Human Origin Sites and the World Heritage Convention in Eurasia

VOLUME I
Human Origin Sites and the World Heritage Convention in Eurasia

Nuria Sanz, Editor
General Coordinator of HEADS Programme on Human Evolution

HEADS 4
VOLUME I
# Table of Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Authors</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foreword</td>
<td>Kishore Rao, Secretary, World Heritage Convention</td>
<td>Page 5</td>
</tr>
<tr>
<td>Scientific Perspectives: Eurasia and HEADS</td>
<td>Nuria Sanz, Head and Representative of the UNESCO Office in Mexico, General Coordinator of the HEADS Programme</td>
<td>Page 7</td>
</tr>
<tr>
<td>How to use the World Heritage List of cultural and natural criteria to demonstrate the Outstanding Universal Value (OUV) of prehistoric sites in Eurasia, with particular reference to criterion (viii)</td>
<td>Robin Dennell</td>
<td>Page 8</td>
</tr>
<tr>
<td>Europe: the Outstanding Universal Value of a marginal area of the Palaeolithic world</td>
<td>Margherita Mussi</td>
<td>Page 26</td>
</tr>
<tr>
<td>The Middle East</td>
<td></td>
<td>Page 33</td>
</tr>
<tr>
<td>Prehistoric archaeological sites in Arabia and their potential for nomination to the World Heritage List</td>
<td>Michael D. Petraglia</td>
<td>Page 34</td>
</tr>
<tr>
<td>Tracking Upper Pleistocene human dispersals into the Iranian Plateau: a geoarchaeological model</td>
<td>Saman Heydari-Guran</td>
<td>Page 40</td>
</tr>
<tr>
<td>Regional Perspective of early human populations in Syria: the case of El Kowm</td>
<td>Jean-Marie Le Tensorer</td>
<td>Page 54</td>
</tr>
<tr>
<td>The case of Mount Carmel: the Levant and Human Evolution, future research in the framework of World Heritage</td>
<td>Mina Weinstein-Evron</td>
<td>Page 72</td>
</tr>
<tr>
<td>Western Europe</td>
<td></td>
<td>Page 93</td>
</tr>
<tr>
<td>Early Human Occupation of Orce</td>
<td>Robert Sala i Ramos</td>
<td>Page 94</td>
</tr>
</tbody>
</table>
Eastern Europe

Rock art from the Russian Far East: the Sikachi-Alyan Tentative World Heritage Site
Ekaterina Devlet

Natural and Cultural Complex the Bashkir Urals
Viacheslav G. Kotov

The traces of the first humans in Eurasia
David O. Lordkipanidze

Perspectives on the Palaeolithic of Eurasia:
Kostenki and related sites
Andrei Sinitsyn

Perspectives on the Upper Palaeolithic in Eurasia:
the Case of the Dolní Vestonice-Pavlov sites
Jiří Svoboda

Approaches to the Palaeolithic archaeological record in Eurasia

Neanderthal adaptation: the biological costs of brawn
Fred H. Smith

Defining a Neanderthal site ‘Cluster’:
reasons for international collaboration
Gerd-Christian Weniger
The World Heritage Thematic Programme Human Evolution: Adaptations, Dispersals and Social Developments (HEADS) was launched in the context of the Global Strategy to broaden the definition of World Heritage as well as the framework and implementation of the World Heritage Convention. The Programme acknowledges that the study of human evolution related sites presents a key focal area for a more multidimensional concept of heritage and continues to demonstrate its outstanding capacity for the implementation of international collaboration in order to enhance the integrated conservation of early properties related to Human Evolution.

This issue of World Heritage Papers is the fourth volume of the HEADS series, following World Heritage Papers 29 Human Evolution: Adaptations, Dispersals and Social Developments (HEADS) World Heritage Thematic Programme; World Heritage Papers 33 Human origin sites and the World Heritage Convention in Africa; and, most recently World Heritage Papers 39 Human origin sites and the World Heritage Convention in Asia. These pages represent the continuous commitment of the HEADS Programme to the implementation of the World Heritage Convention across all continents.

Eurasia presents one of the most complete records on Human Evolution, as the region has been the focus of extensive excavation and scientific investigation for over a century. It is a continent across which many scientific narratives relevant to human evolution have taken place: the emergence of and then the gradual, complete replacement of H. neanderthalensis by H. sapiens sapiens, and the dramatically increased occurrence of parietal art and portable representations, to name a few. They include the origins and diversity of the genus Homo genetically, biologically and anatomically, and its social organizations, major cognitive milestones, technological innovations and the colonization of new environments as well as associated dispersals and migrations.

These pages bring together the interdisciplinary perspectives of twenty-five leading experts in their respective fields presenting and analysing the storehouse of knowledge that is the Eurasian archaeological record. This record is especially relevant within the context of the World Heritage Convention because of the rich Tentative List of the Eurasian continent. In this book, members of an international scientific community explore this unique record and analyse the role of the World Heritage Convention in the support of the future of these precious human origin sites in Eurasia.

This volume furthers the HEADS Programme’s dedication to the Convention through the continuation of its initiative to expand the concept of heritage in that it contains an original dialogue regarding moveable heritage. It acknowledges that the best way to conserve cultural heritage in an integrated manner should include reference to both movable and immovable heritage when preparing World Heritage nomination dossiers.

I cannot close this foreword without offering my most sincere and heartfelt gratitude to the worldwide scientific HEADS community, the contributors to this volume, the University of Tübingen for their outstanding scientific collaboration and finally to the Government of Germany, whose support in this endeavour has been and continues to be most valuable.

Kishore Rao
Secretary of the World Heritage Convention
Scientific Perspectives: 
Eurasia and HEADS

The purpose of this publication and its two volumes is to present the reader with a panorama of Human Origins in Eurasia, by bringing together key papers written by leading scientists in the domain of research into human origins. The first volume focuses on the topic of Human Origins in Eurasia, whilst the second volume focuses entirely on the case of the Swabian Jura Aurignacian, particularly important in relation to some of the major research issues surrounding the dispersal of modern humans on the continent. The perspective of this publication is on Eurasia as a whole, transcending modern, political, cultural and regional frontiers, and thus allows for a greater and more profound study of prehistoric archaeological sites.

The volumes and their papers offer a series of current reflections and a summary of the latest research methodologies and recent discoveries in human evolution and dispersal patterns gathered from the most important prehistoric archaeological sites in Eurasia and their material culture. The volumes provide a compelling interface between the ongoing hypothesis of researchers and the general interests of the scientific community, highlighting the role of the international cooperation in this endeavour and thus enabling State parties to identify the way in which sciences are the best ally to assess the concept of Outstanding Universal Value in regards to Eurasian prehistoric legacy. These contributions are fundamental in understanding the significance of exceptional Eurasian cultural resources that make up our human story.

Up till now, archaeological sites related to human origins and social evolution have not benefited sufficiently from the international community’s efforts to protect our former ancestors’ heritage. The significance of this heritage of human evolution has been overlooked for decades by current heritage scholarly traditions, as a middle-land between biology, palaeoanthropology and geology, distant disciplines from cultural studies. These pages demonstrate that there are very few more accurate and relevant examples like the first step of human evolution that could deeply implement the will of the Natural and Cultural World Heritage Convention.

These volumes, full of wide-ranging and interdisciplinary material, brings together invaluable and up-to-date information and research from leading professionals in the field, useful to a whole ream of people; specialists, heritage managers, teaching professionals, students and the general public.

The discussions in this publication came from the international meeting, Human Origin Sites in Eurasia and the World Heritage Convention, held at the University of Tübingen, Germany, from 25 February to 1 March 2013. 29 scientific experts of 13 different nationalities, representing 25 international institutions, attended.

We conclude this introduction by extending our sincerest appreciation to the University of Tübingen, the academic hierarchy for their warm hospitality and assistance in hosting the international meeting. Special thanks to Prof. Nicholas Conard and his outstanding team at the University of Tübingen whose invaluable discussions led to this publication and, as always, my gratitude goes to the HEADS Scientific Committee for their enduring work in bridging the gap between such paramount scientific research and World Heritage. I also extend my heartfelt thanks to Dr Robin Dennell, whose work and commitment to the HEADS Programme in Eurasia has been instrumental to the project's success. I would also like to recognize the dedication of all the international experts whose work in the study of human evolution in Eurasia has made this publication a reality. It is thanks to this exceptional and brilliant group of people, whose academic, professional and personal commitment are second to none that a publication of this calibre was possible. Last but not least, I thank the UNESCO team for their assistance and support on this paramount topic of human evolution and dispersal patterns in Eurasia.

Nuria Sanz
Head and Representative of the UNESCO Office in Mexico
General Coordinator of the HEADS Programme
How to use the World Heritage List of cultural and natural criteria to demonstrate the Outstanding Universal Value (OUV) of prehistoric sites in Eurasia, with particular reference to criterion (viii)

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Introduction

In an earlier publication (Dennell, 2012), I questioned whether the existing criteria for World Heritage status were applicable to the type of sites that document human evolution and our Palaeolithic past. I pointed out that these criteria were devised with historic monuments in mind – such as the Parthenon or the Pyramids – but not the type of ephemeral, non-monumental evidence familiar to palaeoanthropologists, Palaeolithic archaeologists and many researchers interested in later prehistory. Whilst monuments can be compared against each other in terms of their respective merits, it is hard at first sight to see how a monument or ancient city can be meaningfully compared with a box of stone artefacts or a few boxes of human bones. I thus suggested that a parallel set of criteria might be more appropriate for the types of evidence that document the 8 million year record of human evolution in Africa.

Nevertheless, the existing criteria of the World Heritage Convention (WHC) have to be applied, so the key issue is to suggest how criteria that were initially proposed for monuments can be credibly applied to human evolution sites. In my opinion, this can be done if positive and creative thinking is applied to each criterion. The essential need is to demonstrate why the evidence of our evolution over the last 2.5 Ma as a tool-making bipedal ape is so significant in terms of its ‘Outstanding Universal Value’ that some features of it deserve World Heritage status as testimony to our uniqueness, adaptability and diversity.

At this juncture, a brief reminder is appropriate as to why we and our predecessors over the last 5-8 Ma as a bipedal, tool-making ape are so exceptional in the animal world.

Human exceptionalism as an ape and as a species

Present-day humans are exceptional in a number of ways:

- **First, humans today are the only species within our genus Homo:** with the extinction of Neanderthals 30-40 Ka and *H. floresiensis* on the island of Flores, Indonesia, c. 12 Ka, *Homo sapiens* became the only species in our genus. As Ian Tattersall (2000) has emphasized, we are now alone as a species within our own genus, even if there are now seven billion of us.

- **Humans are exceptional for an ape as a colonising species.** *H. sapiens* (along with its fellow-travellers, the dog and the rat) are the most cosmopolitan of all mammals, having colonized the entire planet. In contrast, our nearest relatives – the African gorilla, chimpanzee and bonobo, and the orang-utan of Borneo and Sumatra – are now restricted to small populations of only a few thousand each and are facing extinction unless protected by its fellow ape, *H. sapiens*. So far as we know (partly because of the poor quality of the fossil record), our ape cousins never dispersed out of the type of habitats they occupy today.

- **Humans are also exceptional in evolutionary terms as a single-species genus that is present in large numbers and has colonized every habitat.** In contrast, the gorilla, orang-utan and panda are obvious examples of single-species mammalian genera in danger of extinction because of their small numbers and restriction to a single type of habitat.

- **We humans are also exceptional in our mental abilities.** Although much has been written about whether animals such as chimpanzees and dolphins have language and cognitive abilities that are ‘humanlike’ in their complexity,
Palaeoanthropology demonstrates more than any other discipline the exceptional nature of our development from one of several nondescript African apes into the global and uniquely creative species that we have become. The evidence may be scant, but is crucial in documenting the route to our global dominance as a bipedal, tool-using ape. With these points in mind, we can consider each criterion of the WHC in relation to human evolution and Palaeolithic sites. The intention here is not to offer a prescriptive list of what factors may be considered appropriate, but to provide examples that show the types of evidence that could be selected. (Much of what follows could also be applied to many later prehistoric sites). The relevant paragraph is 77 of the Operational Guidelines, which states that ‘The Committee considers a property as having Outstanding Universal Value (see paragraphs 49–53) if the property meets one or more of the following criteria’.

**Criterion (i): ‘represent a masterpiece of human creative genius’**.

As a definition, the term ‘human’ includes us as *H. sapiens* as well as all predecessors within the genus *Homo* (such as Neanderthals, *H. erectus* and *H. habilis*) and earlier forms such as Australopithecines that are ‘human’ in that they are anatomically more like the genus *Homo* than any extant ape.

The most obvious Palaeolithic example of ‘human creative genius’ is the art in caves and on portable items such as figurines and engravings, of which the most famous examples are from Eastern and Western Europe and Siberia. However, because much of our pre-industrial technology originated in the Palaeolithic, this criterion can and should be used much more widely in relation to many items of material culture (see Table 1). The Palaeolithic provides several instances of ‘human creative genius’ in the form of innovations that provided an adaptive advantage for their users and thus facilitated their survival in an often hostile world, contributing to the emergence of our own species as the dominant ape on the planet. First and foremost, are the earliest 2.6 Ma stone tools from Ethiopia. Here, the significance lies in the repeated production of sharp conchoidal stone flakes that could be used for cutting (meat from a carcass, for example) or whittling wood (for use as a digging stick, for instance). Secondly, is the Acheulean handaxe, which has rightly been singled out by the British Museum as one of the one hundred most important inventions in human history (MacGregor, 2011). Its significance here is that it was the first purposefully shaped stone artefact and the most successful artefact ever made in terms of the longevity of its design, which combined sharp cutting edges with mass. As ‘the Swiss army knife of the Palaeolithic’, this multi-functional tool was first produced in east Africa c. 1.7 Ma (Lepre et al., 2011) and was used in Africa, Europe, west and south Asia until c. 200-300 Ka. Examples such as the razor-sharp hand axes used at Boxgrove 500 Ka were equal to steel knives as butchery items for cutting and slicing meat when defleshing carcasses.

Many of the key innovations that should rank as examples of ‘human creative genius’ were innovations that aided the procurement of meat in hunting. The clearest example is the spear, as this allowed hominins to kill their prey up to 25 m away. This enhanced the chances of a successful kill and also contributed to hominin survival because it lessened the chances of injury or death when trying to kill an animal at close range, particularly if it was larger than a hominin. The earliest known spears are those from the site of Schöningen, Germany; these were miraculously preserved in water-logged deposits c. 350-400 Ka, measured up to 2 m long and proportioned like a modern javelin. Spears may have been used as early as c. 500 Ka, as a circular hole in a horse scapula at the slightly older site of Boxgrove may indicate an impact wound from a spear. (However, spear-throwers or atlatls, which provided much greater leverage for a throw, were a late Palaeolithic invention.) Stone projectile tips are another important innovation, in that their heavier weight on the tips of spears or arrows increased kill rates in hunting, thus enhancing hominin survival. The bow and arrow, probably first used in the late Pleistocene, is another important innovation, as is the quintessential Australian projectile, the boomerang, which is also evidenced in Poland c. 23 Ka; many key inventions were invented independently in different places. Traps and snares should also be included as examples of human creative genius in that hunting could now be done remotely, as once they were set, humans could leave and then return to collect their catch. The presence of foot bones of the arctic fox and hare at some late glacial sites in Eastern Europe and Siberia implies the use of traps and snares. These animals are difficult to catch, valued for their winter fur and during skinning, the foot bones were often preserved because the feet were cut with the bones inside. Nets should also be included, as well as harpoons and fish hooks as this opened up fish and fowl as additional resources. One should also mention Japanese pit traps that may have been used for trapping elephants in the Late Pleistocene.

*H. sapiens* is the only species that has an awareness of its deep, pre-parental past, its place in the world outside its immediate group or territory and the natural world around it.

Modern humans are also the only species able to project its emotions into art, music, literature and monuments.
Table 1. Palaeolithic examples of masterpieces of ‘human creative genius’.

A surprising amount of our pre-industrial technology has its roots in the Palaeolithic, particularly from 40,000 years ago. The main technological development after the Palaeolithic was to substitute metal for stone. This apart, most of the technology used in the Bronze Age would have been familiar to many late Palaeolithic hunters and gatherers. Starred items (*) are those that are so far associated only with our own species, *Homo sapiens*

<table>
<thead>
<tr>
<th>Invention</th>
<th>Earliest evidence</th>
<th>Prime functions</th>
<th>Country</th>
<th>Site</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conchoidal stone flakes</td>
<td>2.6 Ma</td>
<td>Cutting meat, skinning, whittling wood</td>
<td>Ethiopia</td>
<td>Kadar Gona</td>
<td>Semaw et al., 2006</td>
</tr>
<tr>
<td>Acheulean handaxe</td>
<td>1.7 Ma</td>
<td>As above, plus digging, throwing</td>
<td>Kenya, Tanzania</td>
<td>Koobi Fora, Olduvai</td>
<td>Lepre et al., 2011</td>
</tr>
</tbody>
</table>

**Hunting technologies**

<table>
<thead>
<tr>
<th>Spears</th>
<th>c. 350-400 Ka</th>
<th>Hunting</th>
<th>Germany</th>
<th>Schöningen</th>
<th>Thieme, 1997</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stone projectile points</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Possibly in Mousterian and African MSA. *Definitely post 40 Ka</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>As above, plus digging, throwing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kenya, Tanzania</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>*Bone projectile points</td>
<td>35-40 Ka</td>
<td>Killing at a distance</td>
<td></td>
<td></td>
<td>Shimkin, 1978, Davies, 2000</td>
</tr>
<tr>
<td>*Spear thrower</td>
<td>Magdalenian</td>
<td>Killing at a distance</td>
<td></td>
<td></td>
<td>Dennell, 1983, 88</td>
</tr>
<tr>
<td>*Bow and arrow</td>
<td>23 Ka</td>
<td>Killing at a distance</td>
<td>Spain</td>
<td>Solutrean</td>
<td>See Stanford and Bradley, 2012</td>
</tr>
<tr>
<td>*Boomerang</td>
<td>c. 23 Ka</td>
<td>Killing at a distance</td>
<td>Poland</td>
<td>Oblazowa Roc; made of mammoth ivory</td>
<td>Valde-Nowak et al., 1987</td>
</tr>
<tr>
<td>*Traps and snares</td>
<td>Post 30 Ka</td>
<td>Hunting small mammals.</td>
<td>European and Siberian Upper Palaeolithic</td>
<td>Numerous</td>
<td>See Derev’anko et al., 1998; Honnecker, 2002; Klein, 1971; Shimkin, 1978; Soffer, 1985</td>
</tr>
<tr>
<td>*Nets</td>
<td>Post 30 Ka/late glacial</td>
<td>Hunting, fishing</td>
<td>European and Siberian Upper Palaeolithic</td>
<td>Numerous</td>
<td>As above</td>
</tr>
<tr>
<td>*Harpoons</td>
<td>c. 90 Ka Late Upper Palaeolithic</td>
<td>Hunting, fishing</td>
<td>Zaire</td>
<td>Katanda (2) Magdalenian; China, late Pleistocene</td>
<td>Yellen et al., 1995; Ai Jiayuan, 1991</td>
</tr>
<tr>
<td>*Fish hooks</td>
<td>40 Ka</td>
<td>Fishing</td>
<td>Indonesia</td>
<td>Timor, Jerimalai</td>
<td>O'Connor et al., 2011</td>
</tr>
</tbody>
</table>

**Processing technologies**

<table>
<thead>
<tr>
<th>Fire (1)</th>
<th>700-780 Ka</th>
<th>Cooking, warmth, light, smoke</th>
<th>Israel, also China</th>
<th>GBY, Zhoukoudian</th>
<th>Alperson-Afil et al., 2007; see Dennell, 2009, 411-412 for China</th>
</tr>
</thead>
<tbody>
<tr>
<td>*Microliths</td>
<td>60 Ka (Africa), 30-36 Ka (India/Sri Lanka) 18 Ka, Siberia</td>
<td>Scraping, cutting</td>
<td>Howieson’s Poort, Jawalapuram Studenoe-2</td>
<td>Howieson’s Poort, Jawalapuram Studenoe-2</td>
<td>Goebel et al., 2000</td>
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</tbody>
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*Homo sapiens*
<table>
<thead>
<tr>
<th>Invention</th>
<th>Earliest evidence</th>
<th>Prime functions</th>
<th>Country</th>
<th>Site</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ground stone pestles/</td>
<td>780-700 Ka</td>
<td>Seed/nut processing, ochre grinding</td>
<td>Israel</td>
<td>GBY</td>
<td>Goren-Inbar et al., 2002</td>
</tr>
<tr>
<td>mortars</td>
<td>Post 40 Ka</td>
<td></td>
<td>Australia</td>
<td></td>
<td>Habgood and Frankin, 2008</td>
</tr>
<tr>
<td>*Ground stone adze/axe</td>
<td>35 Ka</td>
<td>Working wood</td>
<td>Australia</td>
<td></td>
<td>Geneste et al., 2012</td>
</tr>
<tr>
<td>Glue</td>
<td>70 Ka</td>
<td>Pitch</td>
<td>Syria</td>
<td>Umm Tlel</td>
<td>Boëda et al., 2008</td>
</tr>
<tr>
<td>*Drilling</td>
<td>100-135 Ka</td>
<td>Perforated sea shells</td>
<td>Israel</td>
<td>Skuhl</td>
<td>Vanhaeren et al., 2006</td>
</tr>
<tr>
<td>*Food storage</td>
<td>c. 25 Ka</td>
<td>Storage pits, food drying</td>
<td>Eastern Europe, Siberia</td>
<td></td>
<td></td>
</tr>
<tr>
<td>*Plant detoxification</td>
<td>c. 40 Ka</td>
<td>For processing otherwise poisonous plants</td>
<td></td>
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</tbody>
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**Clothing and containers**

| *Shoes                      | 40 Ka             | Protection of feet, avoidance of frost bite | China       | Tianyuandong | Trinkhaus and Shang, 2008 |
| *Sewn clothes               | 30 Ka             | Insulation                              | Russia       | Sungir      | Shimkin, 1978, Honnecker, 2002 |
| *Woven fabric               | 26 Ka             | Insulation, bags                        | Czech Republic | Dolni Vestonice | Soffer et al., 2000 |
| *Felt                       | Post 30 Ka        | Clothing, tent covering                 | Late glacial Europe and Siberia |           | Ryder, 1974, Dennell, 1983, 90, suggestions only, no preserved examples |
| *Basketry                   | 26 Ka             | Storage                                 | Czech Republic | Dolni Vestonice | Soffer et al., 2000 |
| *Pottery/burnt clay         | 26 Ka             | Unknown (3) Storage                     | Czech Republic, China, Japan | Dolni Vestonice | Soffer et al., 2000, Cook, 2012 for burnt clay figures, Kuzmin, 2006 |
| *Needles                    | 25 Ka             | Sewing, basketry                        | Late glacial Europe and Siberia |           | Stordeur-Yedid, 1979 |

**Artistic technologies**

| *Ochre                      | 135-75 Ka         | Body ornament                           | South Africa, Israel | Pinnacle Point, Qafzeh | Marean et al., 2007, Hovers et al., 2003 |
| *Music                      | 35 Ka             | Flutes                                  | Germany          | Geißenklösterle        | Conard et al., 2009 |
| *Painting                   | After 35 Ka       |                                        | France, Spain in particular |           | Numerous caves, See Cook, 2013 |
| *Sculpting                  | After 35 Ka       |                                        | France, Spain in particular; also Siberia |           | Numerous examples, See Cook, 2013 |
| *Engraving                  | After 35 Ka       |                                        | East and west Europe, Siberia |           | Numerous examples, See Cook, 2013 |
| *Jewellery                  | 100-135 Ka        | Pierced sea shells                      | Israel, South Africa | Skühl, Blombos | Vanhaeren et al., 2006, D’Errico et al., 2005 |

**Other items**

| *Boats                      | 45-50 Ka          | Colonisation of Australia, later Japan and Timor (c. 40 Ka), New Ireland (30 Ka) and other islands | Australia, Japan, island Indonesia |           | O’Connor et al., 2011; Allen et al., 1989 |
| *Ladders                    | 15 Ka             |                                         |                                   | Lascaux    | Leroi-Gourhan and Allain, 1979 |
| *Lamps                      | Post-40 Ka        | Lighting inside caves                   | France                         |           | de Beaune, 1987 |
Scientific Perspectives: Eurasia and HEADS

Notes: Dates are approximate. (1) Carefully constructed and often stone-lined hearths are much more common after 40 Ka. (2) The Katanda harpoons are exceptional items for their age, whereas harpoons are common items on many European and Siberian late glacial sites. (3) The ceramics at Dolní Věstonice are exceptional for their age and may have been destroyed deliberately (and perhaps ritually) by overheating. The earliest common use of pottery appears to be in China, Japan and also Korea and north-east Siberia.

