colour, it occurs extensively in the Kimberley region of Western Australia, and may have contributed to a visual familiarity in transposing the same colour upon which they walked to the wall or roof of the rockshelter in which they lived.

Although the evidence is scant and identifying any patterns of behaviour with such a limited data set is not wholly convincing, it is interesting that the practice of collecting shells should perpetuate, subsequently to include teeth. The limited data set however draws parallels with the activity of modern humans in Europe, in addition to the staining of cave walls with ochre.

[833] The discovery of a large 'fossil fish tooth' (probably a shark's tooth) found with flint flakes on the Acheulian floor at Stoke Newington, North London (Smith, 1894:272) may help when thinking about the visual importance and/or appeal of teeth.

[834] Evidence of animal and human teeth are found at Bacho Kiro in Bulgaria, Istallosko in Hungary, Kostenki in Russia; Grotte d'Isturitz and Grotte des Hyènes in France

9.4 LEVANT

Similarly, any early evidence from the Levant region is scant, and any arguments concerning the incised stone from Hayonim Cave are tenuous. Until recently, the perceived wisdom was that the Levantine corridor was used as a migration route into Europe, and so the lack of durable artistic activity has been problematic. If the Levantine corridor was used as an exit route for modern humans from Africa, the paucity of art may simply be the result of poor preservation.

Nonetheless, a variety of mollusc species predominate the several hundred shells found at Üçağızlı cave in south-central Turkey, dating to 31,000 – 40,000 BP. Most notable are two species of marine gastropod, the carnivorous scavenger *Nassarius gibbosula* and the omnivore *Columbella rustica*, which together account for between 50% and 90% of the total assemblage. Some of these shells were stained with red ochre. Most of the specimens were modified by humans on site. Less than 5% of the collection display fine polish on the edges of the hole from prolonged contact with fibre. This is an interesting point because if they were not all being for purposes of personal ornamentation then it suggests they were collected for some other reason. Indeed, it has been noted that the inhabitants of Üçağızlı were selective in their choice of shells, preferring varieties with luminous white or brightly coloured shells, some with arresting patterns.[835] In addition a perforated raptor talon was found in the same deposits. Interpretation of the Üçağızlı Cave finds has directed attention to the ability of the shell beads to communicate social identity, such as group membership, gender, and individual life-history characteristics.[836] The diversity in colour and form may imply that their visual appeal was part of their rationale for selection and the coastal location of the cave may suggest that a regular exposure to marine shells may have nourished their visual appeal.

Recent and ongoing research work undertaken in the Arabian Gulf suggests that the Arabian Peninsula may have been the more likely departure route that modern humans took on their way to Europe, India and Australia.[837] Thus, the apparent absence of artistic activity in the Levant may not be so difficult to understand. However, there is very little if anything in the way of durable art-like activities from Arabian Peninsular region either. Archaeological and climatic

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[835] Kuhn et al. 2001:7642
[836] Kuhn et al. 2003, 2004; Stiner, 2003
[837] See Rose, 2006

research in this area suggests that settled areas were periodically submerged underwater. It has been suggested that the almost negligible remains of material culture in this area are the result of inundations that effectively created a *tabular rasa* effect in cultural terms.[838]

9.5 UPPER PALAEOLITHIC EUROPE

The evidence of artistic activities from Upper Palaeolithic Europe presents several large data sets that range from personal ornamentation to monumental painting. In comparison to artistic activities that preceded the migration of modern type man into Europe, new elements are now included. These consist of a new range of materials exploited, the emergence of sculpted animal and human figurines, facsimiles and a qualitative and quantitative increase in parietal art. Thus, the data sets of Europe can be better articulated because of the increased amount of data.

The first evidence of artistic activity in early Upper Palaeolithic Europe is a proliferation of objects under the rubric of personal ornamentation. Perforated shells remain in the archaeological record, but there is an increase in the breadth of materials used. Included in this category is a new type of object, classed as a facsimile. New elements included in the artistic repertoire comprise small sculpted animal figurines, as well as two examples of human figurines. Parietal art is extensive at Chauvet Cave and its significance rests on the life-like renderings of the depictions. The Upper Palaeolithic data will be divided into two sections, the types of materials selected for personal ornamentation, which include shells, teeth and other materials, followed by representational art.

9.6 SHELLS

Perforated shells remain present in the archaeological record and occur at the following sites; Kostenki in Russia, dating to 32,000 -36,000 BP; Grotte d'Isturitz, south-west France, dating to 34,000- 36,000 BP; Grotte des Hyènes in the Aquitaine Basin, France, dating to c. 33,000 BP; and Fumane Cave near Verona, northern Italy dating between 32,000 -36,500 BP, and Abri Castanet in the Dordogne, France dating to 32,000 BP.

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[838] See Rose, 2006:304.

The perforated fossil shells from Kostenki 14, in the Don Valley in Russia are notable for the distance they have travelled from their original source. The species known as *Columbellidae* are derived from a source no closer than the Black Sea, more than 500 km away. Also known as the Dove Shell, *Columbellidae* are brightly coloured, presenting a variety of shell patterns. Shells identified as *Theodoxus fluviatilis NeritidaeI* from Kostenki 17 display perforations and smoothed edges, indicating extensive use. The shell surface is whitish with fine, rather variable, darker markings.

Fifteen perforated shells of the species *Littorina obtusata,* (the flat periwinkle) were found at Grotte d'Isturitz, located in the Pyrénées-Atlantiques, south-west France. Shells have also been located at Grotte des Hyènes, Brassempouy in France, but possibly to the other diverse finds from the same site, there is a lack of information relating to them. In addition to the parietal art found at Fumane Cave in northern Italy, the site has yielded 723 seashells from 58 different species collected and transported from the coast about 120 km distance. A preferential selection of the smallest, very visibly decorated forms seems to have been made. Among the shells, nearly half have at least one drill hole, either made by marine predators or humans.

Finally, the site of Abri Castanet in the Dordogne, France has yielded hundreds of perforated shells from the initial excavations in 1935. Further discoveries of ivory and soapstone beads at Abri Castanet have attracted more attention and thus the genus of shells is not specified. Nevertheless, the shells are thought to have come from the Atlantic shore, some 200 km distant at the time the site was occupied.

The selection and collection of shells in Upper Palaeolithic Europe comprise many different types, the descriptions of which in the archaeological literature draw attention to their different colours and patterns. In some cases shells were transported over great distances, and although many do show evidence of suspension, it does not apply to all of the specimens. The range of shells in the archaeological record seems to suggest that potentially shells were being selected for their colours and patterns. In light of the arguments made here this may imply two developments, either that their similarity to teeth was not an important element in their visual appeal after all, or that this preference for shells perhaps because of their attractiveness, variety, durability and ubiquity became more prevalent. The appearance of real teeth in the archaeological record of Upper Palaeolithic Europe suggests the latter.

9.7 TEETH

As discussed above, the first evidence of teeth in the archaeological record outside of Europe is 14 shark's teeth from the site of Buang Merabak, in Papua New Guinea, dating to between 28,000 – 39,500 BP. On entering Europe, the occurrence of the collection of teeth increases in both quantity and types. At Bacho Kiro in Bulgaria, a pierced bear canine and fox incisor have been found dating to >43,000 BP; pierced teeth of fox, wolf and deer dating to c. 32,000 BP were found at Grotte des Hyènes, at Brassempouy in France; and from the site of Kostenki 17 in Russia, 37 perforated fox canine teeth have been uncovered, also dating to c. 32,000 BP. In addition, Grotte d'Isturitz has yielded a perforated human molar dating to between 34,000 – 36,000 BP, and Grotte des Hyènes, at Brassempouy in France, also uncovered four human teeth prepared by perforation or *rainurage* (grooving).

The dominant animal teeth used for personal ornamentation are bear, fox, and wolf with two sites including human teeth, which stands in contrast to the faunal archaeological data. White observes that the animals of whose teeth are worn are not those whose meat is consumed; in other words, "the consumed fauna and the displayed fauna are almost mutually exclusive".[839] He suggests the animal itself plays a role in the collective symbolic imagination, rather than the particular part of the animal transformed into the personal ornament. White makes two important observations, first, the opposition between what is consumed and what is displayed, and second whether the animal itself is important rather than the particular part they have selected to transform.

Taking the first point, there may indeed have been a conscious differentiation between the consumable and the non-consumable. The meat of carnivores and the meat of herbivores may have been recognised as different; and this structural opposition may have played a role in the choice of mammal teeth to display.[840]

Secondly, White suggests the animal itself may play a symbolic role in the collective imagination. One line of reasoning is that humans may have aligned

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[839] White, 2007a:297

[840] However, Alaskans frequently eat bear, both black bear and brown bear and until relatively recently both lynx and wolf were regularly eaten in Alaska (although this has gone out of fashion now). According to zoologist R. Dale Guthrie, "Carnivore meat is probably a little tastier than most wild herbivore meat. Carnivore meat is typically juicy because it is normally fatter. The fat is rather oily… so like most oily meat it has more flavor, and the oily fat picks up a rich roasted fat flavor from the fire. Lean meat (as in wild ungulates) is without intramuscular fat and does not cook well over an open flame". (R.Dale Guthrie, personal communication, 2009)

themselves with the animals whose teeth they were collecting. Bear, fox and wolf are all predators, and those who were collecting their teeth to perforate (for whatever functions) may have considered themselves as predators. Alliances with particular animals possibly based on behavioural characteristics resonate with ideas of totemism and sympathetic magic as discussed in Chapter 2. While we cannot verify such belief systems we may understand how such correspondences may have arisen. Collecting the mechanism (teeth) by which animal predators kill their prey, may impart a sense of equivalence to those who wore them. Teeth, for any animal, human or otherwise are essentially a row of tools. The prevalence for selecting teeth (and talons in the case of Üçağızlı) may indicate something about the properties of teeth and claws. Canines, incisors and talons are all used for biting, holding and tearing prey, so potentially the functional characteristics of teeth and claws were the significant feature in their selection.

Research undertaken by Peter Lucas (2006), an anthropologist at George Washington University has some interesting implications for the selection of teeth as personal ornamentation. Human dentition is extraordinarily disordered and may be the result of people having evolved to eat relatively mushy cooked food. Lucas's theory is that human dentition began to go "haywire" soon after our early *Homo* ancestors learnt to chop and process food with simple tools and, later, to cook it.[841] Anthropologists have not been able to agree on when our earliest ancestors started to prepare food, but current estimates place the advent of cooking up to 2 million years ago.[842] Human teeth are the only body parts requiring regular surgery, and yet the phenomenon that the normal development of human teeth routinely fails to produce 'ideal' dentition has never been accounted for.[843] If spatially disarrayed or 'maloccluded' teeth were an issue in modern humans who had not only expanded their diet but were able to do so because of the ability to cook food more efficiently, then focusing on the body part of an animal that you covet for its strength and uniformity is not unfeasible.

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[841] Pickrell, 2005

[842] It is now contended that, nearly two million years ago in sub- Saharan Africa, early *Homo* switched from an energy base of fruit sugars to the large starchy underground storage organs (corms, bulbs, tubers etc.) that plants often form in exceptionally dry climates. Cooking is hypothesised to have developed simultaneously as a way of improving the digestibility of such foods. (See Wrangham, 1999)

[843] Pickrell, 2005

The appearance of real teeth in the archaeological record of Upper Palaeolithic Europe builds upon the discussions previously presented. The similarities between shells and teeth advanced in light of the evidence from MSA Africa and Australia are possibly strengthened by the selection of real teeth in Upper Palaeolithic Europe. Moreover, finding human teeth in the archaeological record reinforces the importance of teeth and may suggest that meaningful connections were being made between humans and animals either morphologically or characteristically.