Other examples of ‘human creative genius’ in the Palaeolithic are those involved in the processing of resources. Although Palaeolithic archaeologists have devoted considerable energy in studying the procurement of meat by hunting or scavenging, much less attention has been paid to how resources were processed. Some of these technologies would have been food-related: examples would be technologies for preserving meat by smoking, salting or drying. Here, the one that best shows ‘human creative genius’ is fire. Fire provided heat for warmth. It also facilitated cooking, thus enabling hominins to obtain more nutrition from meat. Wrangham and Carmedy (2010) have argued that fire led to a culinary revolution because it made meat-eating safer (by killing parasites) and more digestible, and it also widened our dietary range by enabling hominins to eat otherwise inedible species, such as many plants. Fire also created artificial light and its smoke could be used for preserving meat (as with smoked fish), repelling insects and as a signalling device.

Fire represents the first instance where hominins were able modify their surroundings by creating heat and light. The initial step lay in utilizing natural fires (as from lightning strikes) and this may be evidenced at Chesowanja, Kenya and Swartkrans, South Africa. The earliest example of fire being used repetitively (and therefore, a high probability of being manufactured) comes from the Israeli site of Gesher Benot Ya’aqob, c. 700-780 Ka, and perhaps also at Zhoukoudian, China, c. 500-700 Ka. Here, evidence for fire and hearths has been contested (Weiner et al., 1998), although burnt bone is certainly present. Evidence from the early and even Middle Palaeolithic is rare however, and in Europe, it is not until the Upper Palaeolithic that it seems to have been used routinely, when stone-lined hearths are also recorded. In Africa, Middle Stone Age (MSA) levels at Sibudu Cave, South Africa, with layers of burnt ash – probably representing the periodic burning of bedding – are dated to c. 77 Ka (Goldberg et al., 2009). The rarity of unambiguous instances of deliberately fabricated fires (for instance, in places such as cave interiors where natural factors can be excluded) before the appearance of H. sapiens may indicate that earlier species lacked the means of lighting fire routinely (with fire-drills, for example) or obtaining sufficient amounts of fuel to sustain it.

Other important technologies were those that aided the processing of plants for use as baskets, fibres and clothing. Unfortunately, most of these involve perishable materials and are therefore rarely preserved (most notably at the Upper Palaeolithic site of Dolní Věstonice in the Czech Republic, see Table 1), but a few are stone-based and thus widely evidenced in the Palaeolithic. One notable example of ‘human creative genius’ is the microlith, first evidenced in southern Africa c. 60 Ka and then, in India and Sri Lanka c. 30-36 Ka. This first example of miniaturisation led the way to composite tools, whereby microliths could be slotted into a wooden (or sometimes bone or antler) shaft and replaced when needed. Besides being a more economical use of stone, microliths also opened up a new range of possibilities such as sawing (reeds, fibres or skins) for basketry, containers or clothing. In north-east Asia, a similar micro-blade tradition developed in the late Pleistocene in which exquisitely-flaked bladelets less than 20 mm long were used in the same way. Ground stone technology also deserves mention: in the form of grinding stones, these opened up possibilities for processing plant foods such as nuts, cereals and tropical starch plants that might otherwise have been indigestible. In the form of ground-stone axes and adzes, wood working acquired a new momentum in that wood could be chopped and shaped more easily than with a hand-held flake or chipped stone axe. The earliest examples here are Australian, but nut-cracking is evidenced at Gesher Benot Ya’aqob, Israel c. 800 Ka from pounding stones, so this technology may be very ancient.

There is also the perishable material culture of skins, fibres and wood that are only exceptionally preserved, but which also underpin our modern technological base. Clothing is one obvious example as it greatly aided survival in temperate latitudes, particularly in winter and in cold periods. The minimum requirement here was to produce skins that were supple and durable, and some kind of cordage (from sinew, skin or animal gut, for example) for sewing or binding. A variety of plant fibres could also be used, ranging from bark to matting woven from reeds or grasses. The earliest example here may be the indirect evidence from Tianyuan Cave, north China, where the foot bones of human remains show little evidence of wear, as in populations that habitually wear shoes (Trinkhaus and Shang, 2008). A much clearer example comes from a c. 30 Ka grave at Sungir, near Moscow, where a double burial of two males were buried in sewn clothing, probably of leather or fur. Although the clothing had disappeared, the presence and arrangement of thousands of perforated beads of mammoth ivory showed that these must have been sewn onto a set of clothes. In considerations of clothing and winter insulation, the eyed sewing needle must also count as an example of creative genius in facilitating the production of tailored clothing that was warmer and long-lasting. Weaving is another example of creative genius with the earliest examples dating to c. 26 Ka from...
the burials at Dolni Vestonice, where fragments of plant fibres have been found; the plants most likely used were milkweed (Asclepias sp.) and nettles (Urtica sp.), which are still used for weaving today in some regions (in Nepal, for example) and produce a fine and strong fibre.

One additional technology with deep roots in the Palaeolithic is music, which is first seen by the remarkable bone and ivory flutes found in caves in the Swabian Alps, Germany (Conard et al., 2009).

Many of the technologies used by the end of the Palaeolithic were integral to later farming and even urban communities, including those that created monuments that are today given World Heritage status. The projectiles of Palaeolithic hunters, notably the spear and later, the bow and arrow continued in use among post-glacial hunter-gatherers, but were subsequently developed for warfare by farming and urban communities. Microliths were used in sickles for harvesting grain until they were replaced by metal and the technologies used in many urban areas for making clothes, working skin, leather and fur, and making containers from plant fibres and even pottery owe their origins to the Palaeolithic world. Fire is so fundamental a technology that we take it for granted and music, of course, has been an integral part of human life for over 30,000 years.

Criterion (ii) ‘exhibit an important interchange of human values, over a span of time or within a cultural area of the world, on developments in architecture or technology, monumental arts, town-planning or landscape design’.

This criterion is too vague to be useful for most of the Palaeolithic because of the lack of material items that are specific to both a region and well-defined period. There are no obvious equivalents of the classical Greek or Roman city, for example. Yet there are instances where ‘an important interchange of human values’ could be postulated amongst Palaeolithic populations that were small, scattered, but nevertheless linked by shared beliefs and values. These are all associated with H. sapiens rather than its predecessors. As examples, there is a common iconography in style and content in the parietal (cave) art across western Europe that was surely based on a common set of values in the same way as, for example, the art of Classical Greece. Although these Palaeolithic examples spanned millennia, it is possible to distinguish between Aurignacian (c. 30-40 Ka) and Magdalenian (c. 15-11 Ka) art, for example. Another example are the ‘Venus figurines’ of Western Europe and their highly schematic equivalents that extend across Siberia in the late glacial period (see for example, Gamble, 1982). Likewise, the same iconography permeates the sculpturing of animal figurines, such as the exquisite mammoth and horse from Vogelherd, Germany (see Cook, 2013 for illustrations and examples).

The ‘interchange of human values’ may also be evidenced in the later Palaeolithic (and its equivalents elsewhere) in the form of long-distance exchange in exotic items. Examples are the presence of shells (used for necklaces and pendants) from the Mediterranean at sites on the Atlantic coast of France and Atlantic shells on Mediterranean sites (Bahn, 1982). In Australia, beads and shells were exchanged north and south across the entire continent.

Criterion (iii) ‘bear a unique or at least exceptional testimony to a cultural tradition or to a civilization which is living or which has disappeared’.

This criterion has frequently been used in World Heritage nominations, including Palaeolithic ones. These are mostly from the Upper or Late Palaeolithic because ‘cultural traditions’ can be defined more rigorously by a wide range of cultural items of stone, bone and sometimes ivory and antler that are specific in style to particular regions and periods. Examples from western Europe, which has a rich and diverse set of Upper Palaeolithic traditions, could include the Aurignacian (c. 30-40 Ka) as the first material culture associated in Europe with Homo sapiens (Davies, 2001), the Gravettian, which is particularly well represented in eastern Europe, the Solutrean of France and Spain, with its exquisitely pressure-flaked ‘laurel-leaf’ points and the late glacial Magdalenian culture of western Europe. Earlier cultural entities such as the Mousterian (largely but not universally associated with Neanderthals) and the Acheulean (associated with H. ergaster in Africa, H. heidelbergensis in Europe and an unknown type in south-west and south Asia) are less easily seen as ‘cultural traditions’ because they are less precisely defined and are better regarded as technological groupings without social or linguistic implications.
Criterion (iv) ‘be an outstanding example of a type of building, architectural or technological ensemble or landscape which illustrates (a) significant stage(s) in human history’.

Because Palaeolithic societies were overwhelmingly mobile, few left behind any evidence of architecture. The earliest examples are from 40 Ka onwards, but most are contentious because the remains are so exiguous that they could indicate natural arrangements of stones or at most, a screen against the prevailing wind. By far the most impressive and least contentious examples of buildings are from eastern Europe and Siberia. Here the huts had frames made of mammoth bones (as at Mezherich and Mezine) or were dug into the ground and then roofed, as at Mal’ta and Buret in Siberia, rather similar to the zemlyanka or earth-house of recent times in Russia. The Palaeolithic examples would have been probably covered with skins or hides and usually had hearths inside them. Without them, survival in a glacial winter would have been impossible.

The Upper Palaeolithic examples of huts from the Ukraine and Russia can also be seen as part of the evidence for human adaptation to the particular landscapes in which they lived. This was a loess landscape that was largely treeless and occupied by a ‘mammoth steppe’ fauna that also contained the woolly rhinoceros, bison, reindeer, horses and many fur-bearing animals such as the wolverine, arctic fox and hare. There is a good case for regarding the late glacial communities as epitomising ‘the golden age of hunting’, with its own distinctive ‘technological ensemble’. One feature deserving attention is that they had a holistic attitude to their resources that is not evident in earlier periods. With the mammoth, for example, they used its meat, but also its bone and ivory for construction, as a material to carve and engrave, and for jewellery. It is doubtless the skins were also used as a heavy-duty hide for clothing, footwear, tent covering, bedding, cordage and containers, and its hair could have been used for felt. Reindeer was used in the same way, for its meat, skin, bone and antler, and small carnivores for their fur, bone and even canine teeth for pendants. (For examples, see Honnecker, 2002; Soffer, 2000; Svoboda et al., 2000; Vasil’ev, 2000).

Criterion (v) ‘be an outstanding example of a traditional human settlement, land-use, or sea-use which is representative of a culture (or cultures), or human interaction with the environment especially when it has become vulnerable under the impact of irreversible change’.

This criterion should be treated in two parts; first, regarding human settlement and land-use.

a) ‘traditional settlement and land- or sea-use’.

Eurasia has several outstanding Palaeolithic examples of traditional types of human settlement and land use. The best documented are those of the mammoth steppe of periglacial Siberia, the Ukraine and eastern Europe (also see above). Settlement data from Mal’ta and Buret in Siberia (Derev’anko et al., 1998), Kostienki and many other sites in the Ukraine (Honnecker, 2002, Soffer, 2000), Dolní Vestonice and Pavlov in the Czech Republic show how late Palaeolithic communities were extraordinarily well-adapted to an environment with long, harsh winters but rich in large mammals such as mammoth, bison, horse and reindeer and many fur-bearing mammals such as wolverine, arctic fox and hare (Svoboda et al., 2000). In western Europe, exceptional examples that tell the same story are the cave sites in the Swabian Alps such as Geissenklösterle, Höhe Stein and Vogelherd; the late glacial open air sites of Gönnersdorf and Andernach near Mainz; and the cave sites in the Dordogne in south-west France.

The Levant has several sites that show how humans adapted to a Mediterranean landscape that was often colder and drier than at present. Examples here are the caves of Mount Carmel and southern Lebanon (for example, Abri Zumoffen, Ksar Akil), and the late glacial open air site of Ohalo II by the Sea of Galilee, which is almost unique for its age because of its wealth of carbonized and water-logged plant remains as well as mammal, bird and fish remains (Nadel and Werker, 1999).

The earliest examples of sea-use are from East Asia, the islands of South-East Asia and Australia. Deep sea fishing for tuna was practised off Timor c. 40 Ka (O’Connor et al., 2011) and islands such as New Britain that were more than 100 km from the mainland were reached c. 30 Ka (Allen et al., 1989). In east Asia, obsidian was being exchanged across the sea as early as 33 Ka from Japan to the Korean Peninsula, north China and over 1000 km into eastern Siberia (Kuzmin et al., 2013). Nothing equivalent was seen in the Mediterranean until the Holocene. Human land-use in tropical rainforest is evidenced for the late glacial period by caves in Vietnam and Malaysia (Rabett, 2012) and especially at Niah Cave, Borneo (Barker et al., 2007).
b) ‘human interaction with the environment especially when it has become vulnerable under the impact of irreversible change’.

The latter part of this criterion is problematic in respect to human evolution sites of the Palaeolithic because under the climatic conditions of the Pleistocene, ‘irreversible change’ was a feature of any long-term use of a region. For example, when the climate was warmer and moister during relatively short interglacial periods (at timescales of several tens of millennia), ice sheets retreated across North American and north-west Europe but re-advanced when the climate became colder and drier for up to 100,000 years. Shorter term but nevertheless irreversible change occurred during glacial periods during interstadia (lasting a few millennia) and during short, decadal length cold snaps known as Heinrich Events.

Because dating techniques are rarely so exact that the occupation of a site can be precisely correlated with a climatic phase, it is rarely possible to place a Palaeolithic site at the boundary of a climatic phase when the environment was vulnerable to an impending climatic shift. The best example where this can be done with a reasonable degree of confidence is the late glacial period of western Europe, where there is now an enormous corpus of environmental and archaeological dates from the Late Pleistocene. These are beginning to show how humans responded to millennial-length climatic shifts, alternately retreating and then re-advancing their limits of settlement as the ice-sheets advanced and retreated (Gamble et al., 2004). In time, similar narratives can be written about earlier periods in western Europe and comparable developments in other parts of Eurasia.

Criterion (vi) ‘be directly or tangibly associated with events or living traditions, with ideas, or with beliefs, with artistic and literary works of Outstanding Universal significance. (The Committee considers that this criterion should preferably be used in conjunction with other criteria).

Unlike in much of the Americas, Australia or New Guinea, it is not possible in Europe and most of Asia to claim, let alone demonstrate, a link in ideas, beliefs, art or material culture between the Palaeolithic past and the present because the two are separated by several millennia of arable farming, pastoralism and, in most regions, urban life. Modern communities in Eurasia might feel a connection between themselves and (according to region) Classical Greece or the Chinese Han Dynasty, even if these links have sometimes been mythologized for political reasons, but scarcely to the local Palaeolithic. In those areas of Asia where hunting and gathering has persisted to the recent past (as in parts of Siberia) it may be possible to demonstrate links between the Palaeolithic past and the ethnographic present in the use of sacred places such as caves, cemeteries, rivers and springs, as in Australia.

Nevertheless, this criterion could be used in two ways. First, palaeoanthropologists can justifiably claim that they themselves are part of a ‘living tradition’ that extends back almost two centuries. As with members of other traditions, they too can claim their totems and sacred sites, in this case, the places where landmark discoveries were made. Obvious examples are the Feldhofer Cave at Neanderthal, Trinil, where Dubois found the type specimen of Pithecanthropus erectus in 1891; Zhoukoudian, where Sinanthropus pekinensis was found in 1927; perhaps Denisova Cave, Siberia, and Liang Bua, the type site of H. floresiensis, will acquire the same iconic status. (Their counterparts in Africa would include Taung, South Africa, where Australopithecus africanus was first discovered in 1924 and probably Olduvai Gorge, Tanzania, where Zinjanthropus (Paranthropus) boisei and Homo habilis were found in 1959 and 1960 respectively and Hadar, Ethiopia, where A. afarensis, aka ‘Lucy’ was found in 1974). These locations have ‘Outstanding Universal Value’ because they are so fundamental in demonstrating the ‘record of life’ - criterion (viii) - and the reality of human evolution.

Secondly, many modern communities have genetic roots that can regionally extend back into the Late Palaeolithic, as has been suggested for some European (Semino et al., 2000), Indian (Kivisild et al., 2003), Chinese (Su et al., 1999) and north-east Siberian/Alaskan (Bonatto and Salzano, 1997) populations. In these cases, it would be possible to argue that there is a tangible link between the present and the Palaeolithic past, even though there is no obvious connection in the material culture.

Criterion (vii) ‘contain superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance’.

At previous HEADS meetings where this criterion has been discussed, those present objected to this criterion because it is relativistic and subjective. There is no universal agreement over what is ‘beautiful’ and beauty is inevitably very
much in the eye of the beholder. To take one example, until the Romantic Movement of the late eighteenth and early
nineteenth centuries, mountainous areas in western Europe were seen by most as barren and inhospitable places
that were to be avoided as much as possible, and landscape artists and poets tended to praise and select gentler,
humanized landscapes such as farmlands and managed woodlands in their appreciation of nature. Only later did
people regard mountains as beautiful rather than fearful, as places to explore, climb and map (as with the British
obsession with the Alps and then the Himalayas). Similarly, polar regions were seen as devoid of any beauty until
they became associated with heroism and competitive behaviour by Europeans (and North Americans) over who
could go furthest north or south, lose the most toes and fingers, and survive the worst blizzards.

Despite the subjective nature of this criterion, palaeoanthropologists and Palaeolithic archaeologists could utilize
the first part of this criterion by considering ‘superlative natural phenomena’. This aspect of criterion (vii) overlaps
with criterion (viii), as is discussed below.

Criterion (viii) ‘be outstanding examples representing major stages of earth’s history, including
the record of life, significant ongoing geological processes in the development of landforms or
significant geomorphic or physiographic features’.

There is major scope for developing this criterion in relation to many Palaeolithic sites or groups of sites. It is also
the most obvious criterion for considering the hominin skeletal record (see below). Examples of ‘major stages of
earth’s history, including the record of life, significant ongoing geological processes in the development of landforms
or significant geomorphic or physiographic features’ can be evidenced at a variety of temporal and spatial scales
or by groups of sites within the same geomorphic setting. Human evolution has taken place against a background
of enormous changes to our planet (see Table 2). These changes have been tectonic, climatic, geomorphic and
biological. Often these are interlinked: mountain uplift, for example, has climatic consequences which in turn can
have geomorphic consequences (for example, by affecting a region’s river systems) and can affect the prevailing
fauna and flora. Sea floor changes may seem to have only a remote connection with human evolution but these
can have profound biological consequences by combining land masses, as when North and South America were
conjoined by the Panama isthmus 3 Ma or when Java emerged from the sea less than 2 Ma.

**Table 2: Major changes during human evolution in Eurasia**

Regarding criterion (viii) ‘outstanding examples representing major stages of earth’s history, including
the record of life, significant ongoing geological processes in the development of landforms, or significant geomorphic or
physiographic features’, Asia has many examples that are now well-documented. Dennell (2009) and references
therein provide an overview of those listed. For Asian deserts, the Toba and Campanian eruptions, see respectively

<table>
<thead>
<tr>
<th>What happened?</th>
<th>When?</th>
<th>Evidence?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emergence of grasslands</td>
<td>8 Ma onwards</td>
<td>Radiation of herbivores, soil isotopes; in south Asia, Siwalik faunal: changes and soil isotopes show grasslands dominant after 8 Ma</td>
</tr>
<tr>
<td>Onset of glaciation</td>
<td>2.6 Ma</td>
<td>North Atlantic ice-rafted debris; marine isotope evidence.</td>
</tr>
<tr>
<td>Loess deposition</td>
<td>2.6 Ma onwards</td>
<td>China, central Asia.</td>
</tr>
<tr>
<td>Long, severe cold periods</td>
<td>After 600 Ka</td>
<td>Ocean cores, pollen, fauna, terrestrial data, for example, loess.</td>
</tr>
</tbody>
</table>
Repeated drops in sea level
Especially after 600 Ka
Main evidence from marine sediment records. Sea level changes before 600 Ka hard to observe on land, but thereafter well-documented from terrestrial records, especially on islands that were colonized by flightless birds or non-swimming mammals when sea levels fell. Creation of Sunda and Sahul in South-East Asia and Australasia; formation of large coastal shelf off east China; Britain conjoined to mainland Europe.

Desert expansion
Particularly after 600 Ka in Eurasia
Abundant evidence from Asia for desert expansion since Early Pleistocene and for lakes in interglacials in areas now desert.

Tectonic

| Mountain uplift | Himalayas, Karakorum, Caucasus, NE China, Tibetan Plateau | Numerous geological studies of mountain uplift and forefront basin formation. |
| Desert expansion | Partically after 600 Ka in Eurasia | Emerging of much of Java. |

Biological

| Mammoth-steppe | 3.0 Ma onwards | Faunal data shows it began in north China/north-east Asia and then spread westwards |
| Stegodon-Ailuripoda fauna | 2.0 Ma onwards | Faunal record of China and South-East Asia. |
| Grassland fauna | 8.0-4.0 Ma onwards in Asia | Siwalik and N. Chinese faunal records for early part; after 2.0 Ma, the Levant and Caucasus. |
| Extinction events | Periodic, not always clustered | Some taxa become extinct because of competition with an immigrant rival, especially at times of climatic instability: Neanderthals may be one example. |
| Extinction peaks | End Pleistocene in particular | Global; end of mammoth, woolly rhinoceros became globally extinct, plus many other species across Eurasia. |
| Faunal fragmentation | Island South-East Asia | Very complex faunal record, with many disjunct taxa (for example, orang-utan in Borneo and Sumatra but not Java). |

Volcanic

| Ashfalls | c. 74 Ka c. 39 Ka | Ash from the Toba super-eruption found as far west as India. Ash from Campanian eruption found over south-east Europe and south. Russia. |
| Tephra sequences | These found from 2 Ma onwards | Used for dating Palaeolithic sequences in Turkey, the Caucasus, Indonesia, Japan and Pakistan. |

Because this criterion is composite, it is appropriate to consider each part separately.

a) ‘major stages of earth’s history, including the record of life’.

The most important stage in the earth’s history within the 5-8 Ma timespan of human evolution was the beginning of the Pleistocene 2.5 Ma when the earth’s climate cooled to the point where ice sheets in the northern hemisphere began to expand. A shift to a cooler, drier and more seasonally-pronounced climate had been ongoing for a few million years earlier and is evidenced by the expansion of grasslands at the expense of woodlands throughout much of East and South Africa, South Asia and China. This expansion of grassland was accompanied by an explosive radiation of herbivores, along with their predators, notably large cats and hyaenids.
The onset of a cooler, seasonally-pronounced climate c. 2.5 Ma was marked by the deposition of ice-rafter debris in the north Atlantic (indicating an expansion of land-based glaciers) and by the onset of loess deposition in north China and central Asia. (Loess is a wind-blown dust and this originated in adjacent desert regions; loess requires both a source of dust and wind systems to transport it). Related to this shift in the earth’s climate towards cooler conditions, the other prominent aspect of global climate over the last 2.5 Ma in particular is its instability. This is indicated by its repeated shifts between cooler and warmer conditions. In the Early Pleistocene, between 2.5 and 0.8 Ma, these were high-frequency but low-amplitude; in other words, numerous but fairly minor oscillations in climate. These became more severe c. 800 Ka during a complex Mid-Pleistocene Transition (MPT) and after 600 Ka there were four major cycles, each roughly 100 Ka in duration; in other words, low-frequency but high amplitude. The longer and cool parts of these cycles are termed glacial in Europe and North America and were marked by a major expansion of ice sheets over northern Europe, Canada, the northern USA and Greenland, and a concomitant drop in sea levels of up to 120 m below the present level. Drops in sea level of this magnitude joined Britain to mainland Europe, exposed a huge area of land off China and created an enormous landmass (Sunda) that linked most Indonesian islands with mainland South-East Asia. New Guinea, Australia and Tasmania were also conjoined in another landmass called Sahul.

These climatic changes were accompanied by, and perhaps partly caused by, some extreme instances of mountain uplift. This is most dramatically seen in the Himalayas and Karakorum, and also along the north-east margin of the Tibetan Plateau. In this region, over 3000 m of uplift is recorded for the Pir Panjal range of Kashmir in the western Himalayas and the Kunlun Mountains of north China. Some researchers have argued that the uplift of these mountains and the Tibetan Plateau had a major influence on the strength of the Asian monsoon system and was a major cause of aridification in central Asia (see Dennell, 2009).

‘The record of life’.

Two aspects can be considered here:

i) the hominin skeletal record

The ‘record of life’ obviously includes our own evolution as a bipedal, tool-using ape, so those sites in Eurasia (such as Atapuerca, Spain, Sangiran, Indonesia and Zhoukoudian, China) that have produced the most important specimens that document our evolution fully deserve their World Heritage status. Other sites such as Dmanisi, Georgia, should also be eligible for nomination.

ii) faunal evolution (excluding hominins)

The dominant trend in northern Eurasia over the last two million years is the development of vegetation and fauna that was adapted to the cold, dry conditions of much of the Pleistocene. First and foremost among these was the emergence of the ‘mammoth-steppe’, of grass and shrub communities and herbivores such as woolly rhino (*Coelodonta antiquitatis*), mammoth (*Mammuthus primigenius*), bison, horse, reindeer and musk ox, all of which were present in the coldest periods from western Europe to the Pacific. In warmer, moister (interglacial) periods, these retreated further north and were replaced by woodland communities (red deer, fallow deer, roe deer, pig, bovids and so on). In South-East Asia and south China, a tropical fauna and flora evolved and is sometimes summarized under the blanket term of a ‘Stegodon-Ailuripoda (panda) fauna’. These had a complex history in which the panda became restricted to a few localities in western China, and the orang-utan retreated from mainland South-East Asia to Borneo and Sumatra.

The history of evolution (or ‘the record of life’) is also one of extinction as well as speciation. Here, Pleistocene data can offer a long-term perspective on extinction in the recent past and likely future. As example, animals such as the panda (*Ailuripoda melanoleuca*) in south-west China and the orang-utan (*Pongo pygmaeus*) in Sumatra and Borneo are now highly localized, protected species in danger of extinction. These are also relict populations, since during the Upper Pleistocene they were extensive across mainland South-East Asia. The Javan (*Rhinoceros sondaicus*) and Sumatran rhinoceros (*Dicerorhinus sumatrensis*) are now highly endangered and limited to a few small populations in Java, Sumatra and Borneo but were once widespread across southern China and mainland South-East Asia. In the case of South-East Asia the impending extinction of these animals results from loss of habitat through deforestation and hunting. In other instances, climate change was the most likely cause of extinction. This is seen most clearly with...
the extinctions that occurred at the end of the last ice age in northern latitudes, in which woolly rhinoceros and the mammoth became globally extinct, and the musk ox became extinct in Eurasia but survived in Alaska.

b) ‘significant ongoing geological processes in the development of landforms’.

By their nature ‘ongoing geological processes’ are too slow to be noticed on a decadal basis without exceptionally precise instrumentation. If, for example, a mountain is being uplifted at a net rate of 1 mm per annum, it will be only 100 mm (4”) higher a century later. Nevertheless, even at this rate of uplift, the mountain would rise 1 km in a million years. The main ‘ongoing significant geological processes’ that are noticeable over the span of a few years or decades are ones of erosion: for example, the coastal erosion in eastern England where houses built a few years ago have now been washed away.

The main geological processes ongoing today in Eurasia are:

i) isostatic uplift in formerly glaciated regions such as Finland and northern Britain

At the height of the last glaciation, Scandinavia and most of Britain were under an ice sheet up to a mile thick. When this ice melted, the underlying surface rebounded. In parts of Finland, for example, maps have to be drawn every few years because islands become larger as they emerge from the sea. This uplift is accompanied by subsidence elsewhere. For example, south-east England is sinking, hence the high rate of coastal erosion; in the Isles of Scilly in south-west England, the iron age landscape is now exposed at low tide/under 10 m of water at high tide.

ii) global sea level changes

There is much concern these days about rising sea levels and humanly-induced climate change that scientists may feel are causing ice sheets and glaciers to retreat. In Eurasia, the main concerns are the threats to coastal cities, such as Venice (which is also subsiding), London, Bangladesh, and the megacities of coastal China and India. It remains to be seen whether future rises in sea levels will be modest and largely the result of thermal expansion or larger because of the additional input of water from retreating ice sheets over Greenland and Antarctica.

iii) loess deposition

In east Asia, and unlike in western Europe, loess deposition was continuous throughout the Pleistocene and not confined only to cold periods. Loess is still deposited in northern China, typically during the dust storms that annually affect cities such as Beijing each spring. Although most is washed away during the summer monsoon, it is nevertheless still accumulating. Almost 200 m of loess has accumulated in the Loess Plateau over the last 2 million years or an average of 1 m per 10,000 years.

iv) alluvial changes

Alluviation in river valleys is contingent on the rate of soil erosion. In many parts of the world, this is increasing because of farming practices, such as forest clearance on hill and mountain slopes or the creation of mega-fields where there are no hedges to impede run-off.

v) desert formation and expansion

Holocene and recent desert expansion has often been exacerbated, if not caused by human activities such as over-grazing and charcoal burning, both of which remove vegetation that can inhibit dune expansion. However, deserts have had a very dynamic history in Asia over the last 2 Ma (Dennell, 2013), and human factors are not always responsible for desert expansion.
vi) coastal erosion; see above

Human evolution sites in relation to this section of criterion (viii)

The cumulative effects of the above geomorphic processes over the timescale of human evolution can be seen in many areas of Eurasia. Many of these processes are crucial to palaeoanthropology because they result in geological sequences that often contain archaeological, faunal and other environmental evidence that can be dated. Some of these sections have great historical importance. For example, the fluvial sequences along the Somme in France were critical in demonstrating the antiquity of man in the 1850s. In many large river systems, sediment deposition is matched by bedrock subsidence, so sediments – and any archaeological evidence – are simply buried. In some tectonically active situations, however, fluvial deposits have been uplifted and exposed. A prime example are the Siwaliks of India and Pakistan, where several hundreds of metres of deposits from the last 20 Ma have been uplifted and exposed. As these contain faunal remains and can be dated, the Siwaliks provide one of the best terrestrial faunal sequences in the world.

Loess sections in China and central Asia show a remarkably detailed climatic record over the last 2.5 Ma, but also a record of human occupation and this is critical for demonstrating when and under what climatic conditions hominins inhabited this part of the world. Many Asian deserts such as those in the Sahara, south-west Asia and the Thar, India, show markedly different conditions in the last interglacial, with extensive lakes and rivers. These also contain valuable records of human occupation.

Sea level changes are best documented in areas of rapid uplift, as these can also record beach lines when sea levels were lower than the present. Coastal New Guinea has outstanding examples and as the resulting ‘stair-case’ of beaches can be dated; those that contain artefacts also help document the arrivals of humans across the Wallace Line.

c) ‘significant geomorphic or physiographic features’.

Several significant geomorphic or physiographic features can be recognized in Eurasia. Obvious ones are the karst landscapes of southern China and South-East Asia; the loess landscapes of north China, Tajikistan and parts of central Asia, and the Ukraine; the tundra and permafrost of Siberia, the deserts of Arabia, south-west Asia, India (the Thar Desert), central Asia and north China (Dennell, 2012), and volcanism, particularly in Indonesia, Japan and the Philippines but also Iran, eastern Turkey and the Caucasus.

Criterion (ix) ‘be outstanding examples representing significant ongoing ecological and biological processes in the evolution and development of terrestrial, freshwater, coastal and marine ecosystems and communities of plants and animals’.

In discussion of criterion (viii), the main ongoing (and long-term) geological processes in Eurasia included the formation of landforms such as deserts, karstic landscapes, loessic areas, tundra and permafrost. Each has its own distinctive fauna and flora, and their history is documented in many of the Palaeolithic sites from the last 1.85 Ma in Eurasia. These sites are time-capsules in that they document aspects of the Eurasian fauna and flora at specific points in the past or over of significant segments of it. For example, the 1.85 Ma old site of Dmanisi shows a distinctly non-African fauna that the earliest hominins outside Africa were exploiting; Zhoukoudian in north China shows the type of rich and diverse fauna that was adapted to cool temperate conditions of the Middle Pleistocene c. 0.5 Ma; Gesher Benot Ya’aqob in Israel, shows the equivalent in west Asia c. 0.8 Ma. The development of the Eurasian arctic fauna, which includes animals such as reindeer, musk ox and the wolf, is documented by numerous Middle and Upper Palaeolithic sites across Siberia and north-west Europe.

As discussed above - see criterion (viii), - humans are also part of a region’s fauna and in many regions, there has been a long association between humans and their prey. Palaeolithic archaeology shows, for example, a 30,000 year adaptation to the Arctic and Siberian data shows the history of humans as part of the fauna from Neanderthals through late glacial hunters to recent herders. Many other examples could be cited.
Criterion (x) ‘to contain the most important and significant natural habitats for in-situ conservation of biological diversity, including those containing threatened species of Outstanding Universal Value from the point of view of science or conservation’.

This is an ancillary criterion in the sense that it is fortuitous if a monument (whether historical or Palaeolithic) happens to lie in an area where habitats or species may be endangered. These habitats or species might not even have been in the area where a monument was constructed or a Palaeolithic site was occupied. Nevertheless, if a site or monument is given World Heritage status, it greatly strengthens local protection measures in the surrounding buffer zone.

An additional problem with this criterion is that a threatened species has to have ‘Outstanding Universal Value from the point of view of science or conservation’. This is inherently subjective. Whilst most scientists and conservationists would agree that mammals such as the Siberian tiger, the Javanese white rhino, the orang-utan and the panda have ‘Outstanding Universal Value’, opinion would probably be divided if the threatened species were a rare type of gerbil or hedgehog.

In some cases, there is a fortunate juxtaposition of a site and a threatened habitat or species. Two of the most obvious are in islands in South-East Asia. Niah Cave, Borneo, Indonesia lies in a protected remnant of rainforest, most of which has been cleared locally for the production of palm oil. The rainforest thus acts as a haven for a wide variety of wildlife, including bats and Aerodramus, a swiftlet that makes the nests that are harvested for birds-nest soup. The island of Flores and the only place where the ‘hobbit’, H. floresiensis, has been recorded and its offshore islands, such as Komodo, are the home of the Komodo dragon, Varanus komodoensis. Varanids were once common in Australia and Indonesia, but are now a relict population regarded as endangered by the IUCN.

It is possible that an outstanding site might be discovered in the areas where rare species such as the snow leopard, Asian elephants, Siberian tiger or pandas are found. The clearest examples would likely be on islands such as the Philippines and Madagascar, as islands often have endemic species resulting from long-term isolation. Another example are lakes. For instance, the Lake Baikal region of Transbaikalia has a rich Palaeolithic record, with major cave sites such as Denisova and O skinino. The lake itself has World Heritage status as an outstanding example of a freshwater lake system because of its unique flora and fauna in and around the lake, including the freshwater Baikal seal, Phoca siberica. Many sites are also used by rare species, so conserving sites helps maintain species diversity. Caves, for example, are often used by bats, so cave sites that are protected because of their Palaeolithic contents can also act as conservation areas.

Summary

The strength of nominations of human evolution and Palaeolithic sites for World Heritage status depends on both the breadth and depth of the criteria that can be used to advocate inscription. Because the evidence from these sites is non-monumental, nominations need to demonstrate Outstanding Universal Value in as many ways as possible. Although the current criteria of the World Heritage Convention were designed primarily for historic monuments, it is possible to use most if not all of them when nominating a human evolution or Palaeolithic site for World Heritage status. Criterion (i), for example, can be used much more widely to demonstrate ‘human creative genius’. Even criterion (vi) ‘directly or tangibly associated with events or living traditions’, which at first sight seems inapplicable to most Pleistocene sites in Eurasia because of the intervening millennia of farming, pastoralism and/or urban life can be used if genetic links can be established between the present and the Palaeolithic past. With regard to the other criteria, sites that contain faunal and environmental evidence are particularly well placed to use criteria (v) ‘be an outstanding example of a traditional human settlement, land-use, or sea-use’, (ix) ‘significant ongoing ecological and biological processes in the evolution and development of terrestrial, freshwater, coastal and marine ecosystems’ and (x) ‘significant natural habitats for in-situ conservation of biological diversity, including those containing threatened species of Outstanding Universal Value’. Because Palaeolithic archaeology has a long and close relationship with Pleistocene studies, it is especially well placed to utilize criterion (viii), with its emphasis on ‘major stages of earth’s history, including the record of life, significant ongoing geological processes in the development of landforms or significant geomorphic or physiographic features’. These are research objectives that Charles Lyell would have approved in his Principles of Geology, written in 1833, and Pleistocene scientists and archaeologists have been studying them for almost two hundred years. World Heritage nominations of Pleistocene should thus pay close attention to this criterion.
Bibliography


Scientific Perspectives: Eurasia and HEADS


Europe: the Outstanding Universal Value of a marginal area of the Palaeolithic world

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Introduction

Europe is the smallest of continents, or nearly so, excluding Australia. Furthermore, it is located entirely outside the tropics, and as primates belong to tropical species, this means that Europe is the periphery of the world where hominins evolved. This was well understood ever since the time of Eugène Dubois and of his successful discovery of ‘Pithecanthropus erectus’ in Java. The high latitude of parts of the continent also resulted in the destruction of archaeological remains whenever the ice caps expanded, while rising sea levels submerged ample coastal plains during the interglacials, just as today. However, notwithstanding the geographic handicaps, the prehistoric record of Europe is rich and complex, and allows discussing the Outstanding Universal Value of this rather marginal area of the Palaeolithic world. Europe’s assets are the outcome of the history of studies and, contrary to expectation, of geography itself.

Accordingly, after a brief presentation of the history of studies and of the main geographic features in relation with Palaeolithic settlement, three relevant case studies will be discussed: the earliest peopling of Europe and adaptation to extra-tropical environments; the late settlement of Anatomically Modern Humans; and the recolonization of abandoned areas after the Late Glacial Maximum.

The history of research

The religion and mythology of many peoples from all around the world make reference to eras that preceded the current one, when human beings or other creatures behaved differently from those of the present-day. The idea was also developed by Greek philosophers, while the Roman poet Titus Lucretius Carus in his ‘De rerum natura’ described in detail the steps of the changes undergone by humans, but refuted the idea of a past ‘Golden Age’. Furthermore, there is also evidence in Roman times of actual access to Palaeolithic implements that were positively collected by Emperor Augustus: according to the Roman historian Gaius Suetonius Tranquillus, in his villa on the island of Capri the emperor assembled immanium belluarum ferarumque membra praegrandia, quae dicuntur gigantum ossa, et arma Heroum (Life of Augustus, 72), in other words, ‘very large bones of enormous animals and raptors, which are commonly said to be bones of giants and weapons of heroes’. An Acheulean site, with hand axes and fossil remains of Pleistocene megafauna, was unearthed in Capri in twentieth century investigations. There is little doubt that the ‘bones of giants and weapons of heroes’ were of Middle Pleistocene age. In the following centuries, flint implements with a pointed shape were collected in various parts of Europe, as they were believed to be the tips of lightning bolts, called cerauniae. They were sought out because of their supposed magic properties. In Methalloteca Vaticana (only published in 1717), Michele Mercati (1541-1593), Superintendent of the Botanical Gardens in the Vatican, was the first to compare ethnographic and prehistoric curios from Asia and America in the Pope Clement VIII’s collections with the cerauniae. His conclusions were that the latter had been produced by flint percussion at a time when iron was not yet in use.

It was only later, however, that the vague knowledge of implementation of eras ‘before iron’ was turned into a scientific approach. This happened thanks to Charles Lyell’s ‘Principles of Geology’ and namely in 1833 after the publication of the third volume of the Principles. Lyell’s assumption that phenomena of the past have the same origin as modern phenomena is the foundation of modern geology and also includes the origin of extinct animals and early archaeological remains. A further, decisive step was the publication of Darwin’s ‘On the Origin of Species’ in 1859. In 1871, the year of ‘The Descent of Man, and Selection in Relation to Sex’, the scientific frame for the study of the remote human past was fully in place. The educated community was able to put the archaeological discoveries into the right perspective. Often these were made by chance and by unskilled workers, as in the Neander Valley (1856) and at Cro-Magnon (1868). Homo neanderthalensis was named and described in 1864 by William King, the first non-Homo sapiens to enter the scene. This prompted debates and controversies, especially so because it was seen as contradicting the biblical Genesis, but at the same time it paved the way to new approaches to prehistory. Those were also the years when Gabriel De Mortillet started characterising prehistoric periods,
putting them in a chronological sequence. Another milestone is his ‘Classification des diverses périodes de l’âge de la pierre’ (1872) where he describes prehistoric lithic collections from northern France. In Palaeolithic archaeology, it is the equivalent of King’s Homo neanderthalensis in physical anthropology.

In the second half of the nineteenth century, however, the debate was restricted to the European scientific community, without contact with the educated circles of the rest of the world. In the following years and decades fieldwork began on other continents, namely in Asia and Africa, but this was always carried out by Europeans due to it being colonial times. The finds, often acquired after they had been discovered and collected by local people, mostly illiterate workmen, were shipped back to European museums. The impact on the development of a locally grounded science was close to nil.

**Geography: constraints and opportunities**

The landmass of Europe is well delimited over most of its perimeter by the waters of oceans and seas. Between the Black Sea and the Caspian, the Caucasus effectively marks another boundary. The limits are much more blurred towards the east and in continuity with Asia: the Urals run more or less straight from the Caspian to the Arctic Ocean, but leave a wide gap and do not even reach 2000 m above sea level. Accordingly, Europe is often described as a huge peninsula and a western extension of Asia.

With less than 10 million square km Europe is a relatively small continent, but also a very diverse one. It matches the geographic complexity of much larger landmasses, such as that of Asia, Africa and the Americas. Admittedly, and as already underlined, it lacks in tropical extension, but extends all the same from the Arctic Circle to the Mediterranean and to less than 40° of latitude. Deserts do not exist either, at least today, differently from in the other continents – but at the peak of glacial periods a polar desert developed close to the ice caps.