The preference for collecting teeth may be supported by research relating to the mirror neuron system. The mirror neuron system is involved in how we understand the actions of others. Until recently this was only concerned with conspecifics, but research undertaken by Buccino *et al*. (2004)[844] showed how this occurs also with other species. For the mirror neuron system to activate the motor action must already be mapped onto the observer's repertoire, in other words the action must be understood by the observer. Observations of biting, regardless of the species of the individual performing the action, revealed points of neural activation, and that observing the action resonates with personal experience. Thus, watching animals use their teeth to tear apart flesh is a motor action we understand. In addition, observing animals or birds using their claws to tear at prey may be comparable in visual terms to the use of stone tools/blades to butcher meat. We may understand the motor actions of animals performing the same activity, using different but comparable tools. This may be the basis for the selection of particular body parts of animals, so that the significance may lie as much in the component parts of animals and how they are used as the entire animal and what it may represent.

Based on the same principles, we may be able to account for the acquisition of human teeth. Stimulated by the brain's chemistry and the mirror neuron system, the acquisition of human teeth may be understood as a particularly intense manifestation of these neural processes. If a positive chemical feedback occurs with the acquisition of animal teeth, and the mirror neuron system activates in response to other species, the preference for human teeth may reinforce the positive chemical feedback even more intensively because it is a conspecific.

[844] Discussed in Chapter 3

9.8 Other Materials

In addition to shells and teeth, a number of other materials appear in the archaeological record. At Istallosko, in Hungary a carefully perforated plate of ivory dates to c 40,000 BP; Kostenki in Russia has uncovered Belemnite and bone beads dating to c 32,000 BP, and a possible carved ivory human figurine dating to c. 40,000 BP. As well as the hundreds of perforated shells from Abri Castanet, beads made from chlorite, talc, calcite, bone, hematite and lignite were found, dating also to c. 32,000 BP; a portion of the collapsed shelter ceiling shows engraved imagery. Grotte d'Isturitz, in southwest France has uncovered pendants made from calcite and amber, dating to 33,000 BP. Thus, new materials being exploited are mammoth ivory, Belemnite, chlorite, talc, calcite, hematite, lignite and amber. In addition, there is evidence of a possible figurine and engraved rock.

Visually, the selection of amber at Isturitz is compatible with the choice of Belemnite at Kostenki, both these materials are similar in colour and translucence and Belemnite "might easily be mistaken for amber".[845] The amber and calcite from Isturitz are also significant; amber is remarkable for its visual properties, and Calcite, while very common[846] exhibits extraordinary diversity and visual appeal. Chlorite is a group of minerals, but derives its name from the Greek *chloros*, meaning green, in reference to its strong green colour. While the forms of hematite vary, they all have a rust-red streak, indeed the name hematite is derived from the Greek word for blood, *aima*. Lignite is either black or dark brown but may contain inclusions, which presents a metallic lustre.

In addition to the visual interest of the new materials, several objects demonstrate a tactile quality. Two different taxa of Belemnite are represented at Kostenki; the primary difference between them is the presence on one of fine transverse ripples, which have a remarkable visual and tactile effect. Four elongated beads made out of fox and bird bone from Kostenki 14, are encircled by deeply cut lines, in one case forming a spiral pattern, and all exhibit a strongly polished surface and smooth edges, suggestive of long periods of use. The use of talc to make beads at Abri Castanet ranges in colour from white to grey or green, but importantly as a material it has a distinctly greasy feel.

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[845] White, 1992:553

[846] It is one of the most common minerals on the face of the Earth, comprising about 4% by weight of the Earth's crust and formed in many different geological environments.

These new materials, to some extent can be understood simply as the result of exploiting new environments. While it is difficult to argue for an enhanced capacity or importance in terms of tactility, what is particularly interesting is that the types of materials selected seem to demonstrate an importance in their visual appeal. This is also demonstrated in the type of shells selected. This will be examined further in the chapter.

9.9 Facsimiles

In the archaeological literature, the class of objects categorised as facsimiles is only found in Upper Palaeolithic Europe. These are the imitation in antler of a perforated red deer canine from Istallosko, Hungary, dated to c. 44,000 BP; two facsimiles of cervid canines, one in ivory, the other in stone, dating to c. 32,000 BP from Grotte des Hyènes, Brassempouy, in France; and seashells sculpted in mammoth ivory from Abri Souquette in the Dordogne, France dating to c 32,000 BP.

Two of the sites present facsimiles of deer teeth, of which one at Istallosko is perforated. In addition, the facsimiles of seashells are of perforated seashells. While this is regarded as a new class of objects, to some degree such facsimiles may have their origins much earlier. The capacity of modern-type humans to copy other objects can be considered to have emerged with the shells found from the Middle Stone Age sites of Skhul, Qafzeh, Grottes des Pigeons, Oued Djebanna and Blombos. The argument already made above is that looking intently at shells, some of which were naturally perforated, may have acted as a visual trigger to select intact shells and subsequently pierce them intentionally, replicating the original form.

A similar argument can be made in the case of facsimiles. The neural networks of modern-type humans may have been shaped by the experience of observing others wearing pierced teeth or shells. Therefore, instead of producing a copy of a deer canine or a copy of a seashell, we may understand facsimiles as imitations of an item of personal ornamentation, a reproduction of a cultural artefact.

The facsimile of a perforated red deer canine fashioned in antler is particularly interesting, because it may represent the making of a metaphor. Ramachandran has discussed the neurological relationship between metaphors and synaesthesia.[847] Synaesthesia is a genetically transmitted condition which results in a mingling of the senses. For example, hearing a particular musical note might invoke a colour, visually perceived numbers can produce a similar effect. Ramachandran suggests that synaesthesia is a sensory phenomenon and that its neural basis can provide a foothold for understanding aspects of the mind, such as metaphor, and the ability to link seemingly unrelated concepts in the brain. He proposes that selective gene expression can occur that allows for a "cross-activation" or "hyperconnectivity"[848] that allows for the capacity to link concepts that are seemingly unrelated, making that person more prone to metaphor. In addition, as discussed in Chapter 3, the area in the temporal lobe known as the Lateral Occipital Cortex, central to object recognition, makes associations between types of objects. Therefore, the production of a red deer canine from deer antler may be a step towards understanding how the brain makes associations between objects, materials, and sensory domains that may help us understand the development of language and metaphor.

The class of objects known as facsimiles are significant because we may understand them as a reproduction of a cultural object, rather than a natural object. If this is the case it demonstrates quite clearly the way that visual familiarity with a particular visual and cultural repertoire may influence further cultural production. This has significant implications for the acquisition of cultural complexity. In Upper Palaeolithic Europe, as cultural objects increase in quantity, we tend to see a resultant increase in material culture, but also that visual culture has an influence upon subsequent forms and practices.

9.10 Interpretations

The category of personal ornamentation has been argued to be one of the key means by which Aurignacian groups constructed and communicated intra-group and regional identities.[849] It has recently been proposed that such regionally distinct configurations correspond to geographically and linguistically distinct ethnic units.[850]

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[847] Interestingly, one of the odd facts about synaesthesia is that it is seven times more common among artists, poets and novelists, and Ramachandran suggests there is a common denominator is that such people have a common skill in forming metaphors, linking seemingly unrelated concepts in the brain. (Ramachandran, 2004:71)
[848] Ramachandran, 2004:71
[849] White, 2003, 2007
[850] See d'Errico & Vanhaeren, 2006

In addition, recent ethnographic comparisons have been used to demonstrate beads as evidence of the visual display of personal information through ornaments, clothing, or other media in order to target strangers or infrequently encountered individuals.[851] The movement of people within a locale and their relationship to ornament production is informative, and provides a clear relationship between social and cultural environments.

The demography of populations in Upper Palaeolithic Europe has been a concern for archaeologists for some time,[852] but recent research[853] has estimated a population density in the Aurignacian between 4500 – 28,000 individuals, increasing to 72,000 individuals by the Magdalenian period.[854] In addition, the distribution of sites is very uneven, with areas having high (North Aquitaine), average (Pyrenees, Belgium Wallone), or small concentrations, and areas where sites are absent or very rare (northern plains).[855]

Recent research undertaken by Powell, Shennan and Thomas (2009) at University College, London has shown that demography is a major determinant in the maintenance of cultural complexity. The authors propose that population densities in early Upper Palaeolithic Europe were similar to those in sub-Saharan Africa when modern behaviour first appeared and that variations in regional subpopulation density and or migratory activity results in spatial structuring of cultural skills accumulation. In this way, demographic factors explain the variation in the timing of the first appearance of modern human behaviour without invoking increased cognitive capacity.

The above studies seem to demonstrate that there are well founded associations between social intensity and cultural complexity. What is of interest here is the role that increased sociality may play in neural functioning, and we can draw on Environmental Enrichment studies in this consideration (discussed in more detail later). One of the three elements considered to comprise Environmental Enrichment is social interaction (as well as physical activity and mental stimulation that involves some degree of experiential learning). Thus, population density and demography are important indicators not only culturally, but neurologically.

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[851] Wobst, 1977
[852] Nougier, 1959; Bordes, 1968; David, 1973; Bailey, 1983; Biraben, 1988; Rozoy, 1989
[853] Bocquet-Appel *et al.* 2005
[854] Bocquet-Appel *et al.* 2005: 1664.
[855] Bocquet & Demars, 2000

The appearance of 'facsimiles' in the archaeological record is important. Only briefly referred to in the archaeological literature, these objects are regarded in the context of the capacity of modern-type humans to "extract a form from a natural context and to transfer it to a completely new medium".[856] The significance of the appearance of facsimiles may indicate the imitation of a form from a cultural context, rather than a natural context. An interesting issue that arises from facsimiles is that it may indicate the formation of thought processes whereby analogies are made between two objects or ideas.

9.11 Summary

The objects discussed here may well have become markers of regional identity. They may have corresponded to distinct geographical and linguistic groups. The animals from which teeth were selected may also have played a role in a symbolic collective imagination. None of these interpretations is mutually exclusive, and all demonstrate valid and well-founded interpretations. The concern here lies in the motivations for the induction of these artefacts in a particular visual and cultural repertoire, by which they acquire symbolic importance. An important component in a natural object making the transition to becoming a cultural object is the role of social relationships for their negotiation and maintenance.

Gamble (2002) has argued for new and different kinds of social networking in Upper Palaeolithic Europe marked by the way that materials and artefacts were exchanged over large distances for the first time. The social and cultural networks are an important factor here in the way in which people are not only responding to their natural environments, but also their social and cultural environments. This is most notable in the category of 'facsimiles', where levels of representation appear rooted in cultural context. In addition, this increase in social networking across Europe may account for an enhancement of the mirror neuron capacity, as new social groups were encountered and exchange networks developed. Such an enhancement of the mirror neuron system because of increased sociality may in turn have enhanced the connections between the motor, visual and memory areas of the brain, where we now know mirror neurons are active in humans.

[856] White, 2003:74

9.12 REPRESENTATIONAL ART

Representational art appears in two particular forms in Upper Palaeolithic Europe, mobiliary and parietal. Mobiliary art occurs as a regional phenomenon in the Swabian Jura, in southern Germany, dating to between 30,000 – 40,000 BP, as well as one human figurine from Galgenberg in Austria, dating to around 29,000 – 32,000 BP. Parietal art occurs in two sites, Fumane Cave in northern Italy at 32,000 – 36,500 BP and at Chauvet cave, in the Ardéche in France at 32,000 BP. Mobiliary art appears slightly earlier in the archaeological record, and for this reason will be dealt with here first.

9.13 MOBILIARY ART

Four sites in southern Germany have yielded the oldest figurative sculptures to date. All the objects come from a single area, Höhlenstein-Stadel and Vogelherd, located in the Lone Valley, and Höhle Fels and Geissenklösterle, situated in the nearby Ach Valley. All the figurines date to 30,000 – 40,000 BP, and are made from mammoth ivory.