Europe is structured in central areas – plains – allowing circulation in different directions and in partially or totally secluded areas at the periphery – peninsulas and islands. Extensive plains characterize central and eastern Europe, where a loess cover was laid down during the Pleistocene. The largest peninsula, that of Scandinavia, extends above the Arctic Circle and is connected to the continent via its eastern sector. In the south, Iberia, Italy, the southern Balkans and Crimea are other major peninsulas. The first three can only be reached getting around or negotiating mountain ranges, which develop as northern barriers effectively delimitating them. Crimea, on the opposite, consists of flat land, but southern Crimea is mountainous: the Yalta Mountains, the main mountain range, shoots up abruptly from sea level to over 1500 m above sea level. Furthermore, Europe is also partitioned in islands. Vast islands occur off the Atlantic façade, such as Britain and Ireland, and Corsica and Sardinia, Sicily, Crete and Cyprus in the Mediterranean are just a mention of the largest islands. The arms of the sea are an obvious natural barrier, but straits should not be overlooked, such as the Dardanelles that, together with the Bosphorus, separate south-eastern Europe from Asia. Huge rivers also exist, such as the River Danube, which were difficult to cross., These important features are also major obstacles; mountains are an example of another natural impediment to animal and human movement, even if they do not peak above 5,000 m.

This concentrate of various environments becomes relevant for human evolution if we put it in the perspective of Palaeolithic peopling, when the only way of moving around was by foot and when small human groups were exposed to a widely fluctuating environment, which was just mitigated by limited technological development – and, undoubtedly, also by the knowledge of natural resources. Furthermore, geographic diversity and environmental changes had a compound effect. Convenient and relatively rapid access to a variety of areas could mean the difference between demographic increase and mere survival, and even between life and death.

The Alps, Apennines, Pyrenees, Massif Central and Carpathians all are extensive mountain ranges. As such, they are both a challenge and an opportunity, allowing adaptation to new environments and the exploitation of more resources, often just seasonally available. Gregarious herbivores are the most obvious resource: wild and modern domestic herbivores tend to migrate in summer to higher altitudes, where there are rich pastures for a few months. This summer migration followed the same itinerary year after year, thus providing prehistoric hunters further opportunity to successfully hunt and ambush them.

Together with smaller massifs, mountains are also a direct and indirect source of raw materials, which are especially diverse as volcanic, limestone and metamorphic ranges all occur, each providing a variety of resources. Lithic resources can be found at the primary outcrop or much farther away after river transport. Ochre and other pigments occur in altered limestone and volcanic deposits. Steatite and other soft metamorphic stones were used for carving in the Upper Palaeolithic, when fossil shells were also collected. Maybe even more importantly, caves and rockshelters are potentially available. Humans and other primates are not dedicated cave dwellers, and the earliest evidence of human settlement, in Europe as elsewhere, is at open air sites. At middle latitudes, however, caves were a valuable commodity. In Europe they have been in use since more than half
a million years ago, as at Caune de l’Arago in southern France (Falguères et al., 2004). Karstic cavities even made funerary caching possible, even from the Middle Pleistocene, if the interpretation of Sima de los Huesos at Atapuerca as a voluntary repository of human remains is confirmed (Bermúdez de Castro et al., 2004). This would be evidence of early development of social and symbolic activity related to the funerary sphere. Furthermore, in the second half of the Upper Pleistocene, when Upper Palaeolithic lithic industries were produced, in parts of Europe caves and rocky cliffs had a symbolic meaning and value. They were incorporated in rituals that produced widely celebrated parietal art.

Mountains can also serve as protection against harsh climate. The Yalta Mountains of southern Crimea are an effective barrier from the northern winds, and the strip of land between them and the sea is currently classified as sub-tropical. Liguria, in northern Italy, is another strip of land between sea and mountains, which enjoys a milder climate than expected taking only the latitude into account. In both areas there is an impressive record of Pleistocene occupation. This is even more evident in refugium areas, as south-western France and the steppes surrounding the Black Sea.

Extreme environments, both in terms of altitude and of latitude, are also a natural yardstick allowing a fine evaluation of changes in human organization and technology. Scandinavia, for instance, was mostly unavailable for human and animal life over the glacial phases of the Pleistocene, but offers an interesting perspective to study tempos and modes of recolonization as soon as the ice caps melted. The record of periods before the last major development of ice caps c. 20,000 years ago, in other words before the Last Glacial Maximum, is virtually lost, but there is ample and well preserved evidence of human groups settling again in the area, as soon as it was possible to access landmass again (Larsson, 2000). Mountains were similarly settled and abandoned again and again, with much more evidence surviving after the Last Glacial Maximum than earlier periods (Crotti, 2000; Grimaldi et al., 2008; Thévenin, 1999).

Natural barriers also change throughout time. Large rivers could be crossed when frozen and when a thick ice crust developed – that is, only seasonally and during parts of the glacial eras. The case of the peopling of England is especially impressive. Over most of the Pleistocene, during low marine stands, the Channel emerged and was transformed into a vast plain, linking Britain to Europe. A powerful river split the Channel plain, resulting from the convergence of the Thames, Rhine, Somme and Seine (Rose et al., 2001). An ice cap also developed on Scotland. All the same, human groups repeatedly settled in southern parts of the new British peninsula. The Palaeolithic peopling was discontinuous, but gives evidence of a constant drive towards colonization of new lands. A different piece of evidence possibly emerges from the geographical diffusion of the Solutrean, a western lithic tradition that flourished on both sides of the Pyrenees at the time of the Last Glacial Maximum. The Pyrenees were not an obstacle, while the Rhone was, marking the easternmost expansion of the Solutrean.

The earliest peopling of Europe and adaptation to extra-tropical environments

The chronology of the earliest peopling of Europe is still widely debated, even if an age in excess of 1 million years is generally accepted for a few sites in southern Europe, starting with Atapuerca’s Sima del Elefante (for an updated discussion, cfr. Muttoni et al., 2010). An abrupt change in global climate happened later, in other words c. 870,000 years ago, at the onset of MIS 22. This is the first prominent cold stage, when the cyclicity of the glacial/interglacial phases also changes from c. 40,000 years to approximately 100,000 years. The first peopling happened, accordingly earlier, but even if the overall temperature was not as cold as it became later, this was not the only climatic obstacle: the marked seasonality of the middle latitudes is possibly much more difficult to overcome and has a direct impact on natural resources productivity. The review by Cordain et al., (2000) of 229 modern hunter-gatherer groups, within a belt of 40° north and south of the equator, remarks that there was enough humidity for the vegetation cycle not to stop over the year and that plant food made the bulk of the human diet. There is a threshold around 40° latitude north or south: at higher latitudes during winter months vegetables can only be collected in small amounts and animal food must be incorporated on a substantial and regular basis to overcome the seasonal lack of productivity.

Europe, broadly speaking, extends above 40° of latitude north, even if its southern fringes extend as far south as 36° north. A stable peopling – as opposed to a short-lived one, lasting for a few generations – could only happen when not only hunting techniques were mastered, but also when human groups were organized in a way allowing non-hunters to be regularly provisioned. Sharing food is unusual amongst primates, but this strategy had to be acquired before any successful settlement of the middle latitudes. A positive attitude towards regularly redistributing food is especially relevant in the case of pregnant/ nursing women, whose survival and well-being is the base for long-lasting groups, reproducing themselves one generation after the other (cfr. Mussi, 2007, for discussion).

After 600,000 years ago, the record includes remains of rather athletic and well-adapted humans at Atapuerca Sima de los Huesos; direct evidence of horse hunting at Schöningen; a number of multi-stratified sites both in the open, such as Venosa Notarchirico and Isernia La Pineta, and in caves such as Caune de l’Arago; substantial amounts of archaeological remains at
sites disseminated over large parts of the continent. Those are proxies for a stable and successful settlement. It is also the starting point for the evolution of the European hominin species or sub-species, in other words, the Neanderthals. Neanderthal adaptation to the middle latitudes encompasses a number of climatic phases, including glacial phases. It is usually believed that, while Neanderthals are fully characterized as such during MIS 5-3, in other words after 125,000 years ago, at least 300,000 years ago they started developing into a direction that is not in common with the other hominins of the time.

The late settlement of Anatomically Modern Humans

Anatomically Modern Humans (AMH) entered late into Europe – even later than into Australia, which had to be reached after crossing a substantial area of the sea. This is no surprise, as AMH had not evolved and adapted in this northern part of the world – which on top of being significantly colder than the tropics, had limited or no vegetation during the winter months, when the days became much shorter. The continent was also well settled by Neanderthals, a different and well-adapted species or subspecies.

AMH remains are very scarce prior to the Gravettian and to c. 28,000 years ago, in radiocarbon chronology, when burying the dead became in some instances an option, allowing a full preservation of the skeletal remains. The Sunghir burials have recently been re-dated to 30,000 years ago (Marom et al., 2012), but this does not substantially change the record, which remains extremely patchy, incomplete and controversial for the preceding time period, when interaction, if any, was possible with Neanderthals. Overall, the interaction cannot so far be tracked by archaeological analysis. Archaeologists have not been able to identify unique cultural traits that can be linked without controversy to one or another of the two species or subspecies. This is especially frustrating as genetic studies seem to have evidenced actual contact, which led to preserving some Neanderthal DNA in the genome of modern populations (Green et al., 2006; Green et al., 2010; Noonan, 2006 – but cfr. Wall and Kim for a critique). After extant evidence the encounters could have happened in the Middle East and/or in Europe.

One has to resume to dealing with lithic industries as a proxy of humans, which means that many inferences have to be made, producing lines of reasoning only partially anchored to a verifiable record. It is generally assumed that the Aurignacian industry was produced by AMH, while Neanderthals were responsible for the Mousterian and for transitional industries – again, not without controversy, as in the case of the Uluzzian and of the Châtelperronian. For instance, the deciduous human teeth found at Grotta del Cavallo, where Uluzzian layers were first excavated in the 1960s and were believed to be Neanderthals, were recently recognized as belonging to AMH (Benazzi et al., 2011); conversely, the Châtelperronian of St Cézaire with an apparently associated Neanderthal burial is seen as closer to the Aurignacian than to the Mousterian by Bordes and Teyssandier (2011), who also surmise that the transitional aspect are the results of post-depositional disturbances.

In the case of the Aurignacian, there is little doubt that it is a fully Upper Palaeolithic industry, which in later phases is sometimes associated with AMH remains, and that it is not a local development happening in Europe. The origins of the Upper Palaeolithic itself, if not in transitional industries, must be looked for elsewhere. Tsanova et al., (2012) trace the development of bladelet technology, which is also characteristic of the Aurignacian, in the wider context of Middle Eastern industries. Sinitsyn (2003) looks farther east, well into Eurasia, in search of the origins of the Spitsynian of Kostenki, which possibly goes back to 40,000 years ago, earlier than any Upper Palaeolithic of central or western Europe.

Whatever the result of this search for the origins, the Russian Plains are characterized by a much more complex array of lithic industries of the Early Upper Palaeolithic than the rest of the continent, also described in a synthesis by Djindjian et al., (2003), and by Tsanova et al., (2012; see also Sinitsyn, this volume). There is a progressive reduction of complexity in the overall record from east to west, ending in the west with Châtelperronian and Aurignacian only. The Russian plains can be reached relatively easily either from the east, crossing the low elevations of the Ural, and/or from the south, via the shores of the Black Sea. Europe, however, as previously stated, is a rather secluded ‘peninsula of Eurasia’. A decrease in circulation of people and ideas was apparently the outcome of geographic constraints.

Notwithstanding the simplification of the record, at the western end of the geographic distribution of the Aurignacian, we also find the sudden explosion of both figurative art (cave art at Grotte Chauvet and other cavities, portable art in the Swabian Jura caves and in the Danube Valley) and of music, as evidenced by flutes (caves of Isturitz and of the Swabian Jura). This phenomenon is unprecedented elsewhere, except in a way, at much earlier AMH sites, such as Blombos, Diepkloof and Sibudu. Intriguingly, the latter sites all are in South Africa, which is another geographic dead end for AMH expansion.
The recolonization of abandoned areas after the Late Glacial Maximum

The steps of the recolonization of north-western Europe and of the lowlands of northern Germany, which had been abandoned at the Last Glacial Maximum, are known in detail, thanks to decades of careful investigations (Housley et al., 1997; Terberger, 2006). Information is also available in other parts of Europe, as in the Don and Dnieper basin or in the Alps and the Apennines. There is no simple model for the process, which is not synchronous everywhere and rather related to local climatic and environmental changes.

In north-western Europe, the recolonization of vast, depopulated areas happened following a rather sophisticated step-by-step process, starting with small, mobile groups systematically exploring the newly available territories. This first happened c. 17,500 years ago, taking into account calibrated C14 dates, when there is some evidence of pioneering activity in the Upper Rhine Valley, with people coming from further south for brief periods only (Housley et al., 1997). Real settlement happens almost one millennium later, in other words, c. 16,600 years ago. At this time there is archaeological evidence of more substantial human groups – the remains of well planned activities in the framework of seasonal moves, which are made after it had been determined that the local resources were abundant enough to live on. Then, from the Upper Rhine, small parties again started to travel further and further north and west, eventually reaching England around 16,000 years ago for short-lived stays. It took probably at least another millennium to enter southern Scania, negotiating the then dangerous Oresund strait, which separates Denmark from southern Scandinavia (Larsson, 1994). At the end of the Pleistocene and during the early Holocene the strait underwent a number of complex geographic changes, which at times made crossing it impossible. Meanwhile, the Upper Rhine, northern France, southern England, central and northern Germany and even Denmark were fully included in the Palaeolithic landscape, as had happened earlier, and were regularly visited by larger human groups. In southern Scandinavia, however, the human presence remained very intermittent for a long time, turning less ephemeral at the beginning of the Holocene.

Elsewhere in Europe the record is less detailed, but there is evidence of the same drive into filling any void, so as soon as the climate changed, plants and animals spread out of their own refugia. South of the Alps, in the Italian peninsula, further information is available and a different pattern emerges. Mountains were actually visited by Homo sapiens well before the Last Glacial Maximum, as evidenced at Monte Avena, 1450 m above sea level in the Pre-Alps (Lanzinger and Cremaschi, 1988). The expanding glaciers of the Last Glacial Maximum destroyed earlier sites in the alpine and pre-alpine valleys, assuming that they ever existed, but at Monte Avena the local morphology allowed for preservation: the site is located on the rather flat top of a mountain, subsequently surrounded, but not covered, by ice expansion. Prehistoric people were attracted by the local, good-quality flint, which was extracted and/or collected, tested and knapped. Aurignacian tools were produced, suggesting an age well in excess of 30,000 years. After the last glacial expansion, by 14,000 BP the lower valleys of the Dolomites were settled. Around 13,000 BP there were residential sites up to 1000 m above sea level and soon up to 1500 m and even 1850 m above sea level (Brogiolo, 1992). Higher altitudes were eventually reached in the early Holocene. In the Apennines of central Italy, at a lower latitude of 42 °N, there is evidence of a much earlier recolonization of the mountain ranges at Grotta di Pozzo (700 m above sea level); a residential settlement is well documented between 16,000 and 14,000 years ago (Mussi, 2010-2011), but the cave was repeatedly and regularly visited immediately after the Last Glacial Maximum.

Discussion and conclusions

Europe extends at the outskirts of the enormous landmasses of Asia and Africa, outside the tropics inhabited by primates. At first glance, the geography of the continent is badly designed to accommodate any relevant evidence related to human evolution. However, the archaeological record is long, complex and articulate, which seems at odds with this unfavourable precondition. The history of prehistoric research, which started earlier than elsewhere, assembling a huge mass of data and helping to elaborate sophisticated methodologies, only partially explains this paradox – after all, Palaeolithic studies started early because there was much to investigate. Europe’s secluded geographic position, at middle to high latitudes, actually prompted adaptations and solutions tailored to specific local characteristics during the Pleistocene. This even includes the local evolution of a hominin species or subspecies, the Neanderthals. Over a million years or so, humans again and again left evidence of being able to adapt to highly seasonal environments that went from rather cold to extremely cold, and furthermore, was characterized by uneven light time throughout the year, with scarce or no vegetation in winter. Developments in both technology and social organization were needed to succeed. A vast and sophisticated knowledge of natural resources, which happens to be different over short distances, built up through time and became an asset. In the end, the small continent is a kind of yardstick allowing to gauge changing human capacities, notably around 1 million years, when hominins first settled there, stably adapting only 500,000-600,000 years ago; and some 30,000-40,000 years ago, when Homo sapiens eventually took the place of Neanderthals.
The World Heritage Convention is designed for sites or clusters of sites. There are a number of Palaeolithic sites in Europe that are found either on the World Heritage List or on Tentative World Heritage List, including some such as Atapuerca or Grotte Chauvet that have been mentioned above. The wording of some of the criteria of the Conventions (especially criteria (i), (ii) and (iii) or parts of them) would help to describe the European record as outlined above. Europe, in its entirety, definitely bears exceptional testimony of cultural traditions that have disappeared and illustrates significant stages in human history; there are outstanding examples of traditional human settlement that are representative of human interaction with the environment. Furthermore, there is evidence of geological processes in the development of landforms and of significant geomorphic or physiographic features, shaped by expanding and retreating glaciers and ice caps, and by high or low sea levels which greatly modified the geography of coasts and islands. The prehistoric hunter-gatherer way of life was resilient to most of the major changes.

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The Middle East
The Middle East

Prehistoric archaeological sites in Arabia and their potential for nomination to the World Heritage List

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Introduction

The countries comprising the Arabian Peninsula have a range of cultural properties listed on UNESCO’s World Heritage List and include properties such as forts, old walled cites, ancient harbours and irrigation systems. The Kingdom of Saudi Arabia, which covers about 90% of the landmass of Arabia, has two rather spectacular listed properties, the Al-Hijr Archaeological Site (Madâin Sâlih), consisting of Nabataean monumental tombs and At-Turaif District in ad-Dir‘iyah, the first capital of the Saudi Dynasty. One property in Saudi Arabia, named the ‘Rock Drawings in the Hail Region’, is on the Tentative List and is currently being nominated on the basis of its rather extraordinary rock art in two separate geographic areas, in other words, Jebel Umm Sanman at Jubbah and Jebel Manjour and Jebel Rata’a at Shuwaymis.

Though the Arabian Peninsula is extremely rich in prehistoric archaeological sites, dating from the early stages of the Middle Pleistocene to the Middle Holocene (Petraglia and Rose, 2009; Groucutt and Petraglia, 2012), none of these have been nominated for listing on UNESCO’s World Heritage List. There is therefore a need to identify archaeological sites in Arabia that may achieve Outstanding Universal Value status, perhaps timely given that the UNESCO HEADS Programme is interested in identifying prehistoric sites relating to human origins and development.

Here, we will briefly review the significance of the archaeological record of the Arabian Peninsula. We will then more specifically address two significant areas in Saudi Arabia: the Acheulean sites and landscapes around Dawadmi and the multiple prehistoric sites of the Jubbah palaeolake region. The archaeological findings of the Jubbah palaeolake region have particular interest as one jebel in the area, Jebel Umm Sanman, is on UNESCO’s Tentative World Heritage List for its rock art.

Background

The Arabian Peninsula occupies a central geographic position between Africa and the rest of Eurasia (Figure 1). Archaeological surveys have established that prehistoric archaeological sites are present across the peninsula and include Lower Palaeolithic, Middle Palaeolithic, Late Palaeolithic and Neolithic sites (Groucutt and Petraglia, 2012). Despite the range of known archaeological sites, Arabia has been, at worst, ignored entirely and illustrated as rather peripheral for understanding main events in human evolution (Klein, 2009). Indeed, most focus for understanding wider regional prehistory has been placed on connections with sites in the Levantine corridor (Bar-Yosef and Belfer-Cohen, 2013), thus marginalizing the Arabian Peninsula. At best, Arabia is sometimes shown as a transit route, with populations hugging the coastal fringe as they dispersed eastwards (Stringer, 2000; Oppenheimer, 2012; Mellars et al., 2013). More recently, archaeologists have begun to argue that the Arabian Peninsula is, in fact, central to our understanding of hominin dispersals, the interior of the region being used more frequently than has been heretofore realized (Petraglia and Rose, 2009). Indeed, hominin expansions over time appear to correspond with wet phases, when rivers and lakes were plentiful across the peninsula (Petraglia, 2011; Groucutt and Petraglia, 2012) (Figure 1).

Determining the degree to which the Arabian Peninsula was central to the story of human migration and settlement has been difficult owing to the fact that the great majority of the identified Palaeolithic archaeological sites were surface occurrences, where relatively little could be said about the timing of human movements, the influence of environmental change on human populations and the adaptive behaviour of hominins (Petraglia and Alsharekh, 2003). Fortunately, this situation has begun to dramatically change in the last few years. Excavations have now convincingly established that well-preserved, stratified and datable sites exist across the peninsula. Most attention has been focused on Middle Palaeolithic sites, excavations revealing stone tool industries dating to between c. 211-75,000 years ago at multiple sites at Jubbah, Saudi Arabia (Petraglia et al., 2011), c. 125-40,000 years ago at Jebel Faya, UAE (Armitage et al., 2011), c. 106,000 years ago at Aybut Auwal, Oman (Rose et al., 2011) and c. 55,000 years ago at Shi’bat Dihya, Yemen (Delagnes et al., 2012). Peer-reviewed publications in international journals in 2011 and 2012 thus represent a major turning point in understanding the prehistory of the Arabian Peninsula. Though a relative paucity of interdisciplinary studies continues to be a major problem, a five year initiative (2012-
2017), known as the Palaeodeserts project, has recently been initiated in the Kingdom of Saudi Arabia, with a goal to better understand hominin dispersals and settlement history across the Holocene and Pleistocene, and the influence of climate change on human expansions, contractions and possible extinctions (for more information, see website: www.palaeodeserts.com).

Given the potential importance of the Arabian Peninsula in understanding human origins, the remainder of this paper will be to consider two exceptional areas that contain key archaeological sites, the Dawadmi landscape in central Saudi Arabia and the Jubbah Palaeolake region in northern Saudi Arabia.

The Acheulean landscape of Dawadmi

The Dawadmi Acheulean landscape represents the richest and most convincing case for the presence of archaic humans in the Arabian Peninsula (Petraglia et al., 2009) (Figure 2). The original discoveries of Acheulean sites were made during the Comprehensive Archaeological Survey Programme of the Kingdom (Zarins et al., 1980). A count of about 32 Acheulean sites were noted to occur over an area measuring 7 km x 4 km (Whalen et al., 1984), making it one of the most significant Lower Palaeolithic site distributions in the world. The sites were situated at the base of a series of jebels with rhyolite and andesite dykes that were the source of stone tool procurement and tool manufacture. Whalen and colleagues (1983, 1984) conducted the very first excavations of Acheulean sites in Arabia, making this area important for considering the history of Palaeolithic research in the peninsula.