Only one figurine was found at Höhlenstein-Stadel in the Lone Valley, dating to around 30,000- 32,000 BP. Termed in German a '*löwenmensch*' (lion-human) because of its assumed lion and human attributes, proportionately it is 5-6 times larger than other figurines found in the area. Vogelherd cave, which lies about 6 km away, is an interesting comparison to Höhlenstein-Stadel because of the number of very small figurines that have been unearthed. A dozen figurines are discussed here, interpreted variously as a horse, bison, mammoth, rhinoceros, lion, snow leopard and a human. All date between 30,000 and 36,000 BP.

In the Ach Valley, Höhle Fels and Geissenklösterle are situated only about 2 km apart. At Geissenklösterle, figurines of a bear, a mammoth, a bison and a possible hybrid half-human, half-animal figure have been unearthed, dating to between 32,000 – 37,000 BP. Höhle Fels has yielded a small '*löwenmensch*' a waterbird, a horse's head, and more recently in 2008 a female figurine. All the objects date to between 31,000-33,000 BP, except the human figurine which may be as old as 40,000 BP. One of the questions we may ask is why sculpted representational art occurs here first.

Modern-type humans are living in a colder environment in Upper Palaeolithic Europe than they have ever previously experienced. The Swabian Jura is a particularly advantageous place to live, as the outcrops of limestone provide caves that afford shelter and protection. In fact, all four of the cave sites have entrances that are particularly well concealed, and thus protected (from either animals or other humans). By the same token, this feature provides the opportunity to see, without being seen.

While all the animal figurines have been classified as belonging to a particular species, out of the 21 objects discussed here, only 5 of them are unambiguously identifiable to a recognisable species (to us). The horse, mammoth and waterbird are clearly identifiable as such, the bison show distinct similarities to the real animal, but the remaining figurines are indistinct. In some cases, there is only a vague similarity with the animal which it supposedly represents. Clearly, there is a capacity for making sculptures that resemble the animal they are depicting; the mammoths and horse from Vogelherd and the waterbird from Höhle Fels are all of an exceptional likeness. In other cases the logic may lie with the properties of animals. In the same way as the selection of particular animal teeth may have been based on the properties of the animals, so the figurines may be concerned with particular attributes. The uprightness of a bear or the stealth of a lion; whatever animal they were looking at with any particular attention, the figurine may have taken on those attributes. Moreover, each figurine may have multiple attributes, making it even more powerful.

The '*löwenmensch*' from Höhlenstein-Stadel is an anomaly in terms of its difference in size to the other figurines. In addition, its interpretation may be subject to some ambiguity, which has subsequently influenced the interpretation of the anthropomorphic forms at Vogelherd (30j) and Höhle Fels (31a). Originally found in 200 pieces, the restoration of this figurine may have pushed its interpretation in one particular direction. Initially classified as male, the identification of male sexual anatomy was an illusion created by poor preservation of the ivory, it was subsequently determined to be female (a lioness) and renamed *Löwenfrau* (lion-lady). Both interpretations lack scientific evidence for sexing however, and more recently it is more often called a *lion-headed figurine*. The current German name *Löwenmensch* is less neutral, meaning 'lion-human'. Therefore, just as the ambiguity of the other animal figurines may underlie something about the properties or characteristics of animals, the '*löwenmensch'* may fulfil the same visual function. The depiction of an upright lion, in addition to its size may imply something about the nature of a lion, its physical characteristics, its power or its roaring sound. From personal observations, the location of Höhlenstein-Stadel situated in the Lone Valley is such that sound travels extremely well; in a way that does not occur at the other three sites. While a lion may not be seen immediately, the environmental conditions indicate it would certainly be heard. If we accept this reading of the figure as demonstrating lion and human attributes, we can make similar connections as we did with the facsimiles and the role of metaphor. The lion as a metaphor may infer various characteristics such as its strength, power, predatory nature, all of which may appeal as human qualities. What this may indicate is alternative ways of thinking about and making connections between modern humans and the environment in which they live. If this is so, then this also influences cultural production in material ways.

In contrast, the only other figurine that has an upright stance is a proposed standing bear from Geissenklösterle (Cat 32a). Interestingly, the interpretation of this figure does not include any anthropomorphic or therianthropic inferences. It simply depicts a standing bear. Based on morphological visual characteristics, despite current interpretations, the 'l*öwenmensch*' from Höhlenstein-Stadel may not be a hybrid figure, but rather a standing lion, similar to a standing bear (Figures 9.1 and 9.2). The shape of the torso, muscular shoulders, arms, thighs and calves all suggest animal rather than human morphology. Certainly, both lions and bears display such behaviour.

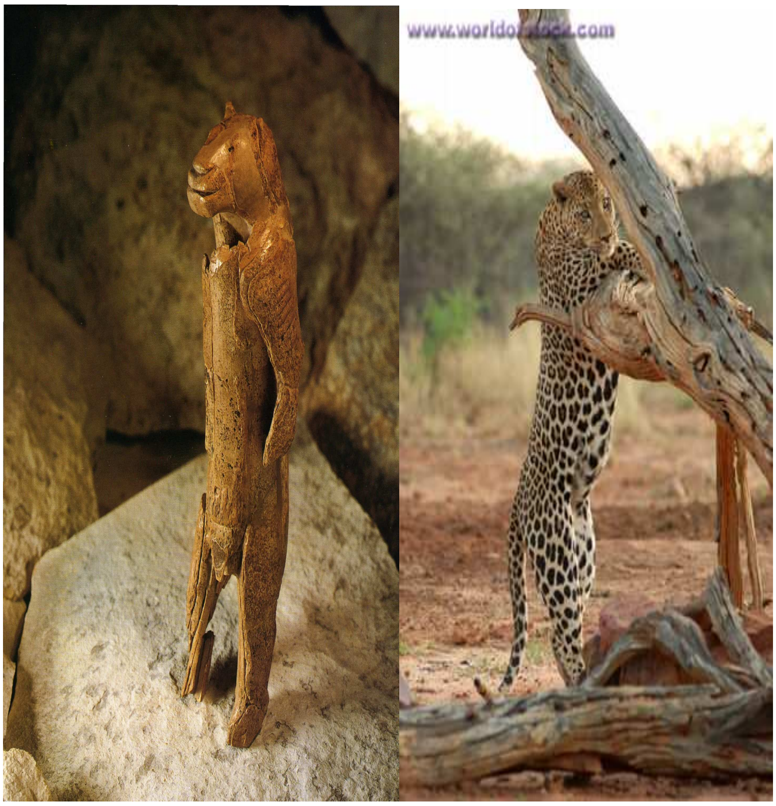

Fig. 9.1 (Left) ‘Lion-Man’ from Höhlenstein-Stadel and (right) leopard standing against tree

Fig. 9.2 (Left) standing bear from Geissenklösterle and (right) seated bear

The use of mammoth ivory in the production of all these figurines points towards a relationship between artefacts, materials and the techniques employed in their production. Mammoth ivory was found at three out of the four sites. At

Vogelherd a large pile of mammoth bones and tusks was situated across the southwest entrance. The repertoire of ivory artefacts ranges from the highly crafted animal figurines to unfinished items, for example, more than two dozen ivory rods, pencil-thin and sometimes split lengthwise which might have been intended for bead production. Found in a bundle the ivory rods are thought to represent a cache of material intended for future use.[857] At Höhle Fels some of the stratigraphic layers have produced hundreds of pieces of debris from ivory working.[858] The bone weight analysis of the Geissenklösterle fauna shows that mammoth is the most important game animal after the horse. In the Aurignacian layer (AH II), remains of several very young mammoths were found, including skull fragments, milk tusks, foot bones and finger bones. These remains are from at least three infants of about 2 months of age. In addition, ivory and ribs of older individuals are present.[859] The significant presence of mammoth ivory at these sites indicates that this raw material was evidently valued as a resource for the carving of these figurines.

The techniques involved in ivory carving involves the splitting and wedging of desiccated mammoth ivory, followed by scraping, gouging, incising, grinding and polishing. The polishing was achieved with powdered hematite, a very effective metallic abrasive, still used today by contemporary carvers.[860] Ivory is a remarkably strong material but its composition and structure also make it an ideal medium for carving.[861] It has been observed that, “the lustrous polish that one can achieve on ivory surfaces mimics the brilliance of more brittle surfaces like tooth enamel and shell”.[862] In light of the discussion of personal ornamentation in the Upper Palaeolithic when shells and teeth increase in quantity in the archaeological record, this is a significant reflection. The selection of ivory may have been culturally significant because of its resonance with materials already held in high esteem.

In an experiment undertaken by Heckel (2009) to reproduce in ivory[863] a mammoth figurine such as the examples from Vogelherd (Cat.31b or 31k), the objective was to explore the process of working ivory with stone tools (limited to the

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[857] Riek, 1931, 1934; Conard *et al*. 2007
[858] Conard, Uerpmann 2001 and 2002; Conard, 2003
[859] Hahn, 1979; Münzel, 2001; Conard *et al.* 2003; Teyssandier *et al*. 2006
[860] White, 1997
[861] Heckel, 2009:75
[862] Heckel, 2009:76. White (1993, 1997) has also suggested that the use of ivory in the Palaeolithic was in part an effort to achieve lustrous tactile and visual properties
[863] The mammoth ivory used in these experiments was taken from a cylindrical tusk segment with an estimated age of 28,000 years, recovered from Alaskan permafrost in the 1920s. (Heckel, 2009:79)

tools and techniques available during the Aurignacian), including the manner in which the material might dictate or influence form. The author describes the complexities and force required in manipulating the raw material, the multisensory experience in the production of the carving and the subsequent time-consuming process of polishing, resulting in a “high luster [which] was quite smooth and pleasing to the touch”.[864] More than one hundred man hours were involved in the shaping and polishing of the figurine and while this is not meant to reflect the processing time of Aurignacian figurines it demonstrates a considerable investment of time and energy. Such manual dexterity and observational skills employed in this experiment illustrate well the relationship between motor actions and visual perception. As discussed in Chapter 3, the division of labour between the ventral and dorsal streams in the brain are often activated simultaneously, whereby the two systems of perception and action engage cooperatively. To produce these figurines required repeated and/or exceptional practice, manually and visually, likely to result in particular skilled people involved in their production. Based on previous discussions in Chapter 3, expert artists uses “higher-order” cognitive functions, in which accomplished ‘doing’ may be more compatible with higher order ‘thinking’. If they were skilled artists who were making these figurines, potentially the areas of the brain involved in production were less concerned with making an exact copy, and used areas of the brain involved in planning motor movements and the formation of associations. We may speculate that the ambiguity in some of these figurines result from such neural formations.

9.13.1 Dimensions

The dimensions of the sculptural forms from the Swabian Jura have not been explored in the scholarly literature and this is probably because, as mobiliary forms of art, their portability, and in turn their size, is part of their rationale. Indeed, if we look back to the earliest art, it seems that humans make small art. However, one interesting factor, as Tables 9.1 and 9.2 indicate, is that there is some regularity in dimensional relationships in the figurines from the Swabian Jura.[865] The correlation

[864] Heckel, 2009:85
[865] The dimensions of each object have been gathered from archaeological reports of the various authors, and relate to maximum dimensions. There may be variability in the locations where things are measured, and this data might not be known or easily characterised.

in dimensions within and across sites is an interesting phenomenon and suggests that there is some uniformity in production, (for a detailed description of the objects and author list see the Catalogue entries in Volume 2). Such perceived regularity may of course be the result of preservation bias, nevertheless, it is striking that all are of approximately similar scale, and that scale is not dictated by the choice of raw material (mammoth ivory). Whether we can think of these objects as miniatures (if we compare them to the *löwenmensch* of Höhlenstein-Stadel), a prevailing condition of their dimensions relates the measure by which they are produced, namely the hand.[866] Mack (2007) has discussed the nature of miniaturisation in terms of not only technologies of production, but also the aesthetic and cultural processes involved by reducing an object in scale. He argues that the sense of smallness or bigness "is related to our own sense of body as the gold standard in the realm of measurement".[867] By comparison, if the smaller figurines, which fit neatly into the palm of the hand, are what Mack terms the "gold standard", then the *löwenmensch* from Höhlenstein-Stadel stands out in terms of scale. Conceivably, making small objects was the 'model' because the measure was the hand; the dimensions of the *löwenmensch* disrupt the 'model' and may help explain why it is the only example of its kind. The issue of scale is an interesting area in Palaeolithic art, and while it is difficult to make any judgements either way, if reduction in scale is considered both a "technical and cultural process",[868] then by implication so is amplification.