Surface artefacts were collected from gridded proveniences and excavations at Saffaqah indicated a dense accumulation of material extending to a metre in depth (Whalen et al., 1983, 1984). A total of 11,360 artefacts was recovered from site 206-76 and 2,444 artefacts was collected from site 206-68, making the artefact count the largest collection of Lower Palaeolithic finds in all of Arabia. A range of biface forms were described by Whalen, including characteristic hand axes, cleavers and picks, later metric analysis showing that they comfortably fit within the Acheulean range of variation in biface forms around the globe (Petraglia and Shipton, 2008; Shipton and Petraglia, 2010). Among the notable finds were giant cores and dense flaking debris along the base of the dykes, indicating procurement of source materials for stone tool manufacture by Acheulean hominins (Petraglia et al., 2009). The entire suite of reduction debris was represented at the sites, indicating that a range of activities...
was present, including access of raw materials, reduction of cores, shaping of bifaces and discard of tools. Only preliminary dating of the sites has so far been conducted, producing uranium-thorium ages of about 200,000 years (Whalen et al., 1984).

As shown by Shuttle radar topography mission DEM (Digital Elevation Model) images, Dawadmi occurs at the drainage divide between two major river systems, the Wadi al Batin and the Wadi as Sahba (Petraglia et al., 2009). Though the precise route of dispersal of the archaic hominins remains unknown, it is likely that these river systems were utilized as corridors for hominins to penetrate deep into the interior of central Arabia.

Though the Dawadmi landscape is of clear significance to Arabian prehistory, the surveys and excavations demonstrate that much information still awaits discovery and description. As part of the Palaeodeserts project, the Dawadmi landscape will soon be the subject of interdisciplinary studies to more firmly establish chronology, palaeoenvironments, hominin dispersal routes, Acheulean landscape behaviours and site assemblage formation.

The Jubbah Palaeolake region

Jubbah is known as one of the most significant areas for rock art in the Arabian Peninsula (Khan, 1993, 2007). The first systematic observations about the Jubbah rock art was made by Parr and colleagues (1978) who conducted fieldwork in the northern province of Saudi Arabia as part of the Comprehensive Archaeological Survey Programme. More recently, the Jubbah rock art landscape has been subject to systematic surveys as part of the Palaeodeserts project (Jennings et al., 2013). On the basis of stylistic observations of rock art, various chronological periods of occupation have been outlined, including late prehistoric (Neolithic, Chalcolithic, Bronze Age), Thamudic and recent. One particular jebel in the Jubbah landscape, Jebel Umm Sanman, has been singled out as a key area with rock art and is thus at the centre stage of Tentative listing on UNESCO’s World Heritage List.

The recent systematic survey of the Jubbah landscape has resulted in two significant realizations: 1) the rock art is broadly distributed on a number of jebels, along the edges of the Jubbah palaeolake and 2) there is a close

![Figure 3. Distribution of rock art and archaeological sites at Jebel Qattar. The palaeolakes at Jubbah attracted human populations for millennia. Note that archaeological sites are in close spatial proximity to the rock art, of importance in considering the value of these cultural resources. Pre-Pottery Neolithic artefacts occur at JQ-101, which is adjacent to Late Prehistoric (Neolithic) rock art sites.](image)
The Middle East

In recent years, it has been recognized that a closer consideration of the relationship between rock art sites and archaeological localities is necessary. This is particularly relevant when considering nominations for UNESCO’s World Heritage List, where greater attention is required to the association between rock art and archaeological sites (Petraglia, 2013). This approach offers both practical and academic benefits. Practically, considering how rock art and archaeological sites relate within a larger buffer zone can lead to the protection of a greater number of cultural resources over a broader area. Academically, it is more logical to treat rock art and surrounding archaeological sites as part of the same cultural context, as many are intimately associated. The Jubbah landscape provides an example of such relationships, where the presence of a palaeolake played a key role in human presence in the area.

The Jubbah palaeolake was first investigated by Garrard and colleagues (1981), during the Comprehensive Archaeological Survey. Field observations and laboratory work revealed the presence of a freshwater lake in the Holocene and Pleistocene, which is believed to correspond with the identification of Neolithic and Middle Palaeolithic sites. A recent survey on behalf of the Palaeodeserts project has identified a series of archaeological sites around the Jubbah palaeolake, including those identified as Lower Palaeolithic (Acheulean), Middle Palaeolithic, Epipalaeolithic, and Neolithic. The Lower Palaeolithic and Epipalaeolithic sites will be the subject of future publications, suffice it to say that these are significant discoveries for Arabia as a whole.

Three Middle Palaeolithic sites have been investigated: Jebel Qattar-1 (JQ-1), Jebel Umm Sanman-1 (JSM-1), and Jebel Katefeh (JKF-1) (Petraglia et al., 2011, 2012). These Middle Palaeolithic sites are significant cultural resources as they represent the first well-recorded and stratified Pleistocene sites in Saudi Arabia. The site boundaries of JQ-1 and JSM-1 are located at the edge of the jebel hill slopes, while the Holocene rock art sites occur in the case of JKF-1, the site occurs on the east side of the lake, about 800 m distant from the jebel with rock art. Though the rock art is much later in its chronology in comparison to the Middle Palaeolithic sites, there is nevertheless a close spatial relationship between the two types of cultural resources.

A clearer and more direct link between rock art and archaeological sites is realized in the late prehistoric (Neolithic, Chalcolithic, Bronze Age), Thamudic, and recent periods (Jennings et al., 2013). As an example of such relationships, a Neolithic site at the base of Jebel Qattar (JQ-101) (Crassard et al., 2013) is situated at the base of Jebel Qattar in northern Saudi Arabia, which is 500 km outside the known distribution of these distinctive Pre-Pottery Neolithic projectile points, indicating the importance of the new finds along the Jubbah palaeolake.
occurs adjacent to a ‘Neolithic’ rock art site (JQ-34) (Khan, 1993; Jennings et al., 2013) (Figure 3). In this case, Pre-Pottery Neolithic A and B projectile points (El-Khiam, Helwan) and radiocarbon ages between 10-8,000 years ago indicate occupation of the area when a lake was present and when images of goats, Nubian ibex and cattle were probably being produced on the surrounding boulders. This culturally distinctive archaeological site assumes great importance given that it is 500 km distant from the Fertile Crescent (Figure 4), thus adding important new information on the distribution of Pre-Pottery Neolithic settlements and geographic connections between groups (Crassard et al., 2013).

Conclusions and future research

In many ways, the significance of the prehistoric archaeological record of Arabia is just beginning to emerge. Though sites of every age have been identified across the peninsula, it is only now that researchers have begun to conduct multidisciplinary studies to understand their chronology and formation. Nevertheless, we can already safely say that Arabia contains prehistoric sites that are important to our understanding of human evolution and societal development. Given that the Arabian Peninsula occurs at the crossroads of continents, well-preserved archaeological sites are bound to contribute to our understanding of global events, such as the exodus of humans out of Africa throughout the ages.

Here we have briefly reviewed the Dawadmi Acheulean landscape and the Jubbah palaeolakes region, two significant cultural properties in Saudi Arabia. Given that Jubbah is already tentatively listed on UNESCO’s World Heritage List, it makes sense to consider the Outstanding Universal Value of the rock art in relation to its spatially associated archaeological sites. Links between rock art sites and archaeological properties can be made at other locations in Arabia and indeed, across the world.

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Bibliography


Tracking Upper Pleistocene human dispersals into the Iranian Plateau: a geoarchaeological model

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Introduction

Western Asia lies at the crossroad of human migrations out of Africa during the Pleistocene. Here, Neanderthals and their African counterparts - Anatomically Modern Humans (AMHS) met for the first time about 100 Ka (for instance, see the Akazawa et al., 1998 and references therein). Therefore, it is in this region that we can expect the earliest evidence for the successful expansion of our species into new regions and environments. Based on skeletal remains from the Levant at Skhul, Tabun and Qafzeh Caves (Lieberman, 1993: 602), AMHS appear to have first left Africa between 80-120 Ka, although these initial dispersals were not necessarily successful. Despite some early evidence for modern human presence in the Arabian Peninsula by 100 Ka (Armitage et al., 2011), most researchers suggest that it was only between 60-40 Ka that a wave of AMHS from Africa successfully moved into Eurasia (Dennell, 2010, Mellars, 2006, Shea and Bar-Yosef, 2005) thereby replacing and admixing with endemic populations of archaic humans (Green et al., 2010). Recent discoveries of AMHS skeletons in east Asia older than 40 Ka years (for instance, see Liu et al., 2010 and Demeter et al., 2012) and the discovery of genetic evidence for a previously unknown species of archaic hominine in southern Siberia (Krause et al., 2010) suggest that the demographic history of Eurasia was much more complicated than previously assumed.

While much archaeological work in south-western Asia has been done in the Levant and recently on the Arabian Peninsula focusing on the movement of AMHS (Rose, 2010 and references therein), other regions of western Asia remain poorly investigated. In particular, the Iranian Plateau, which stands at the centre of most models of human dispersals into Eurasia (for instance, see Bar-Yosef, 1994; Bar-Yosef and Belfer-Cohen, 2001; Flemming et al., 2003; Dennell and Roebroeks, 2005; Bailey et al., 2007; Vahdati Nasab et al., 2013), has suffered from a lack of research on human origins since the political upheavals of the 1979 Revolution. The discrepancy of Pleistocene archaeological data in Iran severely limits our ability to form and test hypotheses about AMHS migrations into Eurasia. However, recent investigations (for instance, see Biglari, F. and Heydari, S., 2001; Jaubert et al., 2006; Conard et al., 2007; Otte et al., 2011; Vahdati Nasab et al., 2013, Ghasidian, 2014 and Heydari-Guran, 2014) in Iran and reviewing old information can clarify part of the problem.

The focus on the Levant and Arabia has led to the formation of two models of dispersal for AMHS out of Africa: the ‘northern Route’ via the Nile-Sinai-Land Bridge and the ‘southern Route’ through the Strait of Bab al Mandab at the southern end of the Red Sea (Beyin, 2011). Yet regardless of which route was followed, AMHS would have had to pass through the Iranian Plateau, since this plateau is situated between two bodies of water - the Caspian Sea to the north and the Persian Gulf and Oman Sea to the south – making it an obvious western-eastern route. This paper presents a geographical migratory model for AMHS by reviewing the Palaeolithic records of the Iranian Plateau with emphasis on the Zagros region and its subsistence qualifications including food, raw materials and the accessibility of shelters, which could have magnetized AMHS to live and expand, rather than seeing it as a large natural barrier in between the west and the east of the Middle East. Archaeologists and palaeoanthropologists use both fossil human remains and other proxies to study the dispersal of modern humans out of Africa. Although sites in the Levant contain a relatively high number of skeletal remains from AMHS and archaic species, the scarcity of palaeoanthropological data in the rest of Eurasia and specifically the eastern Near East lead us to rely on other proxies, such as a) artefact typology and technology, and (McBrearty and Brooks, 2000; Brooks et al., 2006; Shea, 2006) b) land use, to track AMHS migrations (for instance, see Boivin et al., 2013; Bailey and King, 2011).

a) Artefact typology and technology

During the early Upper Pleistocene of western Asia, the lithic industry is typically described as a form of the Mousterian marked by a heavy reliance on the Levallois technique (Brose and Wolpoff, 1971). Later, the Levallois Mousterian was replaced by a technological repertoire emphasizing blade and bladelet production in the Upper Palaeolithic (for instance, see Meignen, 2012).

In a recent reanalysis of Upper Pleistocene lithic assemblages of the eastern Mediterranean, Shea and Sisk (2010) specify that the use of complex projectile points marks a significant break in lithic technology in the Near East during the Upper Pleistocene, and that this shift in lithic technology correlates with the replacement of Neanderthals by AMHS. Their argument is based on
point types from several well-known sites in the Levant region, including Qafzeh and Kebara Caves (Levallois point) and Boker Tachtit in Israel (Emireh point); Ksar Akil in Lebanon (unifacial and El-Wad points); and Üçagizli Cave in Turkey (backed and obliquely truncated points). The authors argue that complex projectile points were a key strategic innovation driving Late Pleistocene human dispersals into western Eurasia during the Upper Pleistocene, thereby enabling AMHS to overcome obstacles that constrained previous human dispersal from Africa to temperate western Eurasia. Since complex projectile technology existed in Africa already by 50-100 Ka, Shea and Sisk (2010) and other researchers believe that these projectile tools can be used as a proxy indicator of the presence of AMHS in the region (McBrearty and Brooks, 2000; Brooks et al., 2006; Shea, 2006).

b) Land use

Other researchers (for instance, Meignen, 2012) have stated that the diversity of complex projectile technology in the Levant reflects a ‘mosaic’ pattern for the earliest Upper Palaeolithic settlement systems in this region. The ‘mosaic’ pattern model argues for small-scale population expansions and migrations into various areas rather than a regional catastrophic replacement. In addition to the variable appearance of points across the Near East, many of the key sites exhibit depositional hiatuses between the uppermost Middle Palaeolithic and Upper Palaeolithic layers. Consequently, difficulties have arisen when examining the Middle to Upper Palaeolithic transitional process directly for this region (Kuhn, 2002). As a result, the ‘mosaic’ pattern model rejects the previous idea, which seeks systematically for a single scenario responsible for the onset of the entire Upper Palaeolithic, either a universal regional continuity of catastrophic wave of population advance out of Africa. Meignen states (Meignen, 2012:13) ‘that in fact, we need to investigate the processes of change in the different regions and examine each area on an individual basis in order to better understand the complexity of the phenomenon’. Another current model for AMHS dispersal from Africa towards Asia states that the scenario of leaving of Africa involved multiple exits, varying terrestrial routes and slow progress (Boivin et al., 2013:1).

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1 The use of complex projectile technology by Early Modern Humans in a wide range of habitats – from the arctic desert to tropical rain forests – suggests that this technology conferred a significant ecological advantage to AMHS. Thus, these technologies increased AMHS’ hunting versatility in comparison to other archaic hominid and allowed for the construction of a wider ecological niche (Sisk and Shea 2011).

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Figure 1. Major geological formations of the Iranian Plateau and adjacent regions (after Emami, 2008).
The natural landscape of the Iranian Plateau

The Iranian Plateau consists of several large geological formations that run through south-west Asia and the Caucasus, between the Tigris River in the west and Sand River in the east. This part of the Eurasian Plate is blocked between the Arabian and Indian Plates. The entire Iranian Plateau is fully encircled by a series of mountain ranges comprised of the Zagros Mountains to the west; parallel to it is the block of Sanandaj-Sirjan, the Caspian Basin and the Kopeh Dag Mountains in the north - north-east, the Makran Mountains in the south-east and the central plateau (Figure 1).

The Zagros Mountains are part of an alpine orogenic system and extend into north-western Iran, towards the Turkish border and towards the Persian Gulf, south of Iran (Figure 1).

Based on the geological and geomorphological investigations, the Zagros Mountains follow a convex-northward line from south-west Iran to south-east Turkey where the Taurus Mountains join (Allen et al., 2013) (Figure 1) and finally, the northern highland of the Levantine Region (Figure 1).

The mountains consist of parallel ranges that are high and rugged with numerous peaks over 3,000 and 4,000 m above sea level. Geological structures, such as these peaks, were shaped by uplift and the formation of extensive mountain systems in the area that included the Alp-Himalayan orogenic mountain belt. As part of this larger system that extends from the Alps to the Himalayas, the Zagros Mountains are structurally young mountains (nearly the same age as the Alps) (Zamani and Hashemi, 2000). The topographic expression of the geological formations in the Zagros Mountains originated from tectonic activity, erosion and variable depositional processes. At the broadest hierarchical level, the Zagros Mountains are divided into Zagros folded and highland zones (Heydari [-Guran], 2007). The folded zone is a generally low, but spectacularly dissected belt of soft, well-bedded sedimentary rocks. This zone occupies most of the Zagros Mountains and the surrounding foothills (Harrison, 1968), which is comprised of synclinal and anticlinal structures, and in general, the folds are incised by tributary rivers (Oberlander, 1965). These plains are typical landforms in these geological structures and composed of a flat area with the rocky mountains acting like a wall to limit the extent of their plain form. The wall-shape structures development within the folded zone of the Zagros Mountains are characterized by longitudinal ridges and valleys in parallel arrangements, both of which trend north-east to south-east. These variations in shape and form of these intermountain plains are important to this study as the highest concentration of Palaeolithic shelter sites in the Zagros Mountains can be found here (Heydari-Guran, 2012 and 2014).

The highland zone of the Zagros Mountains consists of contorted and overthrusted sheets of massive limestone. These form the highest parts of the Zagros, including the Zard Kuh with its summit at an altitude of 4,545 above sea level. The karsts are well-developed within massive limestone of this zone. A very common morphology here are the numerous escarpments that exist at the head of the thrust sheets (Heydari [-Guran], 2007). Steep, stream-cut ravines and gullies are present on nearly all the steeper mountain slopes (Oberlander, 1965). In the northern section of the Iranian Plateau lies the Alborz Range, rising sharply from the southern shore of the Caspian Sea. Its main peak, Damavend (5,604 m), is the highest summit in west Asia (Figure 1). The Alborz Mountains extend across the entire north of Iran, separating the Caspian lowlands from the central plateau, from the south and the Kopet Dag mountain range towards the east. The north-western section, the Talesh Range, turns north-west towards Azerbaijan and its highest peak is the Sabalan (4,814 m).

The central plateau of Iran is a geological zone situated between Helmand block to the east and Zagros Mountains to the west, including several smaller blocks, which consist of three geological blocks of Lut, central and north-west block. The Sanandaj-Sirjan block in central Iran is mainly composed of metamorphic rock from the Palaeozoic to Late Cretaceous, which is infused with calc-alkaline plutons that date to the Jurassic through to the Early Eocene (Masoudi, 1997).

The Makran Mountains occupy south-eastern Iran, to the north of the Oman Sea. The eastern section includes the parallel ranges of Aladagh and Kapet Dag, both of which define the Iran-Turkmenistan boundary and simultaneously provide a link in the Iranian Plateau between the northern and southern arcs of the alpine orogenic system. The highest point within the Makran Mountains is Kuh-e-Taftan (4,042 m), which lies south of the Iran-Afghan-Pakistan trisect.

Approximately 75% of the Iranian Plateau is dominated by arid or semiarid climate. The Iranian Plateau receives less than a third of the world’s average precipitation (350 mm to less than 50 mm per year) (Kehl, 2009:2 and Domroes et al., 1998:151). This climatic condition is the result of the Iranian location and its particular topographical landscapes. Two major mountain ranges in Iran affect the climate: the Zagros chain in the west and the Alborz in the north. Most clouds of precipitation enter the country from the west but the mountains prevent them from reaching the centre, east and south. Therefore, the central and southern lowlands and the east of the country receive very little precipitation. Due to precipitation shortages and/or its uneven distribution in these areas, most rivers are seasonal and their flows depend heavily on the amount of rainfall (Shabanali Fami et al., 2009).
Palaeolithic areas and stratigraphy

Despite the magnitude of the Iranian Plateau, by placing Palaeolithic localities on its map, we notice that with some exception of single localities, there are several areas focused on, including the Rawanduz and Chamchamal areas (Braidwood and Howe, 1960; Garrod, 1930; Solecki, 1963) in the Northern Zagros, the Kermanshah and Lurestan areas in the west central Zagros (Braidwood, 1960; Coon, 1957; Smith, 1967, Jaubert et al., 2006), the Izeh and Iveh areas (Wright and Yaghmai, 1979; Wright and Kossary, 1979) in central Zagros Dasht-e Rostam-Bast (Conard et al., 2007, Heydari-Guran, 2014, Ghasidian, 2014), Marvdasht (Rosenberg, 1988), Arsanjan (Ikeda, 1979) and the Tang-e Bolaghi (Nakamura and Minami, 2008) areas in the southern Zagros region and finally, the sites within the north-west of the central plateau and southern slopes of the Alborz Mountains (Berillon et al., 2009; Heydari-Guran et al., 2009; Vahdati Nasab et al., 2013) (Figure 2.).

Most of the Palaeolithic knowledge from this area comes from the Zagros Mountains where the site is associated with stratigraphy, human skeletal remains and fauna.
The Middle East

Northern Zagros

The Northern Zagros Mountains are located mainly inside the Iraqi-Kurdistan district and principally connect the Zagros geological zone to the Taurus Mountains. Politically they are placed between two border areas of Turkey in the north and Iran in the east and south-east where there are two Palaeolithic areas known as Rawanduz and Chamchamal, which are approximately 150 kilometres away from each other (Figure 2). The main river systems in the Northern Zagros consists of the Great Zab (Figure 3) within the Rawanduz area and Little Zab in Chamchamal area, which run parallel to each other from the highland areas of the Zagros Mountains into the Mesopotamian lowland. Geologically, similar to the other part of the Zagros Mountains, this region comprises several linear ridges alternating with broad valleys or plains (Wright, 1952) from the highlands towards the foothills (Figures 1 and 2).

The Palaeolithic research in the region of the Northern Zagros Mountains took place during the investigations carried out by Dorothy Garrod in the late 1920s in the cave sites of Zarzi and Hazar Merd in the Chamchamal area (Garrod, 1930). From 1948 to 1955, the Jarmo Iraq project, under the direction of Robert Braidwood from the Oriental Institute of Chicago University, carried out excellent work from the Palaeolithic periods to the middle of Holocene (Braidwood and Howe, 1960) in the Rawanduz area. By now several caves and rockshelters associated with Palaeolithic remains have been found in the Rawanduz area, including Shanidar, Ishkaft Hajiyah, Ishkaft Barak and Ishkaft Babkhal caves, but among them, the Shanidar Cave stands out as being one of the most incredibly unique sites in the Northern Zagros Mountains. Solecki's excavations in four seasons (1957-1961) in the Shanidar Cave (Figure 4) resulted in a 14 metre deep archaeological trench exposing 4 major cultural layers: A, B, C and D. Layer A is associated with recent Neolithic, B is Mesolithic, layer C comprises Upper Palaeolithic (typical Baradostian culture) and finally, phase D holds the Middle Palaeolithic period including the typical Mousterian culture (Solecki, 1963).