The regional coherence of these figurines supports current interpretations of social interaction between people at these Swabian sites, and would account for some aspects of imitation across sites. Observing someone carving a figurine is potentially enough to understand and remember the motor actions involved and imitate the action, engaging the mirror neuron system. If practices of emulation or replication are part of the process of production, this may also contribute to the ambiguity in identification in some of the figurines.

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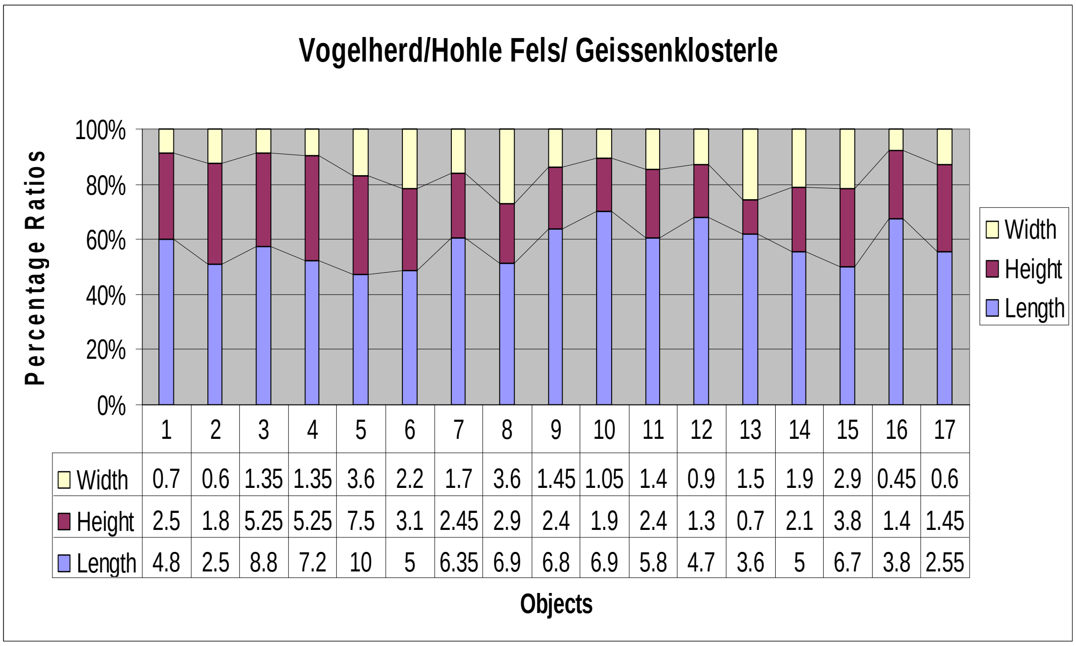
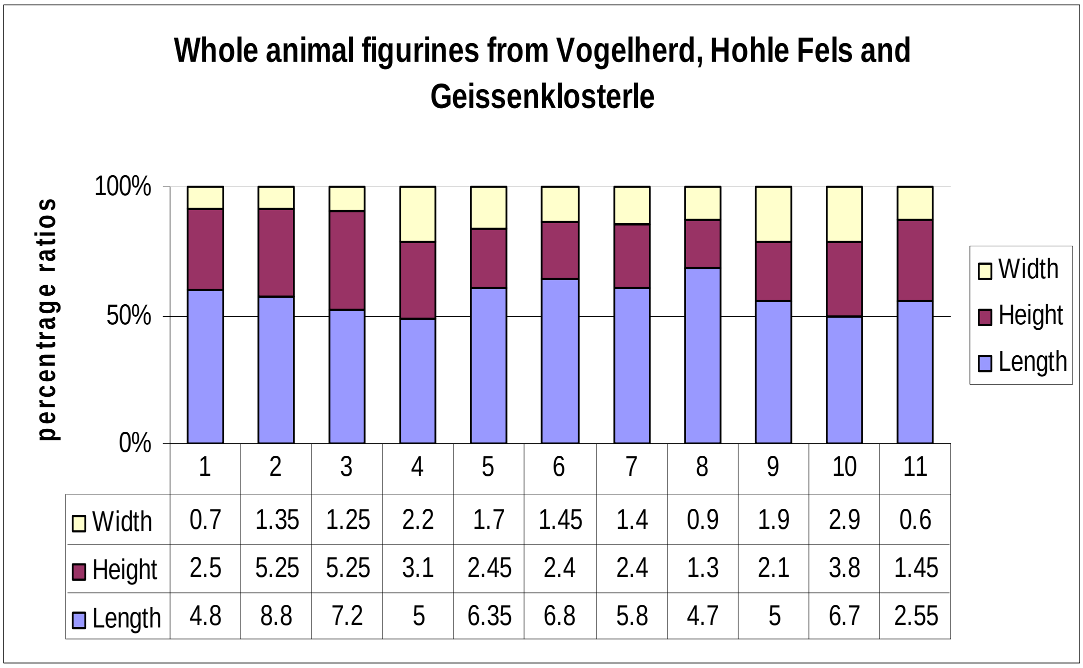
[866] Mack, 2009, personal communication
[867] Mack, 2007:53
[868] Mack, 2007:75



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Width	0.7	0.6	1.35	1.35	3.6	2.2	1.7	3.6	1.45	1.05	1.4	0.9	1.5	1.9	2.9	0.45	0.6
Height	2.5	1.8	5.25	5.25	7.5	3.1	2.45	2.9	2.4	1.9	2.4	1.3	0.7	2.1	3.8	1.4	1.45
Length	4.8	2.5	8.8	7.2	10	5	6.35	6.9	6.8	6.9	5.8	4.7	3.6	5	6.7	3.8	2.55

Table 9.1 Table showing the dimensions of the objects from Geissenklösterle, Höhle Fels and Vogelherd



	1	2	3	4	5	6	7	8	9	10	11
Width	0.7	1.35	1.25	2.2	1.7	1.45	1.4	0.9	1.9	2.9	0.6
Height	2.5	5.25	5.25	3.1	2.45	2.4	2.4	1.3	2.1	3.8	1.45
Length	4.8	8.8	7.2	5	6.35	6.8	5.8	4.7	5	6.7	2.55

Table 9.2 Table showing dimensions of whole animal figurines

9.13.2 Interpretations

There has been considerable debate and hypotheses relating to the interpretation of the figurines of the Swabian Jura. Riek (1934) emphasised the importance of palaeoecology and hunting magic, Hahn (1986), argued that the Aurignacian inhabitants of the region mainly depicted strong, fast and dangerous animals, while Dowson and Porr (2001) and Lewis-Williams (2002) have stressed the importance of mixed representations of animals and humans as evidence for shamanism. Each of these interpretations is plausible and they may all comprise a level of accuracy, because in one way or another they are all concerned with connections between the human and animal worlds. The propositions put forward here concerning the ambiguity of some of the depictions, the possible focus on particular qualities of animal behaviour, the potential for metaphor, and the likely importance of materiality for its visual qualities are all compatible with the interpretations above.

The fact that these sites are producing the same type of figures and they are all in close proximity is an important issue. The setting of the discovery of the *Löwenmensch* deep in the cave of Höhlenstein-Stadel has been argued to indicate that it is a cache or cult site.[869] The larger dimensions of the *löwenmensch,* in contrast to the numerous other smaller figurines also contribute to its prominence.[870] In comparison, Vogelherd, Geissenklösterle, and Höhle Fels, based on the size and content of their assemblages, are considered to represent substantial habitation sites, rather than extraordinary sites.[871] It is suggested that social interactions between local and regional Aurignacian groups may have involved seasonal aggregations at Vogelherd, based in part on the predictability of prey during certain times of the year.[872] The evidence from the Ach and Lone Valleys during the period 40,000-30,000 years ago clearly demonstrates that modern-type humans frequently visited this area or settled for long periods, as the numerous dates for the Swabian Aurignacian indicate.[873] The argument made is that the Aurignacian culture appears

[869] Hahn, 1986; Schmid, 1989
[870] In fact, painted life-size copies of the *löwenmensch* are displayed in the town centre of Ulm where the original object is housed, testifying to its importance in the cultural heritage of the area.
[871] Conard, 2003:831
[872] Invent, 2007:378. Work on the fauna from the Ach Valley sites (Muzzle, 2002) indicates that the caves of the region were used repeatedly in the winter and spring for relatively lengthy occupations.
[873] Conard and Bolus, 2003

suddenly and in a highly developed form in the Swabian Jura.[874] Moreover, the culture is thought to have its roots locally, “since many of its most prominent characteristics, including figurative artworks, many forms of ornaments, and tools are unknown in neighbouring areas”,[875] pointing to a strong regional coherence.

If we accept that people in the Ach and Lone Valleys were interacting regularly, we have a basis for understanding the neurological processes by which the emulation or replication of techniques, materials and forms can be transferred across and within sites. The regularity across sites in terms of depictions and dimensions may indicate shared working practices as well as shared meanings.

9.14 HUMAN FIGURINES

The discovery of the female figurine from Höhle Fels is significant because it is the first unmistakeable representational art-object in human form. In addition, it conforms to a class of objects known as ‘Venus’ figurines that were considered to be a product of the later Gravettian period. Although the head is missing and has been replaced by a simple loop for suspension, the focus of this figurine remains the same as the later classic’ Venus’ figurines, that is the breasts, stomach and sexual organs.

A significant feature in the case of the Höhle Fels figurine is the tactility of the sculpture. The exaggeration of form, deeply incised lines and size (it fits neatly into the palm of the hand) imply that the handling of this object may have been as important as its function as its visual appeal. Numerous other figurines from the Swabian Jura also possess incised lines, strengthening the case for objects that go beyond the visual experience.

Ramachandran has addressed the neural underpinnings of the classic ‘Venus’ figurine model, epitomised by pendulous breasts, and generously proportioned stomach and buttocks. He suggests that the reason for the amplification of such attributes could be based in a neurological principle known as Peak Shift, whereby the brain is hard-wired in such a way that allows it to focus on parts of objects that matter the most.[876] In the case of the Höhle Fels figurine this corresponds to the breasts, stomach, thighs and vulva. Conceptually, this object is intriguing because it appears to intersect both figural representation and personal ornamentation. The

[874] Conard and Bolus, 2006:220
[875] Conard and Bolus, 2006:220
[876] Ramachandran and Kirstein, 1999; Ramachandran, 2006

combining of two particular art forms is unique at this early period, but neurologically it demonstrates the way in which connections and associations are made between cultural objects in the brain, resulting in the creation of new forms.

The other human figurine is the Galgenberg figure, from Austria. Dated to around 29,200 - 31,900 BP, this figure is very different from the Höhle Fels example. There are no overt sexual organs, and the surface reveals no incised markings. The figure has been dubbed the 'Dancing Venus', and while this is a historically and socially contingent appellation, invoking Ramachandran's Peak Shift may advance our understanding. If we consider that this principle allows us to focus on elements of objects that matter most, while her interpretation as a dancer is a contemporary label, the attitude does appear to demonstrate a degree of movement. In the case of the Galgenberg figurine, Peak Shift may relate to an exaggeration of posture.