In addition, these excavations have recovered nine skeletons of Neanderthals in various ages, making the Shanidar Cave an extraordinary case in the world of prehistoric archaeology. The archaeological excavations in the Shanidar Cave have yielded a large amount of faunal remains as well. Although numerous species were recovered in the various layers of the Shanidar Cave such as red sheep, wild goat, wild boar, red deer, fallow deer, roe deer, wolf, jackal and tawny fox, 90% of the bones identified belong to wild goat and sheep (Perkins, 1964). Later studies on the fauna of the Shanidar Cave confirm that the primarily exploited ungulate during the Middle Palaeolithic period was wild goat as well (Evins, 1982). The excavations of the project of Jarmo, Iraq, in the Rawanduz region documented Palaeolithic layers as well in other shelter sites but until now no absolute dates are reported and these are just based on the techno-typological significances they are attributed from Middle to Epipalaeolithic periods.

The Chamchamal area, located in the Northern Zagros Mountains, has yielded a number of Palaeolithic sites such as the open air site of Barda Balka, and the cave sites of Zarzi, Hezard Merd and Palegawra. The open air site of Barda Balka was excavated by Howe and Wright in 1951 and unearthed lithic artefacts belonging to the Lower Palaeolithic period including the Acheulean tool type (Wright and Howe, 1951). Other sites in the Chamchamal area is the well-known Zarzi Cave; Garrod (1930) named the Zarzian culture based on the occurrence of a late Upper Palaeolithic blade industry. The industrial lithic artefacts from Zarzi Cave mainly consist of 'burins (of various forms), backed blade, backed bladelets, retouched-blades, notched blades and flakes, points, various types of scrapers including thumb-nail scrapers, two shouldered-points and a single microburin' (Wahida, 1975:77). The faunal remains that were recovered from Garrod’s excavation of Zarzi Cave are mainly gazelle, wild goat, fox and tortoise (Garrod, 1930). A small amount of animal bone, fragments of wild sheep, goat and fish were recovered from the re-excavation of Wahida (Wahida, 1975).

Hazar Merd is the name of a group of Palaeolithic cave sites excavated by Dorothy Garrod in 1928 (Garrod, 1930) in the Chamchamal area. Garrod’s excavations in the two cave sites of the Hezard Merd complex have provided lithic artefacts from the Middle to Epipalaeolithic periods. The Middle Palaeolithic assemblages (mainly Mousterian artefacts) exposed form the site of Dark Cave in level C, which is three metres thick and consists of several hearths, burnt flints and bones. The lithic artefacts of the Middle Palaeolithic layers largely include side scrapers and Mousterian points. There are also faunal remains from the Dark Cave including wild goat, red deer, gazelle and hare (ibid).

Another cave site is Palegawra, situated in the Baranand Dagh Mountains in the Chamchamal area. Excavation of this site took place in 1951 and 1955 by Howe. The stratigraphy of the excavation area is divided into two layers of upper and lower, and the main Palaeolithic materials come from the lower layer and belong to the post Upper Palaeolithic periods (Zarzian period). The excavator reported about 4,000 lithic artefacts from the depth of 60 to 130 cm from the surface. Braidwood and Howe

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2 Recently M. Zeder found the tenth individual (Shanidar 10) by examination of the faunal assemblage from the Shanidar Cave at the Smithsonian Institution (Cowgill et al., 2007).
3 Turnbull and Reed have provided two absolute dates (C14) for Palegawra cave as follows: level 80-100 cm.: 13,350 ± 460 years BP. and level 120 cm. 14,400 ± 760 years BP. (Turnbull and Reed 1974:84).
(1960:58) made a short report on the lithic artefacts from the Palegawra site and later Wahida reanalysed the lithic artefacts with much more detail (Wahida, 1975: see pages from 131-143).

**West central Zagros**

Since the middle of the last century, the Kermanshah Region in the west central Zagros Mountains (Figure 2) has been the focus of research by prehistorians (for instance, see Braidwood, 1960; Coon, 1957; Smith, 1967; Jaubert et al., 2006). The Middle Palaeolithic sites of Bisetun Cave (Coon, 1957), Ghar-e Khar Cave (Smith, 1967) and the Middle Palaeolithic to Epipalaeolithic site of Warwasi Rockshelter (Braidwood, 1960) are some of the most important in the Kermanshah region. These sites are characterized by the presence of rich Levallois/Mousterian artefacts and blade tools during the Middle Palaeolithic with large numbers of burins, end scrapers, round scrapers, backed blades and strangulated blades in the Upper Palaeolithic period. The faunal evidence show an inclination for large game animals such as horse, deer and bovid throughout all excavated layers from the Middle to Late Palaeolithic. Among these finds, the discovery of archaic human bone fragments (Neanderthal) in Bisetun Cave (Trinkaus and Biglari, 2006) and an Upper Palaeolithic human tooth (Trinkaus et al., 2008) from Wezmeh Cave in the Kermanshah region are outstanding in the history of Palaeolithic investigation in Iran. In summary, the distribution of Palaeolithic sites associated with Levallois-Mousterian and blade/bladelet industries in the Kermanshah Valley and the whole region of the west central Zagros Mountains clearly demonstrates that Upper Pleistocene hunter-gatherer groups intensively occupied the intermountain plains across the west-east trend of intermountain basins.

The classical works on lithic taxonomies from the few excavated sites in this region have drawn a clear line between two different cultural groups or stages of the Zagros Mousterian and the Zagros Baradostian that are associated with the Middle and Upper Palaeolithic. Like other regions in Eurasia, here archaeologists believe the Mousterian industry is associated primarily with Neanderthals, since these types of lithics are found with Neanderthal skeletal remains in the Shanidar (Northern Zagros) and Bisetun caves. However, the presence of the Baradostian (Upper Palaeolithic 36 Ka in the Zagros Mountains) immediately after the Zagros Mousterian (relative date older than 60 Ka) in a few excavated sites in the Zagros Mountains has raised the important question of whether the Baradostian gradually evolved from the Zagros Mousterian cultural group or if the emergence of early modern humans brought these technologies to the region rather abruptly.

To answer this question, a number of scholars have theorized some degree of continuity in the lithic tradition from the Middle to Upper Palaeolithic in the region. For instance, the rockshelter of Warwasi in the Kermanshah Valley was targeted to assess that question since it has yielded a large number of lithic assemblages that span from the Middle Palaeolithic (Zagros

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4 Based on the Braidwood and Howe report (1960) there are a large number artefacts including backed and large, small and round bladelets and other scrapers; simple angle and polyhedric burins; coarse side scrapers; different forms of drills and fabricators; microburins and scrapers by wear or slight retouch; a large number of notched blades and flakes; microlithic geometric forms such as triangles, trapezoids; and a few lunates and rectangles.
Mousterian) until the Epipalaeolithic (Dibble and Holdaway, 1993). Unfortunately, no dating is provided for the site and the deposits were excavated in arbitrary 10 cm spits. Based on the Upper Palaeolithic assemblage, Olszewski (2009) proposes that there is a trace of transitional lithic industry from the Middle Palaeolithic to the Aurignacian. She proposes the transitional levels with the lack of Levallois products and the presence of side scrapers and truncated-faceted pieces. Considering the poor stratigraphic control and documentation of the archaeological units at Warwasi, the proposed transitional layer of Middle to Upper Palaeolithic is questionable.

Based on the excavations in several sites in the Lurestan area within the west central Zagros Mountains, Hole and Flannery (1967) argue that at least some types of Baradostian/Zagros Upper Palaeolithic elements, such as retouched rods, are rooted in the Middle Palaeolithic period. The same procedure happened to the ‘Arjeneh Points’ as the ‘fossile directeure’ of the Baradostian/Zagros Upper Palaeolithic. Concerning Hole and Flannery’s model, the latter evolved from the Zagros Mousterian points with the same function. Recent research in the Yafte Cave in the Korramabad Valley within the west central Zagros Mountains have yielded relatively detailed descriptions of Upper Palaeolithic artefacts (28-35 Ka BP) and have supported Olszewski and Dibble’s idea of redefining the Baradostian of the region as the ‘Zagros Aurignacian’ (Otte et al., 2006; Bordes and Shidrang, 2009).

Southern Zagros

The southern Zagros Mountains (Figure 2), in this study, consist of a vast region that runs around 400 to 300 km from the Zohreh basin in the north to the Hormoz Strait in the south, covering the provinces of Kohgiluye-va-Buyerahmad, Fars, Bushehr and Hormozgan. Another description divides the southern Zagros Mountains into three parts: northern, middle and southern Zagros. Geologically, the southern Zagros Mountains are similar to the two major parts of highland and folded Zagros. The Zagros highlands form the north-eastern mountains and folded Zagros stands in the south and west of the Zagros highlands. Heading east, the Zagros highland face the inner highlands of the Zagros Mountains, also known as Sanandej-Sirjan Zone. Folded Zagros instead ends in the Persian Gulf in the south Khuzestan plain in the south-west and Mesopotamia in west. From the landscape structural view, the southern Zagros Mountains are moderately different to central and west central Zagros. Here, the mountains are more open and the basins are much larger than central and west central Zagros. They also occupy a larger region than the two aforementioned areas. Additionally, this region has several permanent active rivers. Recently several prehistoric archaeologists, studying AMHS dispersal, have taken this part of Zagros Mountains into consideration as it is most closely located on the route from south-west Asia to the Indian subcontinent (for instance, see Bailey, 2009; Vahdati Nasab et al., 2013, Ghasidian, 2014 and Heydari-Guran, 2014).

There are several habitats areas found in the southern Zagros Mountains, including the Marvdasht, Arsanjan, Tang-e Bolaghi and Dasht-e Rostam-Basht Ares (Figures 2 and 7).
A large amount of data on the Palaeolithic of the Marvdasht area comes from the stratified material at Eshkaft-e Gavi and the exploration of a number of caves, rockshelters and open air sites by Rosenberg during the late 1970s. The excavation in Eshkaft-e Gavi Cave uncovered an undisturbed Pleistocene archaeological deposit including Upper Palaeolithic materials that date back to 28 Ka (Rosenberg, 1985). Rosenberg relates the lithic artefacts from Eshkaft-e Gavi to the Baradostian industry, as defined in Kermanshah and Lurestan. However, some Middle Palaeolithic artefacts were also discovered from the lower layers of the site. This led Rosenberg to conclude that there is chronological continuity at the site, from the Middle until the Upper Palaeolithic (ibid). The most characteristic Upper Palaeolithic tools of Eshkaft-e Gavi are retouched blades and bladelets, burins, notched and denticulated pieces, carinated scrapers and two fragments of Arjeneh points (ibid). In terms of fauna, a preliminary analysis of the macrofauna indicates the presence of *Gazella*, *Ovis*, *Capra*, *Bos*, *Equus* and possibly *Cervus*. *Gazella* remains seem to be the most common animal species in every level at Eshkaft-e Gavi (ibid). Additionally, Rosenberg reports that some human bones were also recovered from this site. Later re-analysis of these bones has uncovered a remarkable find, suggesting that the bones belong to anatomically modern humans in every level at Eshkaft-e Gavi (ibid). Additionally, Rosenberg reports that some human bones were also recovered from this site. Later re-analysis of these bones has uncovered a remarkable find, suggesting that the bones belong to anatomically modern humans within the Upper Palaeolithic/Epipalaeolithic archaeological context, which have been burnt with signs of cut marks, probably representing the butchery of human carcasses (Scott and Marean, 2009). In addition to the excavation in Eshkaft-e Gavi, Rosenberg has conducted a systematic survey in the Marvdasht that resulted in the discovery of at least thirty-one shelter sites including Middle and Upper Palaeolithic and Epipalaeolithic sites. Artefact analysis revealed the lithic artefacts from the Middle Palaeolithic assemblages fall into the typical Zagros Mousterian and the Upper Palaeolithic pieces related to the Baradostian. Common lithic artefacts in the Middle Palaeolithic assemblages included discoidal cores, side scrapers, convergent scrapers and transverse scrapers. Among the Upper Palaeolithic assemblages, Rosenberg noted the presence of carinated scrapers, steep scrapers, full size circular scrapers and end scrapers, as well as various burin types. The Epipalaeolithic artefacts came from several shelter sites where he recovered geometric microlithics that represent the Epipalaeolithic period. They mostly contained lunates and curved backed bladelets, and there was at least one scalene and one quadrilateral piece; all are characteristic of the late Zarzian (Rosenberg, 1988).

There are two other intermountain plains in the east of the Marvdasht area: Arsanjan and Tang-Bolaghi, which are easily connected to each other by wide and flat alluvial valleys. The survey and excavation in these habitat areas have clarified that both were extensively occupied by hominids during the Upper Pleistocene (Figures 2 and 7). In 1977, the Archaeological Mission of Kyoto University, Japan conducted a survey in the vicinity of the Arsanjan area in cooperation with the Iranian
The Middle East

Centre for Archaeological Research, with the aim of obtaining information on the Palaeolithic and Mesolithic cultures in southern Iran. During this survey, a bulk of artefacts was recovered representing the Middle Palaeolithic, Upper Palaeolithic, Mesolithic, Neolithic and later ages. In 1979, the joint cooperation published a short report presenting part of their survey results, such as lists of the sites and artefacts, archaeological maps of the research areas, figures from and photographs of the sites and artefacts (Ikeda, 1979). Altogether, 144 cave and/or rockshelters and 21 open air localities were found associated with stone artefacts in the Arsanjan habitat area and several thousand lithic artefacts were collected from the Arsanjan sites. Unfortunately, not all of them have yet been analysed in detail. There are currently two publications available for these lithics, including catalogues containing site locations, metric characteristics and illustrations (Ikeda, 1979; Tsuneki and Nishida, 2007). Although the authors do not assign any distinct time period to the assemblages, their two publications do suggest that the Arsanjan habitat area was most probably inhabited from at least the Middle Palaeolithic to the Epipalaeolithic period.

Another area close to the Arsanjan is Tang-e Bolagh. This site has been investigated by several archaeological teams over the past few decades and has recovered several caves and rockshelters associated with Pleistocene deposits. Therefore, later expeditions in this valley resulted in the excavation of two shelter sites where archaeological deposition associated with lithic artefacts were recovered and correlate to the assemblages with the Epipalaeolithic to the Neolithic periods. Based on radiocarbon dating they cover a time period between 17,800 to 7,500 BP (Nakamura and Minami, 2008).

The Dahst-e Rostam-Basht area in the southern Zagros Mountains is another habitat area which has been under investigation. The joint project consisting of the University of Tübingen and the Iranian Centre for Archaeological Research (TISARP) made intensive surveys during three seasons from 2005 to 2007 in this region. It resulted in identifying 111 caves, rockshelters and open air sites, mainly associated with Upper Palaeolithic lithic artefacts (Conard et al., 2007; Ghasidian, 2004; Heydari-Guran 2014). Meanwhile the team had a test excavation in the Ghar-e Boof Cave in this area, where in a 1.5 m deep trench four archaeological horizons were defined. The current radiocarbon ages for the older stratigraphic layers at the Ghar-e Boof Cave predate 30,000 BP. The available dates fall between 31,000 and 37,000 radiocarbon years, which correspond to 35,150-41,340 cal BP (Conard and Ghasidian 2011:49; Ghasidian 2014). The Rostamian lithic assemblage of Ghar-e Boof is specialized on the production of bladelets from unidirectional single platform cores. The tools mainly consist of different kinds of retouched bladelets including Rostam type bladelets. The latter are tiny bladelets with abrupt and semi-abrupt retouches. The homogeneity among the assemblage of Ghar-e Boof and concentration on bladelet production is so far unique among the contemporary sites in Iran (Conard and Ghasidian 2011:45; Ghasidian 2014).

The Central plateau and southern slopes of the Alborz Mountains

The central plateau is located right in the middle of Iran (Figure 2) and here, the large study region covers a segment of its north-western part. The north-west central plateau of Iran is of considerable size and lies between the southern slopes of the Alborz Mountains, and the northern and eastern edges of the Karkas Mountains where several large Playa of the Howz-e Soltan and Namak (salt) sit. These are connected to the sub-basin of the Iranian internal watershed. These Playas originated as a tectonic basin and the filling of the basins continued perhaps throughout the entire Pleistocene (Krinsley, 1970:74). Geologically, this region is a part of the Urumieh-Dokhtar Magmatic Assemblage and consists of major varieties of Palaeogene igneous rocks of granitoid, diorite, gabbro (intrusive), rhyolite, andesite, basalt and tuff (Heydari-Guran and Ghasidian 2011). The interior flat area in the study region is 800 to 1000 m above sea level. From a topographical point of view, this region encompasses four landscapes of mountains, hills, alluvial-colluvial fans and Aeolian deposits. Based on the amount of precipitation, the climatic condition throughout the north-western central plateau is divided into three climatic zones of arid, semiarid and moderate. Precipitation in the region is relatively low and originated in the Mediterranean climatic system. The area loses a major part of its moisture on its rising over the Alborz or Zagros mountain ranges. In this region, daily maximum temperatures range from lows of 5 °C in December to highs of 45 °C in July. Rainfall rarely exceeds 180 mm per year in the lowland areas and is mostly concentrated in the winter months. This results in a semi-desert vegetation that supports a sparse fauna of rodents, gazelle and wild donkey in the patchy areas of greater fertility around permanent water sources and at higher altitudes where there is more rainfall there are ibexes (Uerpmann, 1987). The earlier weak Palaeolithic archaeological evidence in the central Iranian Plateau and southern slopes of the Alborz Mountains had persuaded some earlier archaeologists that this region was not used by humans during the Pleistocene era, but recent discoveries (for instance: Conard et al., 2009, Heydari-Guran et al., 2011, and Vahdati Nasab et al., 2013) show rich Palaeolithic evidence in the previously unexplored region across the Iranian plateau.

Discussion and conclusion

It is important to stress that, on a continental scale, aside from a few regions, the Zagros Mountains are an exceptional region in the world; they have a very high number of intermountain plains, formed in vast geographical units of various shapes and sizes, associated with fertile soils and are capable of producing abundant vegetation. It became obvious here that almost all of the known
Palaeolithic sites in the Zagros Mountains are concentrated in these environmentally rich intermountain areas such as the Kermanshah and Khorramabad intermountains in the west central Zagros Mountains and Dasht-e Rostam, Marvdasht and Arsanjan in the southern Zagros Mountains. The other important environmental factor is its drainage pattern. In general, the streams and rivers in this region are flowing transverse to the geological structures. The drainage systems therefore act like a network that connects the parallel intermountain valleys and plains to each other. These natural phenomena facilitated communication between intermountain valleys for herbivores and humans. The existence of extended tectonized carbonate rocks, the Mediterranean climate and consequently karstic topography resulted in the formation of many caves and rockshelters across the Zagros Mountains. The extended region associated with these natural shelters created this opportunity of shelter accessibility across this wide region. In addition, there are ample reports that indicate richness of local raw materials. These sources have been used by hominids within the intermountains habitat areas of the Zagros Mountains (Heydari [-Guran], 2004, Biglari, 2004 and 2007; Heydari-Guran, 2014). Climatic data show a strong variability in precipitation and temperatures across the Zagros Mountains from the western foothills to the highland zones (ibid). These climatic conditions could have potentially impacted land use and the size of a home-range zone for the herbivores and early humans as well. The annual resource cycle in the Zagros Mountains region engages a large abundance of plants and herbivores from winter to summer. It has been investigated (ibid) that in both regions in the west central and southern Zagros where these four landscapes came together, the number of habitat areas and Palaeolithic localities were higher.

This clearly implies that the questions of from where and when the earliest AMHS came to the Iranian Plateau are complex and remain open. However, the synthesis of several interpretative models, including the ‘mosaic’ pattern (Meignen, 2012), Boivin and colleagues’ models of AMHS dispersal across diverse environments of Asia (Boivin et al., 2013), along with geological considerations in the area suggest that it may have been a dispersal zone for AMHS moving from west to east across the northern Levant, towards the Taurus/Zagros Mountains and the rest of the Iranian Plateau. We must consider these models in view of the fact that the Zagros and the Taurus mountains are geomorphologically connected to the northern Levant (Fig 1). Finally, we must take into consideration that this geological belt is associated with the network of intermountain valleys and a large number of occupational Palaeolithic sites.

But regardless of the geographical position of the Iranian Plateau, its physiographic settings and archaeological evidence, the lack of Palaeolithic sequence in different parts of the Plateau biased any estimation about the time of arrival of AMHS into this strategic region. Nevertheless, based on the relative large number of Palaeolithic sites, especially in the Zagros Mountains, it is expected that carrying out systematic excavations associated with the geoarchaeological view will solve parts of the AMHS dispersal puzzle in one of the least known regions of the world.

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Bibliography


Regional Perspective of early human populations in Syria: the case of El Kowm

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Introduction

The El Kowm area, located in the very centre of modern Syria (Figure 1) can be considered as a region of reference for early Prehistory in the Near and Middle East. The presence of permanent water sources in the heart of the arid steppe attracted not only plenty of game but also favoured continuous occupations since the Lower Pleistocene. There, in a small territory, conditions concurred to supply the Palaeolithic population with their basic needs – water, food and raw material for their tools. The way sediments became trapped into mounds around and inside the springs explain the mighty deposits. At certain places, thick stratigraphic sequences comprising a large number of archaeological layers cover a period of around 2 million years. It is quite unusual for open air sites to offer such a range of layers. Thus, this area is particularly favourable for studying the evolution of the way of life of hunter-and-gatherer societies, as well as the dynamic of their settling within this territory, throughout the Palaeolithic.

In the 1960s, for the first time, researchers such as Buccellati and Buccellati (1967) or Suzuki and Kobori (Akazawa et al., 1970) surveyed central Syria. The results of Buccellati’s survey led R. Dornemann to carry out the first excavations at the ‘tell’ of El Kowm, revealing a substantial settlement of PPNB aceramic Neolithic (Dornemann, 1969, 1986). In spite of these encouraging explorations, research almost totally ceased for a decade until 1978 (Bader and Tchoumakov, 1977), when Jacques and Marie-Claire Cauvin began systematic investigations in this area because of the good conditions of preservation for early agricultural settlements (Cauvin et al., 1979; Stordeur, 2000). During their initial work, numerous Palaeolithic sites were recognized. From 1980 onwards, systematic surveys unveiled the Palaeolithic riches around El Kowm. This important archaeological fieldwork has been achieved by L. Copeland, F. Hours, J.-M. Le Tensorer and S. Muhesen. Within the core area of about 150 km² 72 Palaeolithic sites were recorded. (For example, Hours et al., 1983).

At this stage, observations were limited to qualitative confirmation of the archaeological period found on each site. At the same time an extensive geomorphological survey permitted a basic understanding of the natural setting of Palaeolithic sites in the region of El Kowm (Besançon and Sanlaville, 1991). Later fieldwork was carried out during an extensive survey until 2004 and about half of the 152 sites known nowadays where recorded at the time (for instance, Le Tensorer et al., 2001, 2007; Jagher and Le Tensorer, 2011). Unfortunately most of the shafts of the traditional wells are now filled up and the majority of the stratigraphies are difficult to access. Later surveys and research focusing on the local Quaternary geology brought about the discovery of additional sites. We extended our research to a larger scope. From 1981 to 1988 investigations on Palaeolithic sites focused also on the stratigraphy and Quaternary geology of selected sites, especially the large well of Hummal (Copeland, 1985) and the Acheulean site of Nadaouiyeh Aïn Askar (Hours et al., 1983). During this first period, preliminary studies were carried out on the newly discovered Hummalian industry (for example, Hours, 1982; Bergman and Ohnuma, 1983; Copeland, 1985) and focused on the Yabrudian culture (Copeland and Hours 1983; Le Tensorer, 2004). During the same period additional field work was carried out on the late Palaeolithic site (Geometric Kebaran) of Nadaouiye-2 (Cauvin and Coqueuniot, 1989).

Since 1989, the Institute for Prehistory and Archaeological Science of the University of Basel has been taking part in an interdisciplinary research programme, together with the Department of History of the University of Damascus and the Direction General of Antiquities and Museums of Damascus, for a better knowledge and understanding of the beginnings of Prehistory in this region. With the systematic excavations at Nadaouiyeh Ain Askar from 1989 until 2003 (Le Tensorer et al., 1997; Jagher, 2000, 2011; Reynaud, 2011), the Palaeolithic period became the main focus of archaeological research in the El Kowm area. Since 1991 comprehensive excavations have been conducted at Umm El Tiel by E. Boëda, S. Muhesen and H. Al Sakhel in a Syrian-French joint venture relating to Middle and Upper Palaeolithic settlements (for example, Boeda et al., 2001, 2008). In 1997 the still ongoing archaeological investigations were resumed in Hummal as a Syrian-Swiss cooperation and a new extensive excavation began under the direction of J.-M Le Tensorer and S. Muhesen (Le Tensorer, 2004, 2011a, 2011b; Hauck, 2011a; Richter et al.; 2011, Schumann, 2011; Wegmuller, 2011; Wojtczak, 2011). Additionally to these main excavations, smaller explorations were carried out at three Acheulean sites: in 1989 at Juwal Ain Zarqa and 1991 in Qdeir Ain Ojbeh, both by the Syrian-Swiss team, and from 1996 to 1998 in El Meirah under the responsibility of E. Boeda and S. Muhesen (Boeda et al., 2004).
And recently, Oldowan layers were discovered in 2008 by H. Le Tensorer in the site of Aïn al Fil, (Le Tensorer, 2009; Le Tensorer et al., in press). The first palaeomagnetic investigations and the presence of an archaic fauna show that the human occupations at this site occur in the Matuyama reverse palaeomagnetic period before two normal events and could be dated between 1.5 and 2 million years BP.

To date, this fieldwork has covered about 200 Palaeolithic settlement units. Between them, the combined stratigraphies of Aïn al Fil, Hummal, Nadaouiyeh and Umm El Tlel cover the whole Palaeolithic record known in the El Kowm area, from Mode 1 Oldowan core and flakes cultures to the latest Palaeolithic. These archaeological results are of Outstanding Value. They do outline the importance of the region for the knowledge of the dispersal of the first humans out of Africa and the settlement dynamic in the Levant (for example, Le Tensorer, 2009; Le Tensorer and Schmid, 2009; Le Tensorer et al., 2011a, 2011b)

Issuing from Africa, the first humans migrated at different periods towards Asia and Europe. During these migrations, Syria played a leading role as a crossroads between the three continents. In fact, humans have been present for over 1.8 to 2 million years in Syria, and the passageway of the Orontes Valley following the Jordan River has always been a favourable place for Early Palaeolithic settlements. After we discovered a significant skull fragment of Homo erectus in the region of El Kowm at Nadaouiyeh Ain Askar in 1996 (Jagher et al., 1997; Schmid and Le Tensorer, 2009), it became clear that a second route was also a way for migrations towards the east. This is all the more obvious because the H. erectus bone shows typical Far-Eastern characteristics. As mentioned, recently in the same region, Oldowan assemblages were found in the sites of Aïn al Fil and Hummal.

Presentation of the area

The region of El Kowm (Figure 2) spreads between two mountain ranges; along its southern margin lies the eastern end of the northern Palmyrides range, a stately chain of steep mountains rising from 400 to 650 m over the landscape and, Djebel Al Bishri in the north-eastern part, towers as a round 400 m high broad dome. It is cut off by a spectacular crag and commands the plain of El Kowm below. The El Kowm area lies in a circular, 20 km wide gap in the mountain range, which stretches across Syria from the Anti-Lebanon Mountains in the west to the Euphrates River in the east and divides northern Syria from the Arabian Desert. On the whole, the land shows very few structural features in this area, except for the south-eastern part of the plain around El Kowm, right at the foot of the Bishri escarpment, where small hills and low cliffs appear. In the past, the open landscape between the mountain ranges offered a preferential route for passing herds, as witnessed nowadays by well-preserved tracks in the desert around El Kowm. The numerous springs or water points in an arid landscape must have played an obvious part in attracting, from far away, a large number of animals to this region.
The hydrological system in the area of El Kowm is supplied by a mere 120 mm annual precipitation. Considering the geographical situation of the region, the normal rainfall patterns prevailing over inland parts in the Near East did not change throughout the Pleistocene. To be clear, it means that intermittent rains during the winter and long, dry summers prevailed at all times. Under these circumstances any long lasting settlement could rely upon basic water sources. Most of the scarce water, which comes from rainfall, is drained off by a few wadis to the south-east. These waters disappear into the huge alluvial plain of Qsar al Heir. Drinkable surface water is only available at the bottom of the wadis and only for a few days right after heavy rains; otherwise, numerous springs around El Kowm enable permanent settlements in the arid steppe.

The natural springs of the region (Figure 3) are epithermal artesian wells, highly saturated with mineral salts and flowing out at a temperature of about 30 °C. The circulation of these waters is probably based upon a single geological structure; hence, natural springs clearly cluster around the platform of El Kowm and along the south-west and northern rim of the plateau of Qdeir.

The landscape is also characterized by accumulations of sediments into prominent mounds at certain springs. The long archaeological sequences at the spring sites show how reliable these sources have been over extremely long periods, while prehistoric activity seems to have been intermittent (Figure 4).

Raw material

Around El Kowm raw material was provided throughout prehistoric times mainly by Lower Eocene flint. Siliceous nodules from the Cretaceous sediments were used only on rare occasions.

Despite mineralogical studies of flint material and locations of flint outcrops during intensive surveys of the region and its surroundings we were not able to identify exactly the possible strategies of provision. flawless, appropriate-sized nodules available in the outcrops offer raw material of exceptional quality. Three major sectors have yielded raw material (Figure 5):
The north strip

Though the low hills north of the Wadi Qdeir are located only at 3 to 4 km away from the nearest base camp, they show outcrops with scattered, generally heavily weathered raw stones. Heading east of the north strip, conditions tend to improve; narrow strips of flint beds appear in and along the few wadis.

The south strip

South of the Djebel Minshar, or behind the limits of the present El Kowm area, we find rich outcrops of flint beds teeming with raw material in primary and secondary positions along the course of Wadi Latum.

The eastern part

The foothills, below the Djebel Al Bishri escarpment represent a real godsend for flint knappers. In this sector, countless wadis cut across low hills in which the flint levels of Lower Eocene are exposed over 200 km² (Medvedev, 1966). First-rate quality raw material is available in unlimited quantities all over this sector. Continuous layers comprising 20 cm high slabs and blocks of flint stretch all along low cliffs (15 to 20 m high) for hundreds of metres.

Conservation of sites and condition of discovery

As it is the case for caves in other regions where people settled again and again on the same place, the water sources in the El Kowm area attracted humans over long periods to the same place, and the cultural remains of the settlers and their occupations accumulated over the years. On the spring sites, fine sediments piled up rapidly and these Palaeolithic open air sites are exceptionally well-preserved and represent a fourth of the sites known in the area.

As for the others, they are mainly surfaces scattered with flint tools providing no further information on the structure of the ancient settlements. The Kebarian sites however, were not affected by strong Pleistocene erosion phases and the very good condition of their preservation still offers more or less the original pattern of settling. All these different sites belong to three main types:

- **Open air settlement sites on surfaces, which have been uncovered by erosion.** This type of site is quite often related to debitage workshops that are connected to natural outcrops of flint. These debitage workshops and open air settlements occur all over the region with which we are dealing and this type prevails in most of the recorded sites.
- **Stratigraphies revealed by natural processes** (for example, erosion by the wadis). They are in situ and may appear anywhere where geological conditions are suitable (sufficient relief, rain channelled into narrow courses). This type of site is exceptional.
- **Artificial profiles.** They usually result from the digging of wells where old springs were located. For archaeological purposes, in the whole area around El Kowm, we have checked all the traditional wells and other holes carried out by the locals. Though there are a large number of sites situated on the old springs, only half of the investigated wells have produced Palaeolithic sites. This type of site is limited to the core area.

The evaluation of the general frequency of human settlement distribution in the El Kowm region is also based upon stratified sites where successive occupations are visible in various archaeological levels. For instance, the site of Ain al Fil shows the oldest human activity of the region, that of Nadaauiyeh at least 32 distinct Acheulean levels, that of Hummal more than 60 levels starting from the oldest Palaeolithic. Hummal yields a very important series of layers relating to the transition between Lower and Middle Palaeolithic. The site of Umm el Tiel comprises a long sequence from the Acheulean to the Neolithic with a remarkable Mousterian and Initial Upper Palaeolithic stratigraphy.
Palaeoecology and fauna

Palaeoecological data for the Palaeolithic in the El Kowm area are meagre despite extensive fieldwork. They are limited to the main sites that are presently being excavated. Both palaeobotanical and palaeontological studies indicate that the climate prevailing throughout the Middle and the Upper Pleistocene was dry and offered only a few short periods affording better conditions for the vegetation. Core and flake subsistence depended largely on hunting steppe animals such as gazelle, equids and mainly camelids. The prevailing bone material at Hummal relates to steppe and desert genera such as *Camelus, Gazella, Hemionus* and *Struthio*, which form the major part of the Saharan-Indian species. The El Kowm area contributes to our currently poor knowledge of the Saharan-Indian fauna adapted to arid conditions during the Pleistocene. Fossil records and modern distributions suggest that the climate in the El Kowm Basin during the Middle Palaeolithic occupations was not essentially different from the semi-desert conditions prevailing today. It suggests that this fauna has been established for a long time and adapted to the semi-arid environment of this area. A very special feature of the bone-assemblages at Hummal consists of a megafaunal giant camel, *Camelus moreli*, that had never been recognized before.

In addition, hominine remains from the Mousterian layers were discovered in 2005. The association of possible Neanderthaloid fossils with a Saharan-Indian fauna is interesting.

Considering the continental geographic position of the area, the present pattern of rainfall couldn’t have been much different during the Pleistocene. There might have been merely a few fluctuations in the normal rainfall, which allowed steppe vegetation but never a woodland cover. Another reason why there was no opportunity for a lush vegetation to develop is linked to the nature of the subsoil, which does not retain rainwater. Most of the water flows on the surface and does not infiltrate.

Chronological framework and Palaeolithic settlement patterns in the El Kowm area

Figure 6 shows the chronostratigraphy of the region of El Kowm in comparison with the Levantine chronology.

The oldest traces of human settlements are present in the site of Aïn al Fil and at the lower layers of Hummal showing an Oldowan assemblage of flakes and pebble tools in association with numerous animal remains, tokens of very old human dispersals through the Syrian desert steppe. Issued from Africa, this first wave, attested by Mode 1 lithic industries, is found at Dmanisi (Georgia) at 1.8 Ma and at the same time in the region of El Kowm, then in Asia (in China and India since at least 1.2-1.9 Ma) and in Europe (in Spain, for example, since 1.2-1.4 Ma).

A second phase is clearly characterized by the appearance of new tools, especially hand axes. These large tools occur in Africa around 1.6-1.7 Ma (Konso, Ethiopia; Kokiselei, Kenya) and around 1.4 Ma at Hummal. They are considered to be the first signs of Acheulean tradition (or Mode 2).

The key site for the Acheulean in the El Kowm area, as well as for the whole Near East, is the site of Nadaouiyeh Ain Askar. This site enables us, for the first time in the Near East, to follow the evolution of the Acheulean over a succession of at least seven distinct stages. In Nadaouiyeh, throughout the whole stratigraphy, we notice a steady decrease of the quality and finishing touch of the manufactured hand axes.

A common characteristic to all Acheulean groups is a heavy predominance of the hand axe concept as the basic tool and a nearly complete lack of retouched flakes throughout the whole sequence. Our own observations in Nadaouiyeh infer that hand axes appearing to belong to an evolved stage and which have been found out of...
stratigraphical contexts (such as open air finds) might be much older than first assumed by archaeologists based on their outward form. Hence, we cannot evaluate the age of isolated finds out of geological context on open air surfaces. So far, out of the 31 Acheulean sites recorded in the area, only 3 show similar assemblages to that of Nadaouiyeh and can be related to its sequence (Juwal, Umm el Tlel and Qdeir 23). Most of the isolated finds and small assemblages of hand axes cannot be attributed to a specific Acheulean stage. The size of Acheulean assemblages is highly variable, ranging from a few items to several dozen, several hundred or even to several tens of thousands of hand axes.

The Acheulean sites are more or less regularly scattered all over the surveyed area. We cannot say to what extent the Acheulean people were independent of water points – though the distribution of small sites seems to bear no relation to water points – as we are in the dark about the size and history of these sites.

The Early Middle Palaeolithic ('Yabrudian and Hummalian')

When we refer to ‘Early Middle Palaeolithic’, we mean Acheuleo-Yabrudian and Tabun D type Mousterian. Although Yabrudian still includes a small number of hand axes, it is nevertheless to be completely disconnected from the Acheulean. There is a drastic change toward a systematic production of flakes in a typical Mousterian core reduction, completely unknown in the preceding Acheulean. During the first stages of the early Middle Palaeolithic, distinct technological diversity was already present. The second phase of the Early Middle Palaeolithic is characterized in the Near East by a widely spread change, namely the production of elongated blanks by a prismatic core reduction. In the area of El Kowm and in most sites, the Levallois technique was applied parallel to the laminar production in order to secure broader and mostly triangular flakes.

The Early Middle Palaeolithic (Yabrudian and Hummalian) is only known in the core area. Except for two dubious discoveries on workshop sites, all early Middle Palaeolithic settlements are related to water holes and appear to have been important. It is difficult to say how we should interpret the absence of settlements and workshop sites in the open landscape. At present, we favour the hypothesis of a post-formation erosion destroying most of the previous surfaces.

The Late Middle Palaeolithic

Most of the main settlements belonging to the Late Middle Palaeolithic are only known thanks to finds in refuse sediments from the digging of wells. Consequently, stratified material is rarely available. The material collected in these sediments can be related to the Tabun B and Tabun C Mousterian that we name ‘Levallois-Mousterian’. The considerable diversity in Levallois production systems appearing in the late Middle Palaeolithic throughout the Levant is also found in El Kowm. Several Middle Palaeolithic sites show obvious differences from the Tabun B and C group. Rarely found in stratigraphical context, these sites are difficult to place in a general scheme.

Contrary to the Early Middle Palaeolithic (Yabrudian and Hummalian), the Late Middle Palaeolithic shows an extensive proliferation of sites. If we consider a roughly similar period of time, the number of sites increases from 18 to 60. However, it is hard to compare these different periods because significant erosion, probably during OIS 12 and to a lesser degree OIS 6, have most likely destroyed many sites.

As regards the later part of the Middle Palaeolithic, we note a clear division in the land use: on one hand, most of the time, huge base camps were situated around water sources or springs yielding outstanding numbers of Levallois flakes at all stages of modification and showing a near total lack of Levallois cores; on the other hand, debitage workshops were spatially connected to natural outcrops providing numerous Levallois cores but rare target flakes. The Middle Palaeolithic workshop sites are usually to be found on the low ridges and flats contiguous to the flint outcrops that were exposed by gentle erosion.

The Upper and Late Palaeolithic

Except for the site of Hummal where the Upper Palaeolithic is clearly represented, the other sites of Initial Upper Palaeolithic (Ahmarian) and Levantine Aurignacian are located in the northern part of the Al Qdeir Plateau. Only two of them are related to springs, the most important at Um el Tlel.

The most important occupation of the hunter-and-gatherer societies around El Kowm took place shortly after the major climatic deterioration of OIS 2 during the Late Palaeolithic (Kebarian). 31 out of 35 recorded sites are concentrated in the core area around the Al Qdeir Plateau and the platform of El Kowm where water points are located. Only ten of them seem to be directly related to the springs. However, a few occupations can be found elsewhere, namely at the top of the Djebel Minshar at an elevation of 700 m and at the foot of the Djebel Bishri escarpment.
The Kebarian sites are large settlements with thousands of artefacts. Most of the time, the sites spreading over several hectares, show a well structured spatial organization and are located on a rise, which affords favourable conditions. The area was largely occupied during the Kebarian, as inferred by the great number of sites from this period.

Short presentation of the major sequences of the El Kowm region

Hummal, Nadaouiyeh and Umm el Tlel

Hummal

Within the region of El Kowm, the site of Hummal (Figure 7), a prominent mound at an artesian spring, yielded a most complete sequence from Lowest to Upper Palaeolithic. It lies 2 km north-north-east of the village of El Kowm. Discovered by G & M. Buccellati in 1966, the well was also noted as Bir ‘Onusi after the name of the owner of the site.

In 1980, during a first field campaign devoted to geomorphology and Palaeolithic research in the region, the site was somewhat roughly reviewed (Besançon et al., 1981). In the lower part of the well, a new blade industry from the Early Middle Palaeolithic, named Hummalian, was recognized (Copeland, 1981; Hours, 1982). As the late F. Hours was directing the Palaeolithic research group in the El Kowm area, J.-M. Le Tensorer was invited to carry out a series of stratigraphic and sedimentological studies of the site in 1982, 1983 and 1985. He was able, among other things, to place the Hummalian above the Yabrudian, contrary to what the first observations performed in a disturbed area had led to think. During the winter in 1987, a collapse caused by a massive erosion of excavated earth piled all around from the digging of the modern well brought about the filling up of the lower part of the stratigraphy, which is still out of reach nowadays. This is the reason why, in 1997, we decided to resume our study of Hummal. The first fieldwork consisted only in cleaning the existing profiles and collecting samples for further analyses. The proper excavations started in 1999 within the Syrian-Swiss Research Programme on the Palaeolithic in the El Kowm area (Le Tensorer, 2004).

The deposits in Hummal actually come from two, quite different, sedimentary processes (Figure 8):

- An in situ consistent sedimentary series of lacustrine carbonates, clayey deposits and soil formations processes extends over 15 metres, preserving tens of archaeological levels ranging from the Holocene to Lower Pleistocene, vouching for hominid presence over one and half million years at least around the spring-pond of Hummal. These levels have been integrated into large cultural complexes or units, identified by capital letters.

- A central sink hole in which detritic sand series accumulated as well as anarchical, non-stratified scree issued from massive deposits, colluvia and collapsed strata from the eroded margins of the spring well. We note, at least, six detritic sequences comprising a great number of Hummalian and Mousterian artefacts. Therefore, the phases of erosion responsible for the massive deposits took place essentially during Middle Palaeolithic times.

Simplified stratigraphy of in situ units and layers (Le Tensorer et al., 2011b):

**Unit A, Layer 1**: historical Holocene sediments starting from Roman Times to the present.

**Layer 2**: pre- and proto-historical sediments

**Layer 3**: colluvial sediments from the beginning of the Holocene period, disrupting Upper Palaeolithic and Late Middle Palaeolithic deposits in the western and northern sections.
Unit B, Layer 4: Late Upper Pleistocene sediments from an Early Upper Palaeolithic (Possible Ahmarian and Levantine Aurignacian) in the southern section.

Unit C, Layers 5a to 5h: Upper Pleistocene sediments from Late Middle Palaeolithic (an almost 4 metres thick Mousterian sequence, see Hauck in this volume).

Unit D, Layers 6 and 7: Late Middle Pleistocene sediments from an Early Middle Palaeolithic (Hummalian sequence, see Wojtczak in this volume).

Unit E, Layers 8 to 12: Upper Middle Pleistocene sediments with the Yabrudian sequence.

Unit F, Layers 13 to 16: Lower Middle Pleistocene sediments encompassing a Lower core and flakes Palaeolithic culture with extremely scarce hand axes. Temporarily, we named this culture Tayacian or Acheuleo-Tayacian, owing to analogies and in reference to the non-standardized Tabun G flake industry identified by Dorothy Garrod.

Unit G, Layers 17 to 23: Lower Pleistocene sediments comprising an Archaic Palaeolithic with pebble-tools relating to an Oldowan core and flake facies.

So far, we have not reached the bedrock.

Remarks on the archaeological assemblages

Oldest Palaeolithic: Oldowan core and flake industries (unit G)

The base of the sequence of Hummal comprises the layers 17 to 23 preserving Oldowan assemblages (Le Tensorer et al., 2011a; Wegmüller, 2011). The lithic industry can be characterized by non-modified, very fresh flakes, with, once in a while, traces of use but never bearing intentional retouch. These flakes are found with pebble-tools: choppers, chopping-tools, polyhedrons, spheroids and other core-like artefacts (Figure 9). In a broad sense, this assemblage is typical of an archaic Palaeolithic, thedebitage of which corresponds to ‘Mode I core and flake Industries’. From a techno-typological point of view, this industry fits
quite well in the so-called Oldowan facies. It also shows remarkable similarities with the oldest assemblages at Ubeidiya, considered as Old Acheulean (Bar-Yosef and Goren-Inbar, 1993). From a chronologic point of view, the Oldowan-like levels of Hummal occur before the Matuyama-Brunhes palaeomagnetic reversal as it clearly appears in the current analyses that are being carried out by J. J. Villalain in Burgos. The accurate dating of the lowest sequence of Hummal is in progress. If we take into account stratigraphic and techno-typological observations, we assume that the Oldowan levels of the site should be older than 1.3 million years at least. With the Oldowan sequence of Ain al Fil, these levels would be among the oldest ever found in Syria.