9.15 PARIETAL ART

Parietal art occurs at two sites in early Upper Palaeolithic Europe, Fumane Cave, dating to between 32,000-36,500 BP and Chauvet Cave, dated to c. 32,000 BP. The data set from Fumane cave is limited and is not comparable in quality and quantity to Chauvet cave. The fragments seem to have been part of a larger wall painting that has flaked off, rather than individual representations, but the depictions are ambiguous and not easily identifiable. This makes the development of an argument problematic. If we look to the environment for any clues, during the time of their production, the western part of the Lessini Mountains offered Palaeolithic hunters a huge range of resources. Game on the high plateau included ibex, chamois, bison/aurochs, alpine hare, dormouse, alpine chough (crow). In the underlying woods could be found red and roe deer, megaloceros deer, mountain pheasant, and thrush; and in the wet environment of the high plateau, ducks.[877] If we are seeking a source and possible motivation for the representation of animals at Fumane (similarly with Apollo 11 Cave), the environment provides a good starting point.

[877] Broglio, 2001; Broglo *et al*. 2001, 2003, 2006; Broglio & Gurioli, 2004; Broglio & Dalmeru, 2005

9.16 CHAUVET CAVE

The data set from Chauvet cave comprises three sections of imagery, dating to c. 32,000 BP. The ‘Bison Panel’ which comprises three bison, the ‘Horse Panel’ which includes two confronted rhinoceroses and a drawing of a Megaloceros.

When taken as a whole, the animals depicted at Chauvet cave, largely share similarities with those in the Swabian Jura. The vital difference is that the representations at Chauvet, unlike some of the Swabian figurines, present no ambiguity in their identification. Not only are they easy to identify to species level, they are considered such life-like renderings that they have even been compared to “a modern wild-life film”.[878]

The life-like property of many of the images at Chauvet is of great significance to and indeed underpins the neural approach already undertaken by Onians (2007). Onians has argued that the realistic renderings are neurally derived from the location of Chauvet Cave. The Pont d’Arc, a natural limestone arch across the Ardèche River, could have made a practical crossing point for the herds of migrating animals travelling north or south. Twice a year, he argues, those living at Chauvet were presented with “the sight of an exceptional procession of animals [and] those who witnessed that sight would indeed have had neural networks exceptionally attuned to seeing large mammals”.[879] It is this biannual visual experience of migrating animals that is considered to be at the root of the life-like renderings and compositionality of the left wall of the End Chamber at Chauvet (Fig 9.3).

However, this explanation may be problematic when thinking about the dating of Chauvet. Pettit and Bahn (2003) have called into question the oldest proposed dates of Chauvet cave, advising that the radiocarbon dates may need more rigorous validation, as well as citing Zuchner’s observations (1996; 1999) that the style of art more likely belongs to the later Gravettian and late Solutrean/early Magdalenian periods. If indeed the art is much later than 32,000 BP, this potentially poses a dilemma for Onians’ proposal. If the migration of animals had been an event occurring over millennia and presumably witnessed by those living at Chauvet, then the reason for why they suddenly began to have an impact upon people’s visual cortex thousands of years later is difficult to explain.

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[878] Onians, 2007:311
[879] Onians, 2007:315

Figure 9.3 Left Wall of End Chamber, Chauvet Cave.

One explanation may be that the visual preferences of modern humans *were* influenced by the sight of migrating animals but that it took a further set of conjunctions before the application of pigment to cave walls and the depiction of images of those animals occurred.

Onians' argument for why modern-type humans might have made marks on walls in the first instance invokes the mirror neuron system as a method of explanation. He argues that many engraved representations and silhouette handprints superimpose claw marks made by bears. He reasons that the sight of claw marks on the cave walls may have activated the same neurons in the pre-motor cortex in modern-type humans that led to the making of a similar mark on the wall.[880] The impetus to make marks on walls as a result of a visual trigger may have taken place at any time, and so if Chauvet is confirmed to be of a later date, it would not affect this proposition.

If we accept Onians' argument that the site of large mammals attuned the neural networks of those living around Chauvet cave, the steep limestone cliffs that rise up out of the Ardèche gorges may have played a similar role in influencing the placing of pigments on cave walls. Because of impurities, such as clay, sand, organic remains, iron oxide and other materials, many types of limestone exhibit different

[880] Onians, 2007:312

colours, especially on weathered surfaces. A significant feature of the limestone cliffs rising from the Ardèche River is that they display black and red/orange colouring. This colouring looks like trickling pigment and covers large surface areas of rock face (Figures 9.4). If the sight of migrating animals were sufficient to adjust neural networks, the daily observation of large surface areas of limestone rock presenting black and reddish hues may have been sufficient to trigger the application of black and red colouring onto the walls of the cave.

Fig. 9.4 Limestone cliffs near to Chauvet Cave

(Image: Helen Anderson, 2008)

9.16.1 Interpretations

The dexterity, expertise and visual perceptivity in the execution of these images have resulted in the depictions being described using art historical terminology and interpretations. For example, the terminology and interpretation used for 'The Panel of the Horses' is entrenched in value-laden expressions, such as 'spectacular', 'expressive', and 'harmonious'.[881] The panel is treated as a contemporary painting in that it has an axis and a preconceived mental template of the overall composition. Moreover, there is an explicit acknowledgement that within the panel we can see "an artistic approach in the most contemporary sense of the term".[882] Similarly, Onians' analogy of the imagery as a modern wild-life film recalling scenes of migration potentially makes assumptions about the way we read images. What we regard as a particular depiction may not necessarily reflect the same perceptions in the past. The superimposition of animals, one on top of another may engage the same neural processes as Peak Shift, where the visual amplification of an image or imagery produced positive neurological associations. This may explain not only the significance for Palaeolithic people, but of course our own interpretations and appreciation.

While the interpretive analysis presented by Clottes and his colleagues is subject to some biased terms, Clottes recognises that what is chosen to represent, is guided by experience.[883] Guthrie[884] (2005) also has observed that artists "do not choose images at random"[885] and drawing on his expertise in zoology, palaeontology and modern hunting, has argued the case that Palaeolithic artists, "focused again and again on a particular range of large mammal images",[886] demonstrating an intimate knowledge of natural history.

9.17 SWABIAN JURA AND CHAUVET CAVE – A COMPARISON

Thinking about the environment and experiences of modern-type humans at Chauvet, allows us to see why Chauvet might be the earliest and most life-like representations. Yet, as Onians states, "it doesn't require it to be".[887] The argument made is that a particular set of conjunctions occurred at Chauvet that provided the suitable conditions in which making marks and painting life-like depictions of animals transpired. Different conjunctions could have had comparable results elsewhere, and all such conjunctions could be independent of each other.[888] If Pettit

[881] Clottes, 2003:116
[882] Clottes, 2003:116
[883] Clottes, 2003:116
[884] R. Dale Guthrie is professor emeritus of zoology at the University of Alaska
[885] Guthrie, 2005:52. A sentiment supported by Clottes in his reflection on Chauvet.
[886] Guthrie, 2005:52
[887] Onians, 2007:316
[888] Onians, 2007

and Bahn's concerns over the antiquity of Chauvet are substantiated and the imagery is found to be younger than currently thought, then the set of conjunctions would indeed be independent of each other.

An aspect of the emergence of representational art which interests me is related to the differences in medium between the depictions at Chauvet and those in the Swabian Jura. When modern humans start to produce representational art it comes in two very different forms; parietal and mobiliary, which is very regionally specific. The cave art at Chauvet, although similar to the Swabian Jura in terms of what is depicted, manifests quite different forms. These two regions are both broadly of comparable date.[889] However, in France, modern humans at Chauvet are painting on the walls of the cave, scenes that span entire walls, covering areas several metres long. On the other hand, in southern Germany, they are sculpting small-scale figurines made from mammoth ivory. How can we account for such similarities and disparities in practice? Based on our knowledge about the neural correlates between the visual brain and the environment, we may look to their differing environments and the particular visual experiences of animals within those environments.

The selection of species for representation is quantitatively different between Chauvet and Swabian Jura. The latest publication of Chauvet documents 420 images of which 65 are rhinoceros, 71 felines, 66 mammoths, 40 horses, 31 bovids, 20 ibex, 25 cervids, 15 bear, 2 musk ox and one an owl, not to mention a whole group that are unidentified, as well as four or five female genitalia and many silhouettes and stencils of hands.[890] In comparison, figurines from the Swabian Jura comprise 21 (as catalogued here) of which there are 2 horse, 2 bison, 5 mammoth, 1 rhino, 4 felines, 1 bear, 3 human figures and 1 waterbird. As discussed above, White has already observed in relation to personal ornamentation, that the animals of whose teeth are worn are not those whose meat is consumed, suggesting the animal itself may have some symbolic importance. The same argument may be made for the representations

[889] In both regions, the chronological period varies between 36,000 and 30,000 years BP. The consistency of the 46 AMS radiocarbon dates from Chauvet indicates that most of the black paintings fall between 33,000 and 29,000 years BP. In the southwestern German case, all the absolute dates from mobiliary art are dated to *c*.36,000– 27,000 years BP. For instance, the radiocarbon dates from Vogelherd, Höhlenstein-Stadel and Geissenklösterle proposed by Joachim Hahn (1986, 130–1) range between 34,000 and 27,000 years BP, and most are clearly concentrated in the period between 33,000 and 30,000 BP. According to the 14C dates published by Nicholas Conard (2003, 831), artwork from the four German sites was created between 30,000 and 36,000 years BP. This chronology is confirmed by the stratigraphy. (Abadia et al, 2007:118)

[890] Clottes, 2003

at Chauvet and in the Swabian Jura. There are some similarities between Chauvet and Swabian in the types of animals depicted, such as felines, rhino, bison, and mammoths, as well as one bird depicted in each, an owl at Chauvet and a waterbird at Höhle Fels. Why these particular animals had an impact upon the visual cortex and not others is difficult to account for. Moreover, why we find human and human-like depictions in Swabia and not Chauvet is similarly difficult to explain.

The selection of particular animals may have been predicated upon what they offered modern humans in terms of resources (subsistence, tools, materials), or for their behavioural qualities (strength, agility, cunning). But exactly why the paintings are located deep within the cave is difficult to explain. Chauvet was used as a place of hibernation and shelter for bears; this cave was not a habitation site for modern humans. It seems this was not a place of safety, and yet representations were painted deep inside the cave, and seemingly visited on several occasions. It has also been attributed as a site of ritual/shamanic or religious significance. It may fulfil any of these functions. More research in the future might assess whether the activities may have been related to purposeful risk-taking behaviours.

The context of the Swabian images is very different in that the caves were not so labyrinthine and were used for habitation, and the differences in site use may certainly have had an impact upon the function of the imagery. The Swabian figures are different both in scale and tactility; their size, highly polished appearance and incised markings may suggest that regular handling and contact were part of their rationale. Current thinking about these sites as evidence of seasonal aggregation would support this line of reasoning, as artefacts of social value.

The chronological, thematic and formal resemblances between the Chauvet paintings and the carvings from the German Aurignacian period have been well-documented,[891] and it is not the intention within this discussion to contribute to that debate. The issue here is, as Hahn states, that “During the Aurignacian, people had a special way of reproducing parts of their environment that was different from the following Gravettian…Aurignacian art represents its own manner of visual perception”.[892] Although Hahn is talking here about conventions of art styles, there is no doubt that he has recognised a way of looking that relates to work produced in a particular time and place. Current readings suggest that Chauvet Cave shows a

[891] See Abadia & Morales, 2007
[892] Hahn, 1993:232

quantitative awareness of animals interacting with each other; the sites in the Swabian Jura demonstrate a different perception of animals, the observations of discrete and solitary animals.

The reason for the differences may lie in the topography and environment, which ensured such different observations and experiences of animals. As already mentioned, Chauvet Cave is located close to what may have been a bottleneck on seasonal migration routes. Although Chauvet is located in a deep cut gorge, it is situated quite high up in the surrounding limestone cliffs, and above the gorge the view is expansive (Figures 9.5); the sight (and sound) of migrating herds would probably have been possible from a substantial distance away.

Fig. 9.5 View from the top of gorge overlooking Ardèche River looking north

(Image: Helen Anderson, 2008)

In contrast, the sites located in southern Germany are situated in river valleys, enclosed by woodland (Figure 9.6). We know from palaeoclimatic research, outlined in Chapter 3, that river valleys in southern Europe were more wooded than previously thought, and thus there is less expectation of migrating herds. Rather, the act of seeing was likely more partial and immediate and potentially a more enhanced visual acuity was required to detect movement, shapes and colours within such an environment. Vogelherd is the only site of the four where visibility across the landscape is less impeded (Figure 9.7), and therefore migrating herds may have been a feature of this visual environment. Certainly, Vogelherd has yielded many more animal figurines to date than the other caves.

Fig. 9.6 Woods near Geissenklösterle

(Image: Helen Anderson, 2008)

Fig. 9.7 View from Vogelherd

(Image: Helen Anderson, 2008)

The physical environments in terms of topography and types of cave systems and the ways in which humans experienced animals within those environments is likely to have played some significant role in the way humans thought about animals and the meanings that were attached to the representations they made of animals. The difference in the medium by which representations are made is obvious, but their context seems to point towards the ways in which the representations may have been articulated socially. The Swabian sites indicate the artefacts belonged to an inclusive, shared system of display, handling and meaning. In contrast, the potential element of risk and the locating of imagery within a deep cave system at Chauvet seems to indicate a more exclusive and restricted visual display of representation. Clottes' suggestion of Chauvet as a place of shamanic practices and beliefs may be accurate, but a question that arises for me is whether the environmental context of Chauvet triggered shamanic beliefs or was the belief system was enhanced by the environmental context?

9.18 RETHINKING THE 'REVOLUTION'

Having considered the data, from Africa to Europe, from 100,000 BP to 28,000 BP, let us reconsider the so-called 'Human Revolution' in neural terms. Chapter 3 posited the notion of Environmental Enrichment as a potential way of understanding why the wealth of new artistic activities may occur in Upper Palaeolithic Europe. The suggestion is that moving into a radically new environment may have altered neurological structures to the extent that it affected cultural behaviour in observable ways. However, what is more likely is that Environmental Enrichment may have affected all those modern-type humans who migrated into a new environment, not just in Europe. The variables lie in the extent to which the new environment and the accompanying experiences affected neural structures.

The elements considered to comprise Enrichment include physical activity, social interaction, and mental stimulation that involve some degree of experiential learning. In varying degrees all these criteria were in place as modern-type humans moved into South Africa, North Africa, the Levant, India, Australia, Papua New Guinea and Europe (as well as the numerous other places modern humans colonised). As each new environment was navigated and learned, it would have altered neural networks in measurable ways, and thus had some impact upon the way in which modern-type humans behaved; which we can see in the archaeological record. South Africa presents some innovative behaviour in mark-making and shell collection; North Africa too shows similar behaviours across sites. As modern-type humans move into other environments, responses to the new and challenging environments result in the production of differing artefacts. Moreover, once artefacts are introduced into a cultural repertoire, they become not only part of a shared system of representation, but part of a neurological repertoire of objects, patterns and shapes, available to draw upon and make associations with in the production of further cultural objects.

The move into Europe potentially provided the greatest challenge. If we consider the criteria for Environmental Enrichment in relation to Upper Palaeolithic Europe, what inferences can we make? Taking physical activity as the first element of Environmental Enrichment, while the obvious activities of walking, hunting, butchery and general subsistence pursuits spring to mind, this is an element in which all modern-type humans engaged as they migrated into new environments. What may be different in Europe are the effort and survival skills involved in keeping warm and protected in such a harsh environment. Some of the earliest sites appear in Eastern Europe and the Russian plains. During the Würm Glacial, notably between 46,000 - 28,000 BP temperatures were 10˚C below modern European temperatures.[893] In addition, it has been established that the Aurignacian sites attributed to modern-type humans are found in areas where the average winter wind chill was colder than -18˚C (0˚F).[894] Neanderthals, who we conventionally think of as adapting to colder climates, located their dwelling sites in areas above this temperature. This would suggest that modern-type humans had the technical and social expertise to manage living in such an extreme environment. The implications however are more extensive, because that expertise has to be learned and passed on, and neural plasticity shows us that learning something new alters neural networks in considerable ways. In addition, as Neural Constructivism proposes, the learning experience not only builds upon existing neural systems but creates new neural structures changing the ways in which we learn. Therefore, learning to adapt and live in new and challenging physical environments required an active neural process that likely had behavioural consequences across generations.

In terms of social interaction, the move into Europe entailed modern-type humans encountering Neanderthals. This may not have been the first encounter that modern humans had had with Neanderthals, as there is some evidence they existed contemporaneously in the Levant in the Middle Palaeolithic. However, the evidence that they co-existed or if indeed there was any interaction is not well-defined and there are two schools of thought. Shea (2001) proposes that current fossil evidence shows that only early modern humans were present in the Levant between 130,000-80,000 BP, and re-appear again after the Middle-Upper Palaeolithic Transition, around 47,000-40,000 BP. Only Neanderthal fossils appear in the intervening period, 75,000-47,000 BP, suggesting little or no interaction. In comparison, Kaufmann (2001) suggests that there is a strong possibility that both modern humans and Neanderthals occupied the region simultaneously rather than in an alternating fashion, and as such we cannot negate the possibility of interaction.

However, very recent evidence suggests a previously unknown hominin living in Europe simultaneously with Neanderthals and at the time that modern humans entered Europe. Nicknamed "X-Woman," this unidentified species has a

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[893] Guiot *et al*. 1989
[894] Van Andel, 2002:7

different genetic code than that of humans and Neanderthals, but coexisted with Neanderthals and our own species between 30,000 to 50,000 years ago. An international team of researchers from the Max Planck Institute for Evolutionary Anthropology in Leipzig made the discovery after sequencing ancient mitochondrial DNA from a finger bone of a female found in the Altai Mountains, southern Siberia.[895] This discovery means that "representatives of three genetically distinct hominin lineages may all have been present in this region at about the same time".[896]

Encountering another modern-type human requires a certain amount of social skills, encountering potentially two different species is likely to have made that experience even more demanding. Neanderthals already inhabited, (rather successfully) the European environment into which modern humans migrated. Therefore, entering a landscape already occupied by a group of people[897] who have different adaptive strategies is arguably going to be more challenging, "for now there is a complex social landscape to navigate".[898] Although population estimates are relatively low, the concentration of regional sites and the potential for regional movement suggests that a link between cultural expansion and diversity and social intensification are interrelated; the sites in the Swabian Jura certainly seem to demonstrate this.

The third element in Environmental Enrichment is mental stimulation that involves some degree of experiential learning. Of course, the first two elements are allied with the third, and potentially the combination of these two may have been sufficient factors. However, we may consider that differences between northern and southern hemispheric landscapes in terms of, flora, fauna, climate, topography, and seasonality, length of day, exposure to light/sun/warmth, textures, smells, sounds, plus a host of other experiential features would test the learning process. With each successive generation modern humans were traversing through unfamiliar landscapes, adapting, negotiating and learning about new environments. Invoking the principles of Neural Constructivism, the learning process alters cognitive architecture in a way that what is learnt affects the very architectures that support future learning. The behaviours witnessed in Upper Palaeolithic Europe may not have been

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[895] Krause *et al.* 2010
[896] Krause *et al.* 2010:4
[897] See Conard, 2006, a publication comprising 20 papers on the nature of the interaction between Neanderthals and modern humans.
[898] Meltzer, 2003:236

revolutionary, rather the environments and skills already acquired in previous and successive generations informed and affected the way in which the European environments and accompanying experiences were successfully and resourcefully managed.

Of the large range of neural changes occurring in relation to Environmental Enrichment, one of the most significant is the increased number of excitatory synapses per neuron and the decreased number of inhibitory ones in the visual cortex. The implication is that neurons in the visual cortex may be more reactive to visual stimulation.[899] This is important because if modern-type humans became more sensitive to visual stimuli as a result of a new environment, then this strengthens the arguments made here. Each new environment may have had implications for the visual system, the greatest of which led to the increasingly complex artistic activities in Upper Palaeolithic Europe. As research has shown, the more enriched and stimulating the environment, the greater the likelihood for brain development and enhancement and neuronal growth. The notion that neural plasticity plays an essential role in the construction of new cortical circuits, and affects the way we engage and interact with our environments, offers a new way of thinking about the relationships between biology and culture.

9.19 SUMMARY

Using a neural approach to the artistic activities of modern-type humans has demonstrated the importance of a number of factors. One of the most significant is that the relationship between the brain and artistic activity is not arbitrary, but more importantly that the relationship is mediated by environment (physical, social and cultural) and experience. We cannot consider why art looks the way it does without thinking about the environment in which it was produced and the experiences of the person who produced it. This is difficult in prehistory where in some cases the environmental and/or contextual information is insufficient to make an argument either way. Yet it is an important principle, because it allows us to understand similarities and differences in art across time and space. It is always difficult to develop an argument where the data sets are limited, but in some cases, rather than looking at the data as an isolated case it may be more useful to expand the data set

[899] Discussed in Chapter 3

and address it in light of other similar activities. This may help us make connections between sites that previously have gone unnoticed.

Although the data from Middle Stone Age sites discussed are small in relation to that from Upper Palaeolithic Europe, there are still some interesting observations we can make, that may have implications for the later European data. The similarities in cross-hatching on stone and ochre seen in South Africa may be understood through particular environmental contingencies stimulating innate visual predispositions, relating to lines of orientation. Where cross-hatching occurs more frequently, Blombos Cave is where environmental exposure may be more intense and other potential factors such as striated ochre through pigment testing, fish traps, and woven fibres could strengthen those visual predispositions.

Neurons in our visual system form columns that respond to categories of shapes, a significant aspect of which is that neurons that respond to particular features tend to cluster together. What this means is that one particular visual stimulus that shares properties with another visual stimulus will be grouped together. In this way, particular shapes or forms can trigger the response of similar neurons. For example, certain shells may look like teeth; when they are strung together and worn around the neck the visual associations between shells and teeth are arguably strengthened.

The same line of reasoning concerning the visual properties of teeth may be made for ostrich eggshell beads. In addition, ostrich eggs were potentially used as water carriers, and would thus have carried positive associations. The origins of incised markings on eggshell are more difficult to determine, but they may have related to fibre netting used for carrying purposes. The selection of ostrich eggshell as a material for making beads is notable because it is likely to have had positive resonances in the brain, as an instrument for carrying the most important resource, water. The appearance of representational art at Apollo 11 Cave is limited and by itself is problematic. However, by understanding it in the light of the European data, we may find similarities and differences between sites that help us understand those conjunctions.

The evidence from India, Papua New Guinea and Australia is very small. What we can say is that a preference for shells remains evident in the archaeological record. In addition, this is the first evidence we have for the collection of teeth, possibly supporting the argument that shells and teeth may share some visual correlations and/or importance. The importance of both types of artefacts becomes more apparent from the European data, when both shells and teeth in the archaeological record intensify, and are sourced from distant locations.

Since the European data set is more expansive it allows for better articulation, but it also has consequences for the interpretation of the earlier data. For example, the choice of shells expands to include those that comprise different colours and patterns. This may suggest that the associations with teeth are unfounded. While the emergence of animal teeth early in the Upper Palaeolithic archaeological record could be argued to mitigate this, it seems clear that teeth acquire (for whatever reason) significance. In addition, the perforation of a raptor talon has marked similarities with teeth, sharing properties related to tearing and cutting. The increase in the types of materials chosen may simply be a result of more available resources but they may also tell us something about the importance of visual appeal. Materials selected all share particular visual properties that might have made them appealing, such colour, translucence or lustre. Indeed, it has been suggested that the lustre provided by polished mammoth ivory mimics that of shells and tooth enamel.

The appearance of representational art occurs first as mobiliary art and a short time later as parietal art. The interesting differences between the depictions of animals in the Swabian Jura and Chauvet Cave relate to the medium by which these animals are represented, carved or painted, and the life-like quality of the representations. The latter issue in terms of Chauvet was addressed in neural terms by Onians. While Chauvet Cave is significant for its life-like renderings of animals, predicated upon its location and twice yearly procession of migrating animals, the figurines from the Swabian Jura, for the most part, exhibit more ambiguity. In the light of Onians' theory, such ambiguity may be based upon different visual experiences of animals. The figurines may be representing particular attributes, rather than a life-like visual representation. Both situations have implications for Fumane Cave in Italy and Apollo 11 Cave in Namibia, where representations share the ambiguity of the Swabian Jura figurines.

Such differences in representation can be seen in the human figurines from Höhle Fels and Galgenberg, whose attributes are very different. The Höhle Fels figurine exaggerates the breast, buttocks and genitalia, possibly indicating the importance of these particular attributes. Moreover, this figurine has an exceptional tactile quality about it. In comparison, the Galgenberg figurine does not share the same realistic depictions, but rather her power may lie in the portrayal and/or exaggeration of posture or movement. Both figurines could arguably be based on the principle of Peak Shift whereby the brain focuses on parts of objects that matter most, in both these cases it is probably related to physical attributes, but represented in different ways.

Finally, while the principle of Environmental Enrichment has been well-tested on animals, and significant neural changes have been observed as a result, its value remains in the early stages in human terms. Nevertheless, examining the neural effects of Environmental Enrichment in humans is a growing sector of neuroscience research. Its importance in this context is that it may help us to understand other elements in the environment, such as social and physical activity, and the learning process that affects our neurological capacities. As such, these elements are worth considering in light of the genetic and fossil data we have of modern-type humans having to adapt to a variety of new and challenging environments both within and out of Africa.

The relationship between brain and behaviour is not indeterminate; rather they are inextricably linked. However, it is sometimes difficult, and perhaps a little uncomfortable, to regard ourselves as being governed by biological laws. As Perry eloquently states, “We have made our own world with its own rules. In good ways and in bad, we stand out from all other species. So much so that we often forget that we are ultimately accountable to the laws of nature”.[900] For now we cannot be certain why the earliest art emerged and developed in the ways that it did, we may though try and find a way to think about such issues. This approach remains speculative and does not intend to be reductionist but aspires simply to put the earliest art in the context of the environment in which it was made together with the organ responsible for its production, namely the brain.

[900] Perry, 2002:80

CHAPTER 10

Conclusion

10.1 SUMMARY

Our understanding of the time and place when modern-type humans made their first forays into art-making has undergone some serious shifts, especially in the last decade. As new discoveries have been made the origins of the human activity we call art have become increasingly complex. No longer is Upper Palaeolithic Europe accepted unquestioningly as the temporal and spatial origin of art. More recently, evidence from Middle Stone Age Africa has challenged this view. In addition, the nonrepresentational nature of the finds from Africa has called into question what constitutes art, and as such the focus has turned to the symbolic nature of objects. Yet this in itself has caused dilemmas. For how do we identify whether something is symbolic? By definition, a symbol is "something that stands for, represents, or denotes something else".[901] It may be worth considering Saussure's[902] definition of the signifier and signified as relevant to the production of some of the earliest art forms. Objects such incised ochre blocks and perforated marine shells may be deemed the signifiers that presumably signified something (proposed here to relate to the physical or cultural environment) to their makers and users. These may be the first steps towards the more symbolic representations that begin to appear after 40,000 BP. The implication is that there is a level of intentionality in an object having symbolic status; that the goal of its makers was to create something that stood for something else. Unfortunately, most authors writing about the earliest art do not define what they mean by an object being symbolic. As such we are left with a term that is used by many, but explained by few.

The aim of this thesis was, in part, to highlight such problems, and find another way of thinking about these artefacts. The endeavour was to use the same set of objects that archaeologists class as evidence of symbolic thought from MSA Africa to Upper Palaeolithic Europe and to observe in what form/s they emerged and

[901] Oxford English Dictionary

[902] Ferdinand de Saussure is widely considered to be one of the fathers of 20th-century linguistics and of the field of semiotics, the study of signs. He defined a sign as being composed of a 'signifier', the form which the sign takes and the 'signified', the concept it represents.

developed. Most importantly, the aim was to approach these objects in another way, by focusing on the organ responsible for guiding the hand that produced them; namely the brain. Until recently, knowledge of brain function was probably insufficient to make an enquiry such as this, and I accept that as an approach it is in its infancy and that potentially it may yet be premature in its aspirations.

Despite these reservations, there are governing principles by which the brain functions, the significance of which is that the environment (physical, social and cultural) has a tangible and measurable effect on the way in which the brain is structured. This is particularly the case in the visual cortex. As we navigate our environment, neurons respond to particular shapes/objects/ places and people, creating a changing dictionary of shapes. Moreover, repeated environmental exposure results in a visual familiarity with an object, a pattern or a form, without us even being aware. This thesis has attempted to reassess the earliest art based on these principles of plasticity.

This may be seen to problematise the issue of intentionality and in turn symbolic behaviour; but it does not necessarily have to be the case. Rather, if we look to what may acquire visual importance within an environment, we may infer why an object, a pattern or a form, could be imbued with significance and thus take on symbolic significance. Symbolic thought should not be assumed, but the role of visual perception may help to advance and mature our thinking in that direction.

The role of mirror neurons is significant in this context because of their functional roles; first is that mirror-neuron activity may be at the basis of imitation learning and second, that they are at the basis of action understanding.[903] Such neural representations could be used both for imitating others' actions and for understanding the meaning of those actions, thus enabling appropriate responses to them. These neurons therefore provide the link between the sender and the receiver of communication. The observer understands the action because he knows its outcomes when he does it.[904] Unlike most species, we are able to learn by imitation, and at the basis of the experiential understanding of other's actions is the activation of the mirror neuron system. Recent direct findings of mirror neurons in humans have demonstrated that mirror neurons operate in areas associated with motor activity, visual perception and memory. Further research in the area of the human mirror

[903] Rizzolatti et al. 2001
[904] Gallese et al. 2004: 396

neuron system will contribute to our current understanding of their functions and extent in the brain. An important point in the context of this thesis is that understanding other's actions is not confined to conspecifics. Providing the observer understands the motor action and that the action is mapped onto the observer's repertoire, then the mirror neuron system is activated. This may assist in comprehending why we may empathise with certain animals, actions or body parts of animals. This is a particularly important point of interest as some of the earliest art is focused so heavily on animals.

Inextricably linked with symbolic thought in the 'modern human behaviour' debate is the role of language. It has not been my intention to explore this particular issue, predominantly because space constraints would not allow a comprehensive examination. Nevertheless, the role of mirror neurons in this debate is meaningful. It has been argued for the ochre from Blombos Cave in South Africa that the incised lines would have relied on syntactical language "because the designs are too complex for imitation alone".[905] However, the mirror neuron system emphasises that language may not have been a necessary factor in production or reception, because simply watching someone incise a piece of ochre may have been sufficient for the process of imitation. Furthermore, the meaning of those actions was understood. Fundamentally it has been proposed that, "this faculty is at the basis of human culture".[906]

The use of Environmental Enrichment as a resource in the context of looking at the earliest art is informative, but I accept that further research is required to make this a more effective analytical tool, especially in this context. Nevertheless, knowing that elements such as physical activity, social interaction, and changes in the learning experience can alter brain structure that increases and enhances neuronal growth is notable when considering the development of modern-type behaviours. From exploiting coastal environments in Africa to navigating bodies of water to reach Australia to adapting to harsh, cold environments in Europe required enormous adaptive strategies. The degrees to which each of these elements played a part in the adaptation to different environments would have affected neuronal structure in different ways. Possibly, the biggest change may have occurred in Upper Palaeolithic

[905] Henshilwood & d'Errico, 2005:256
[906] Rizzolatti and Craighero, 2004:169

Europe, when all the criteria of Environmental Enrichment came into play most intensely.

The application of neuroscience in this enquiry resulted from the identification of a particular problem for which a neuroscientific approach seemed both constructive and progressive. Neuroscience is only a useful resource if it helps to explain or facilitate an understanding of a particular problem. The logic of this approach is that such neural principles may be applied to art of any place and any time. Arguably, there may be a greater relevance to contemporary or historically known forms of art production. Conversely, the application of this approach to contemporary or historically known works may inform our thinking about art in prehistory.

10.2 FUTURE RESEARCH

The objects selected for this enquiry were based on the combination of particular interpretations and dating methods. Although only objects that were absolutely dated were included here, it could be opened up to include objects that are relatively dated. Provided the time frame is not too extensive, and on condition that we know the environments in which they were produced, a more comprehensive remit may reveal patterns in the data, which are more difficult to identify with a smaller data set. A more comprehensive study has the potential of making any conclusions more dependable and authoritative.

One of the characteristics of 'modern human behaviour' is the sophistication and regional development of lithic technology. Yet, its relationship to other forms of material culture is overlooked. An interesting avenue to explore would be to look at the relationship between the ways in which art emerges and develops, in relation to lithic technology. It might be a useful endeavour to observe if lithics and art objects have any connection in terms of regionality, tool types and artistic practices, the development of lithics in visual terms, or simply to make connections between types of art objects and forms of technology both chronologically and spatially as undertaken here.

In the case of Environmental Enrichment, in this enquiry it was used as a method of potentially understanding how the movement of modern-type humans into new and challenging environments may have affected their neural networks and thus behaviour. This was most noticeable in the cultural spike of Upper Palaeolithic

Europe, termed the 'Human Revolution'. Other such archaeological anomalies may benefit from this knowledge; of which the Neolithic Revolution comes to mind.

This period is the transition from a mobile hunter-gatherer way of living to settled communities and the domestication of plants and animals. Watkins (2006a) has argued that the Neolithic saw, "the emergence of entirely novel human societies – large, permanently co-resident communities numbering hundreds or thousands of individuals".[907] Settlements were large, people were living in close quarters and social relations were under constant stress and negotiation. This engagement in a completely new form of settled social life coincides with the production of built environments and monumental architecture, for the first time creating a "cultural world",[908] in stark opposition to the Palaeolithic world.

Understanding social interaction is one of the key components of the Environmental Enrichment model, the increase and transformation in social life in the Neolithic would have required significant alterations in the way humans interacted with each other and negotiated social relations and personal space. The neurological effects of such a marked change in social interaction, combined with the emergence of a 'cultural world' are an interesting area of research, in relation to its antecedents and its consequences.

My opening statement in this thesis was that "art is a global phenomenon".[909] But this may not be entirely true. The Pirahã people are a group of indigenous hunter-gatherers who mainly live on the banks of the Maici River in Brazil's Amazonas state. They have recently come to the forefront in linguistic debates due to claims made by Dan Everett[910] who proposes that the absence of recursion in the Pirahã language, falsifies the basic assumption of modern Chomskian linguistics. Other claims and the one that is of interest here is the proposition that they have an "absence of drawing or other art".[911] If this is accurate, then the rationale behind such a statement requires further scrutiny concerning the relationship between art and language. The connection between art and language has been referred to here in the context of Middle Stone Age Africa. Examining whether language constraints

[907] Watkins, 2006a:647
[908] Watkins, 2006a:647
[909] Chapter 1: page1
[910] Everett, 2005, 2008
[911] Everett, 2005:621

impose cultural restrictions, especially in the production of art, may help in our understanding of the emergence of art and language in prehistory.

The possibilities of future research using a neural approach are numerous. Its application in the field of the Humanities means we are reliant on a dynamic and sometimes contradictory field. As such, we have a responsibility to engage with neuroscientists and neuroscience cautiously but willingly, because a neural approach provides the opportunity to potentially answer questions or advance our thinking on problems that may otherwise remain elusive.

The aim of this thesis was to question some of our assumptions about the earliest art, and look to recent knowledge about the brain as way of reconsidering what we think we know about its production. As a theoretical framework, a neural approach has the potential to contribute to an understanding of why art may be a global phenomenon, and unique to the human species.

Glossary of Terms

A

Abri: French term for rock shelter

Ahmarian: One of the earliest Upper Palaeolithic cultures of the Levant, pre-dating the Aurignacian.

Anatomically modern humans: Anatomically modern human (AMH) refers to hominids that have physical appearance similar to existing humans. Anatomically modern humans evolved from archaic Homo sapiens around 200,000 years ago. The emergence of anatomically modern human marks the dawn of *Homo sapiens sapiens*, a species that includes all modern humans. The oldest fossil remains of anatomically modern humans are the Omo remains that date to 195,000 years ago, and from Herto in Ethiopia that are 150,000 years old.

Anthropomorphic: Of a form resembling a human

AMS: Accelerator Mass Spectrometry. Radiocarbon dating is a way to obtain radiocarbon dates from samples that are far tinier than that needed for standard radiocarbon dating. Standard C14 dates require amounts of between 1 and 10 grams of charcoal; AMS can use as little as 1-2 milligrams, and under special circumstances to samples as small as 50-100 micrograms.

Art for Art's Sake: A now abandoned interpretive framework which saw art as the simple pursuit of aesthetic pleasure.

Aurignacian: An archaeological culture, defined by its stoneworking, rich bone and antler industry, and abundance of representational objects. It spans the period from 40,000 – 28,000 years ago and covers most of Europe. The name originates from the type site of Aurignac in the Haute Garonne area of France.

Axon: The single fibre of a neuron that carries messages to other neurons.

B

Basal Ganglia: A group of structures in the forebrain that have connections to the thalamus and midbrain; thought to have motor functions that co-ordinate the movement of the limbs and the body. The basal ganglia have long been associated with the processes of reinforcement learning.

Bas Relief: A sculpting technique which involves the placing in relief of sculpted images such that they protrude a few centimetres above a field or background. This technique first appears in the European Aurignacian and Gravettian, but is especially prevalent in the Solutrean and Magdalenian.

Belemnites: Fossilised spines of a kind of sea urchin, used as raw material for personal ornaments at sites such as Kostenki (as well as Sungir in Russia, and the Grotte du Renne at Arcy sur-Cure, France)

Bichrome: Consisting of two different colours

BP: Before Present, noted as 1950, the approximate year of Willard Libby's establishment of the method of radiocarbon dating.

Brain Plasticity: The ability of the brain to change its structure in response to experience, drugs, hormones or injury.

C

Chatelperronian: An archaeological culture, defined by its stoneworking industry. It spans the period from 38,000 to 33,000 years ago and exists only in Western Europe. While its stone industry is undoubtedly Upper Palaeolithic, the human remains associated with it are those of Neanderthals.

Culture: Behaviours that are learned and passed on from one generation to the next through teaching and learning.

Cerebral cortex: Layer of brain tissue composed of neurons that form the surface of the brain; the human cerebral cortex contains many folds.

Cerebrum: The major structure of the forebrain, consisting of two equal hemispheres (let and right); the most recently evolved part of the central nervous system

D.

Dendrite: A branch of a neuron that consists of an extension of the cell body, thus greatly increasing the area of the cell.

Dopamine: A chemical neurotransmitter released by dopamine neurons. Dopamine has many functions in the brain, including important roles in behavior and cognition, voluntary movement, motivation and reward, inhibition of prolactin production (involved in lactation), sleep, mood, attention, and learning.

E

Engraving: A representational technique in which a pointed tool is dragged across a surface in such a way as to remove material, leaving behind a linear track with a cross-section that is the negative imprint of the tool edge. This profile can vary from a crisp V-shape to abroad U-shape depending on the tool used and the manipulative gestures of the engraver.

Ethnography: A branch of anthropology concerned with the description of ethnic groups

Ethology: The study of the behaviour of animals in their natural habitat.

Evolutionary Psychology: The study of behaviour that uses principles of natural selection to account for human behaviours.

Excitation: A process that increases the likelihood that neurons will be active

Extra-striate cortex: The visual cortex areas outside of the striate cortex; also known as secondary visual cortex

F

Functional Magnetic Resonance Imaging (fMRI): A type of magnetic resonance imaging that takes advantage of the fact that changes in the distribution of elements such as oxygen alter the magnetic properties of the brain. Because oxygen consumption varied with behaviour, it is possible to map and measure changes that are produced by behaviour.

G

Glial cell: Belongs to one of the two classes of cells of the nervous system; often referred to as a support cell. Glial cells provide insulation, nutrients and support; they also aid in the repair of neurons.

Gravettian: An archaeological culture, defined by its stoneworking, rich bone and antler and abundance of representational objects. It spans the period from 28,000 – 22,000 years ago and covers most of Europe. It is named after the type site of La Gravette in the Dordogne region of France where its characteristic tools were first found and studied.

Grotte: The French word for cave

H

Hematite: Mineral iron oxide which, when abraded, produces the powder commonly known as ochre (both red and yellow)

Homo sapien sapiens: Anatomically modern humans, with origins in Africa prior to 100,000 years ago. See *Anatomically Modern Humans*

Homunculus: The representation of the human body in the sensory or motor cortex; also any topographical representation of the body by a neural area.

Hunting Magic: Refers to the set of ideas and practices in some cultural groups that seek to increase success in the hunt through representational acts such as sculpting, engraving, body painting, and ritual killing of animal representations.

Hypercomplex cell: A type of visual cortex neuron that responds best to a precisely limited type of visual stimulus; often a stimulus of a particular size and orientation that moves in one direction.

I

Ice Age: A colloquial term for the Pleistocene epoch.

L

Late Stone Age: The name for the prehistoric period in Africa that extend from c. 25,000 – 10,000 years ago. It is more or less the equivalent of the Upper Palaeolithic in Europe, although it is comprised of its own sequence of cultures that are quite distinctly African.

Lithic: In archaeology, lithics refer to man-made stone tools or artefacts made from chipped stone. Lithic technology refers to a broad array of techniques and styles to produce usable tools from various types of stone.

M

Magdalenian: Magdalenian refers to an archaeological culture, defined by its lithic technology, bone, and antler industry and by an abundance of representational objects and decorated caves. It spans the period from 18,000 – 11,000 BP and covers most of Western and Central Europe.

Magnetoencephalogram (MEG): A recording of the changes in tiny magnetic fields generated by the brain.

Middle Palaeolithic: The period of African and Eurasian stone tool industries that ranges from c. 300,000 years ago until c. 35,000 years ago. In Europe, it is more or less synonymous with the Mousterian, and in Africa it is more or less synonymous with the Middle Stone Age.

Middle Stone Age: An African stone tool-making tradition or cultural period ranging from more than 200,000 years ago until sometime between 40,000 and 25,000 years ago.

Mind-body problem: problem of how to explain how anon-material mind can command a material body.

Mirror Neuron: A neuron that fires when a monkey or human observes a specific action being made by another conspecific.

Mobiliary: Mobiliary art is a term used in archaeology for a general category of Palaeolithic artefacts which can be moved or transported. Because mobiliary art is found in stratified layers when excavated, it is often easier to date than parietal art.

Motor neuron: A neuron in the central nervous system that sends axons to activate body muscles.

Mousterian: A Eurasian and North African stone tool-making tradition or cultural period ranging from more than 300,000 years ago until sometime between 40,000 – 25,000 years ago. In Europe, it is associated almost exclusively with the hominin known as Neanderthals.

N

Neanderthals: Also known as *Homo neanderthalensis*. A hominin that lived in Europe within the past 300,000 years and is a close relative of modern humans; the name derives from the Neander Valley in Germany where the first skeletal remains were found

Neuron: An information-transmitting cell in the nervous system

P

Parietal art: Parietal art is artwork done on cave walls or large blocks of stone.

Pleistocene: A long period of global climatic cooling that began around 2 million years ago and ended about 10,000 years ago. Thick glaciers were widespread for 80% of the Pleistocene, from as far south as present day New York, London and Moscow and as far north as the southern regions of South America. The Pleistocene is colloquially known as the Ice Age.

Primary Visual Cortex: Also known as the striate cortex (area V1); it receives input from the lateral geniculate nucleus (the primary processing centre for visual information received from the retina of the eye)

R

Radiocarbon dating: The measurement of remaining carbon isotope C14 to determine the time elapsed since the death of an organic substance such as wood, bone, shell etc. It has been used successfully to date small fragments of wood charcoal in Palaeolithic paintings. It can be used to date artefacts up to 40,000 years ago.

Receptive field: Region of the visual world that stimulates a receptor cell or neuron.
Radiocarbon

S

Shamanism: Shamanism refers to a range of traditional beliefs and practices concerned with communication with the spirit world. A practitioner of shamanism is known as a shaman.

Simple cell: Type of visual cortex neuron that is excited by a spot of light in one part of its receptive field and inhibited by a similar spot in another part of the receptive field.

Speleology: Speleology is the scientific study of caves and other karst features, their make-up, structure, physical properties, history, life forms, and the processes by which they form and change over time.

Steppe: In physical geography, a steppe is a grassland plain without trees (apart from those near rivers and lakes).

Stratigraphic sequence: An accumulation of deposits, each layer having its own particular colour, texture and sedimentary composition. When such geological sequences contain artefacts they become archaeological sequences, with the uppermost layer being the most recent.

Structuralism: An intellectual movement within the social sciences that seeks to study the ways in which societies are structured and sees society as as a complex system of interrelated parts.

Symbolic representation: The representation of ideas or sentiments by depictions, bodily movements, or sounds that stand for or embody those ideas.

Symbolism: The ability to have something stand for something else even though it odes not physically resemble that thing. The ability to embody meaning in images, sounds or substances (e.g. holy water). A characteristically human capacity.

Synapse: The connection between one neuron and another neuron, usually between an end foot of the axon of one neuron and a dendritic spine of the other neuron.

Syntax: The way in which words are put together, following the rules of grammar, to form phrases, clauses or sentences; proposed to be a unique characteristic of the human language

T

Taxonomy: The branch of biology concerned with naming and classifying the diverse forms of life.

Thermoluminescence (TL): Thermoluminescence dating is the determination by means of measuring the accumulated radiation dose of the time elapsed since material containing crystalline minerals was either heated (lava, ceramics) or exposed to sunlight (sediments). As the material is heated during measurements, a weak light signal, the thermoluminescence, proportional to the radiation dose is produced.

Therianthropic: An image that combines the anatomical features of a human and an animal.

Totemism: A now nearly abandoned concept used by ethnographers to describe the relationship between particular plants or animals (including representations of them) and human social groups and their subunits, e.g. the bison clan.

Transcranial magnetic stimulation (TMS): A procedure in which a magnetic coil is placed over the skull to stimulate the underlying brain; can be used either to induce behaviour or to disrupt ongoing behaviour.

U

Upper Palaeolithic: The Upper Paleolithic is the third and last subdivision of the Palaeolithic or Old Stone Age as it is understood in Europe, Africa and Asia. Very broadly it dates to between 40,000 and 10,000 years ago, roughly coinciding with the appearance of behavioural modernity and before the advent of agriculture. The terms 'Late Stone Age' and 'Upper Paleolithic' refer to the same periods. For historical reasons, 'Stone Age' usually refers to the period in Africa, whereas 'Upper Paleolithic' is generally used when referring to the period in Europe.

V

Ventral stream: A visual processing pathway that originates in the visual cortex and progresses into the anterior temporal cortex. It controls the visual recognition of objects.

Venus figurines: Venus figurines is an umbrella term for a number of prehistoric statuettes of women sharing common attributes (many depicted as apparently obese or pregnant) from the Upper Palaeolithic, mostly found in Europe, but with finds as far east as Siberia, extending their distribution to much of Eurasia. Most of them date to the Gravettian period, but there are a number of early examples from the Aurignacian.

Visual field: Region of the visual world that is seen by the eyes.

Visual perception: Visual perception is the ability to interpret information and surroundings from visible light reaching the eye. The various physiological components involved in vision are referred to collectively as the visual system, and are the focus of much research in psychology, cognitive science, neuroscience and molecular biology.

Z

Zoomorphic: Having an animal-like form

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