Lower Palaeolithic: Acheulean or Tayacian sequence (Unit F)

On the top of the Oldowan series, a succession of layers encompasses a similar material with a coarse debitage and opportunistic cores, but in these levels we discovered very few typical hand axes (Figure 10). They are thick and elongated, issued from hammerstone knapping. Before the discovery of these bifaces, the industry had been named ‘Tayacian’ with reference to the Tabun G and Umm Qatafa assemblages, which show similarities with the industry of layer 13 at Hummal (Copeland, 2003; Le Tensorer, 2004). Clark Howell had even named the Tabun G industry ‘Tabunian’ because he wanted to emphasize the differences with Acheulean. It has to be underlined that, all the cultures labelled ‘Tayacian’ in the different sites of the Levant, are always located at the base of the stratigraphic sequences preceding an ‘Upper Acheulean’ stage. In other words, it seems that these ‘Tayacian sequences’ are by and large contemporaneous with a Middle to Lower Acheulean stage; they would fit roughly into a time-span between 1.2 Ma and 0.7 Ka. Do we have to link this assemblage to the non-Acheulean ‘core and flake’ culture or do we have to link it with an Acheulean culture without (or scarce) hand axes?

Today, the definition of Tayacian (Copeland, 2003) for want of accuracy does not wholly qualify to characterize a culture. Usually in the Levant, as in the region of El Kowm, all Acheulean sites yield an extraordinary amount of hand axes, such as Al Meiha for the Middle Acheulean and Nadaouiyeh, Juwal B or Qdeir 23 for the Upper Acheulean sequences (Jagher, 2011). In Hummal, the bifaces are extremely rare. Consequently, we consider these levels comprising very few hand axes to belong to a different ‘Acheulean’ than those found in Nadaouiyeh or Al Meiha. Is this culture of layer 13 in Hummal an independent culture from that of the Acheulean and do the scarce bifaces found show that they had been in contact with them or that they picked up Acheulean bifaces? Up to now, in these levels, we have never found biface trimming flakes. Or, does this culture belong to a Middle Acheulean facies largely deprived of hand axes? This ‘Acheuleo-Tayacian or evolved core and flake culture’ from Hummal Unit F probably fits in a time-frame compatible with a Middle Acheulean period.

Lower to Middle Palaeolithic transition, the Early Middle Palaeolithic I Yabrudian sequence (unit E)

In Hummal, the Yabrudian sequence develops over a very long spell of time, under changing climatic conditions that brought about the formation of diverse sedimentary facies. Most of the time, the Yabrudian occupations took place in humid and cool (even cold) times. During arid warm periods, humans seem to have been away from the region.
In the *in situ* deposits we found no hand axe in the Yabrudian complex, except for an Acheulean-like fragment at the basis of layer 10.

The Yabrudian is an industry characterized by a predominant production of very thick flakes, quite often transverse or déjetés, which were used as blanks for nearly exclusively scaled and stepped-retouched side scrapers. The artefacts are always deeply retouched and resharpended; the recurrent retouch of the edges again and again on double side scrapers led to a characteristic shaping of the limaces (Figure 11).

The Yabrudian industry is quite in keeping with the Lower Quina culture just as it is defined in Europe in terms of core reduction and typical stepped retouch (Bourguignon, 1997, Al Qadi, 2008).

The question has been raised in the last few years as to whether the Yabrudian, as a cultural chronological stage, should be placed within the Lower or Middle Palaeolithic. A. Jelinek (1982, 1990) and others (Goren-Inbar, 1995) consider it to belong to the Lower Palaeolithic. R. Barkai and A. Gopher, from new observations carried out at Qesem Cave, emphasize the originality of the Yabrudian and Amudian stages and suggest that we should distinguish this ‘cultural complex between Acheulean and Mousterian as an independent, long, creative and innovative cultural entity reflecting dynamic human behaviour and flexible local adaptations’ (Barkai and Gopher, 2011). As he reconsiders the sequence of Tabun, A. Ronen expresses another point of view and proposes to limit and redefine Jelinek’s Mugharan Tradition concept. This notion applies ‘solely within Garrod’s Yabrudian layers, between about 450 Ka and 250 Ka. The terms Mugharan and Yabrudian thus become synonymous’ (Ronen et al., 2011). What sustains the use of the term ‘transitional’ for the Yabrudian culture? Is it a Late Lower Palaeolithic or an Early Middle Palaeolithic?

From our point of view, it amounts to a theoretical debate. Today, we know in Europe how difficult it is to substantiate a conventional distinction between Lower and Middle Palaeolithic (Monnier, 2006).

When we sum up all the distinctive traits that characterize this culture, we clearly separate the Yabrudian and the Acheulean; we discard the term Acheuleo-Yabrudian that does not fit for the Yabrudian in Hummal. In this site, these layers are unquestionably located between the Lower Palaeolithic context and a typical Middle Palaeolithic context with blade and Levallois debitage. Levallois technology is non-existent in the Yabrudian assemblages of Hummal. Thus we are led to think that Yabrudian comes apart from Hummalian and Mousterian, too. In a previous paper (Le Tensorer et al., 2001), we suggested to place the Yabrudian in an Early Middle Palaeolithic I, the Hummalian in Early Middle Palaeolithic II and the Mousterian in a Late Middle Palaeolithic.

The dating of the Yabrudian units of Hummal is in progress. The base of the overlying Hummalian complex is dated around 250 Ka and a burnt artefact found in a secondary position in layer 6 yielded a TL date between 243,00 ± 40 BP and 422,000 ± 55 BP (Richter et al., 2011). This tallies quite well with the time frame 400 to 250 Ka currently accepted for the Yabrudian period in the Levant (Barkai et al., 2003).

**Early Middle Palaeolithic II: Hummalian sequence (unit D)**

The second phase of the Early Middle Palaeolithic is characterized in Hummal by a major change: the production of elongated blanks in a special core reduction method (Figure 12).

The Hummalian industry is subdivided into stratified geological layers, which are clearly in between the Yabrudian and Mousterian sequences (Le Tensorer, 2004). In the heart of the doline, the massive sand deposit encompasses a large number of Hummalian artefacts. Archaeologically speaking, these artefacts are not in situ, but correspond to a homogeneous assemblage, while stratigraphic observations show that these Hummalian sands are in place, geologically speaking.

A thorough and detailed study of 10,000 lithic artefacts was carried out by Dorota Wojtczak (2011), including the nearly 7000 items found in the stratified layers 6 and 7. The technological studies bear out the existence of a special typical laminar system of debitage, very different from a Levallois knapping technique and yet, the use of a genuine Levallois technique occurs at the same time. It appears that there are two concomitant reduction strategies. The dating of layer 6 in Hummal yields an average of 200 Ka, while the complete sequence lies between 160 and 220 Ka.
Late Middle Palaeolithic: Mousterian sequence (unit C)

Technological observations support a Mousterian sequence divided into three parts: the upper, middle and lower industries. This partition reflects the association of several assemblages into major techno-typological traditions (Hauck, 2010, 2011a, 2011b). We recently discovered evidence for bitumen use for hafting on lithic artefacts (Hauck et al., 2013; Monnier et al., 2013).

The outstanding discovery in this Mousterian period consists of the remains of a giant camel that coexisted with *Camelus dromedarius*. The animal measured over 3 m at shoulder-height. Roughly speaking, it was 1.5 to 1.75 times bigger than the modern camel (Martini, 2011).

In the same layer, in addition to the large number of flint artefacts, two human remains were unearthed. At the moment, it is not possible to say for sure to which species it belongs, Neanderthal or Anatomically Modern core and flake. A medial left upper incisor, designated W1374 (Figure 13) was found in level 5a4. The combination of traits favours a determination of the tooth as belonging to the Neanderthal group (Schmid and Le Tensorer, 2009). However, the root length (15.3 mm) is below the range observed in Neanderthals. Other measurements, such as the labio-lingual diameter, seem to cluster the tooth with the latter but compared to the specimens from Qafzeh, we cannot exclude a certain resemblance to the oldest anatomically modern man. The second element is a fragmentary but robust rather straight radial diaphysis discovered in 2003. Despite variation in radial diaphyseal proportions in the context of the available human remains from the later Pleistocene of western Eurasia, the Hummal radius has proportions that align it predominantly, by no means exclusively, with early modern human remains (Le Tensorer et al., 2011b; Richter et al., 2012).

We have very few dates at our disposal so far (more dating is in progress) so we cannot present a complete chronological framework for the Mousterian sequence yet. Preliminary TL dates (Richter et al., 2011) for sediments of layer 5g in the lower part yielded a round 100 Ka of age. Even though better chronological control is clearly needed, the large Mousterian sequence is of great importance and establishes Hummal as a key site for reconstructing human presence in an arid environment and the conditions under which it was exploited during Middle Palaeolithic times.

Upper Palaeolithic (Unit B)

An erosive discontinuity clearly divides the Holocene and Pleistocene levels. An Upper Palaeolithic occupation (Ahmarian or Levantine Aurignacian) is embedded in a colluvial formation (layer 4), which truncates the Mousterian levels. In the southern section, the knapping strategy of this assemblage focuses mainly on the production of blades and bladelets; flakes amount to 13% of the artefacts. Retouched pieces come to 10% of the whole assemblage. They are mostly end-scrapers (almost half of the tools with retouch), a few dihedral or on-break burins (about 20% of the retouched pieces); the remaining percentage parts into retouched blades (among which, one of them, is a typical Aurignac blade), notched pieces or denticulates.

Holocene (Unit A)

During the Holocene (Layers 1 to 3), the spring was not really active. Due to the deflation, fine Aeolian quartzitic silts and gypsum sands covered the former Pleistocene topography of the site. In stratigraphic terms, several levels are easily identified, but their archaeological content is very poor; it amounts to a few scarce ceramic shards pointing to a period from Bronze Age to Roman times. A few Neolithic or eventually Epipalaeolithic stone artefacts were found outside a stratigraphic context.
The Middle East

Thanks to an exceptional archaeological sequence preserving at least sixty levels, from Archaic to Upper Palaeolithic and Holocene cultures, Hummal has become a key site for the Prehistory of the Near and Middle East. It withstands the comparison with the largest Pleistocene stratigraphies of the Levant, especially with Tabun in Mount Carmel.

From a cultural perspective, the sequence of Hummal should allow a better understanding of some major questions such as relationships between Acheulean and Oldowan core and flake industries or the transition from Lower to Middle Palaeolithic. The enlargement of the excavation area should provide new data on the site function and answer questions on behavioural patterns.

Finally, the site of Hummal shows that a very large sequence is also encountered in an open air settlement and that the steppe regions between the Mediterranean coast and the Euphrates River were also favourite territories for long-lasting human settlements, a fact that should be taken into account in the current debate about the routes of human dispersal.

Nadaouiyeh Aïn Askar

The site of Nadaouiyeh about 7 km north at Hummal (Figure 14) shows a sequence covering a rough 600,000 years span of time. The older part is especially well-documented. The spring site comprises 32 layers of Acheulean and levels of Yabrudian, Hummalian, Levalloiso-Mousterian, Upper Palaeolithic, Epipalaeolithic, Neolithic and historical times (Omayyad period). Actually, with a 32 m thick stratigraphy, the Nadaouiyeh sequence is the most extensive site for the Upper Acheulean in the Levant (Jagher, 2011).

The geological history of the site is well established in its general outlines. The ancient, nowadays dried up spring depends on a karstic system that developed at the intersection of faults in the bedrock (Turberg, 1999). Due to the tectonics the cave system evolved vertically, eventually reaching the surface and opening extensive dolinas between 30 to 50 m wide and roughly 5 to 10 metres deep. This is basically the system that allowed the accumulation of Pleistocene deposits as the depression acted as a sediment trap. We know of at least eight cave-ins of the underground accounting for quite a complex stratigraphy as these events overlap. Important sections of the deposits have been lowered as extensive slabs by several metres from their original level. Although the primary situation has been destroyed, the lowered sections were protected, as the remainder of these layers is lost to erosion. This intricate stratigraphy eventually comprises about 30 m of deposits. Dependent of the activity of the aquifer the depression on the surface remained dry, accumulating washed-in detritic deposits collected by runoff from the margins. During periods with a high water table the depressions filled with water, creating a spring pond producing limnic sedimentation. Both topographic situations were appropriate to human settlement, as the dry depression offered natural protection against the strong winds in the open landscape. With the presence of water the advantage is obvious, especially when considering the lush vegetation developing around the spring, providing natural shelter.

Due to the natural radioactivity of the site, several attempts of radiometric dating failed. An indirect estimated age can be deduced from geological observations. Layer c.7 shows clear solifluxion phenomena, occurring under periglacial conditions. The same process was observed in two other Acheulean sites in the same region. At the latitude of El Kowm (35° north) and the elevation of the site (485 m) it indicates a very important drop of temperatures. A correlation with MIS 12 is highly probable. It was one of the most important glacial periods during the Acheulean, culminating at about 435,000 years BP (Jagher, 2011).
Combined with the sedimentological and palaeontological studies, the presently known base of the Nadaouiyeh sequence could be dated over 600,000 years BP.

The archaeological levels in Nadaouiyeh Aïn Askar are extremely rich in artefacts (over 13,000 hand axes) among which 8000 hand axes were discovered in the limited excavation of layer 7 and, at a rough estimate, we assume that the whole layer would yield around 80,000 to 90,000 hand axes. This outstanding number is due to an accumulation of artefacts carried by solifluxion. This very large amount shows that people have been continuously living around the spring site over several hundred thousand years.

The Acheulean sequence is of outstanding importance for the prehistory of the Middle East (Figure 15). For the first time we are able to follow a complex evolution of the Acheulean culture during roughly 400,000 years. Today we can characterize seven major different phases of hand axe traditions at least. Surprisingly, the oldest occupations discovered in situ present the most refined hand axes of outstanding quality exceeding by far pure functionality, a feature gradually disappearing in the course of time. An almost complete left parietal bone of *Homo erectus*, about 500,000 years old, was discovered in 1996 in a well-preserved Acheulean living floor.

It is usually considered that artistic creativity is a trait of the modern human and that art appears only with *Homo sapiens*, at the beginning of the Upper Palaeolithic. If this fact seems well established, however it looks likely that the emergence of symbolic thought and aesthetic feeling has to be dated back to the Old Palaeolithic. Indeed, the Acheulean biface shows a morphological symmetry and remarkable aesthetic. Whenever this tool exclusively constitutes the lithic assemblage of a culture, particularly those from Nadaouiyeh Aïn Askar, it can be suggested that it holds a strong symbolic component. The question is, was this harmonic aspect of the form really conceived by the tool maker or does it result from an unconscious phenomenon related to the knapping of the artefact? If it is indeed a conscious and desired symmetry, it is not impossible that the artisan tried to project a part of himself into the tool. Through this harmonic component of the bifaces, it seems that *Homo erectus* was already capable of symbolic behaviour and a kind of artistic creativity. It is not a question of art as a traditional conception, but probably of its first steps (Le Tensorer, 2006, 2009, 2012).

**Umm El Tlel**

Umm el Tlel is an open air site located on the northern slope of the Qdeir plateau, about 1 km from Nadaouiyeh (Boëda and Muhesen, 1993; Molist et al., 1987). It contains a large continuous stratigraphic sequence from the Acheulean to the Neolithic (Figure 16). Excavations of the Middle and Upper Palaeolithic sequence carried out from 1991 to 2010 by a French-Syrian team under the direction of E. Boëda, S. Muhesen and H. Al Sakhel have resulted in the recognition of 89 levels extending over 6 m in depth. 29 layers are attributed to the Upper Palaeolithic (Levantine Aurignacian and undetermined); 3 to intermediate Middle/Upper Palaeolithic (Ahmalian and

![Figure 16. General stratigraphy of Umm el Tlel (after E. Boëda, property of El Kowm archaeological project).](image-url)
transitional phases) and 57 to the Mousterian. One of these layers, IV 3b’1 has yielded a mesial fragment of a Levallois point embedded in the 3rd cervical vertebra of a wild ass – Equus africanus – (Boëda et al., 1999). The Mousterian levels are very rich in archaeo logical and palaeontological material and correspond to lacustrian sedimentation. The entire assemblage of lithic and bones is remarkably well-preserved. The researchers identified natural bitumen on stone implements dating to 70,000 BP and they put forward that it represents residue from hafting. The analyses establish the use of bitumen as well as its importance in the Mousterian lithic technological system. Far from being a rare occurrence, it appears rather to be an omnipresent element on Levallois artefacts. The raw material came likely from a natural source more than 40 km east in the Bichri Mountains (Boëda et al., 1996, 1998, 2008).

Concluding remarks

The region of El Kowm in central Syria encompasses one of the largest archaeological sequences in Eurasia. Therefore it constitutes an area with Outstanding Universal Value (OUV). The discovery of round 150 Palaeolithic sites developing as huge stratified well-sites or surface scatters in the vicinity of raw material outcrops vouches for a continuous and dense occupation of the area since the Lowest Pleistocene. This concentration in a round 20 km wide territory is exceptional. It challenges the density found in the Vézère Valley in France but under other environmental conditions and during a period four times longer as regards chronology. Four sites, Ain al Fil, Hummal, Nadauuiyeh Ain Askar (Swiss-Syrian team) and Umm el Tlel (French-Syrian team) are currently being excavated. Together, they represent at least 2 million years of human settlement and evolution. Our investigations in El Kowm demonstrate that the steppe areas played a remarkable role in the conquest of Eurasia. This was underlined in 1996 by the discovery at Nadauuiyeh of an entire parietal-bone together with part of occipital, cranial remains belonging to Homo erectus.

The oldest cultures ever encountered in the Levant were discovered at the site of Ain al Fil and, as such, it stands as a remarkable site of pre-eminent value for better grasping the Out-of-Africa dispersal.

The sequence of Hummal allows a better understanding of some major questions such as relationships between Acheulean and Oldowan core and flake cultures (Mode 1 vs. Mode 2) or the transition from Lower to Middle Palaeolithic. Another major discovery at Hummal is the presence a new species of giant camel roughly dating back to 100,000 years. Nowadays, it is quite remarkable to be able to discover such a new fossil of large mammal. The new camelid was found together with Middle Palaeolithic human remains.

Moreover, the archaeological results are of outstanding importance. The study of transitional cultures such as Yabrudian and Hummalian between Lower and Middle Palaeolithic might certainly provide an answer to one of the most important question into which scientists have been looking for a certain time: the origins of modern humans.

Nadouiyeh Ain Askar shows a sequence roughly spanning a 600,000 years period of time. The older part is especially well-documented. The spring site comprises 32 layers of Acheulean. It is truly the most comprehensive and extensive site in the Levant for a better knowledge of the Acheulean culture.

Umm el Tlel comprises a very long sequence from the Acheulean to the Neolithic with a remarkable Mousterian and Initial Upper Palaeolithic stratigraphy. The systematic use of bitumen on lithic artefacts, probably as a hafting technique, is outstanding. Several human remains were found in the Mousterian sequence. The species attribution, between Neanderthal and Anatomically Modern Human is still being discussed.

Finally, the region of El Kowm demonstrates that a very large sequence is also not only in caves encountered in an open air environment and that the steppe regions between the Mediterranean coast and the Euphrates River were also favourable territories for long-lasting human settlements, a fact that should be taken into account in the current debate on the routes of human dispersal.

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I dedicate this study to the people of Syria, and their long and rich cultural heritage.

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The case of Mount Carmel: the Levant and Human Evolution, future research in the framework of World Heritage

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Introduction

The Mount Carmel Caves in Israel are undoubtedly among the most famous prehistoric sites in the world. Figuring prominently in all relevant textbooks dealing with human evolution (for example, Klein, 2009; Stringer, 2011), the site has been recently inscribed as a World Heritage Site. The caves are located c. 20 km south of Haifa (32° 40’ 12’’ N; 34° 57’ 55’’ E), on the southern cliff of Nahal Me’arot/Wadi el-Mughara (within the Nahal Me’arot Nature Reserve), where it opens to the coastal plain and comprises four natural caves (Figure 1, from west to east): Tabun, Jamal, el-Wad and Skhul. Formed within one of the most completely exposed fossilised rudist reefs in Israel (Bein and Sass, 1980), together they represent a cultural and natural heritage site of significant global interest. The archaeological layers exposed at the site bear witness to a long sequence of human evolution through the major stages of the Stone Age and exhibit the roots of our cultural and evolutionary diversity.

Heritage values

The unique significance of the Mount Carmel Caves is best expressed through criterion (iii) and (v) that express its Outstanding Universal Values (OUVs) (Weinstein-Evron et al., 2012a).

Long cultural continuum and changes in ways of life

The long cultural sequence exposed at the four caves that make up the site extends from the Lower Palaeolithic to the present day (Garrod and Bate, 1937), representing at least half a million years of human evolution (Figure 2). Documented within this long sequence are some of the most significant developments in human evolution in terms both of cognition and culture. One is the early (Middle Palaeolithic) existence of the intentional burial of the dead (McCown, 1937; McCown and Keith, 1939). Significantly, Skhul cave is among the world’s first burial sites demonstrating evidence of ritual burial as early as c. 100,000 years ago (Grün et al., 2005). Another issue is the transition from nomadic hunter-gatherers to complex, sedentary communities and the adaptations they were developing which led soon afterwards to the advent of agricultural societies. This is best expressed at el-Wad Cave and Terrace where thick accumulations attributed to the Natufian culture were unearthed (Garrod and Bate, 1937; Weinstein-Evron, 2009).

The importance of the site’s long sequence was fully acknowledged following Garrod’s excavations (Garrod and Bate, 1937), as conveyed by the statement made by C. N. Johns, the excavator of the nearby Athlit Crusader castle:

Of the caves to be seen from the road, the lowest [el-Wad] and highest [Tabun] prove to have been inhabited by early man over long periods, the highest first, the lowest last; but the occupation of the latter commenced before the former was abandoned, hence the two caves together give a continuous range of human occupation […] It is rare to find such a range of ‘industries’ as we have found in these caves, layer upon layer, in such depth and with such a variety of skeletal remains, animal and human.’ (Johns, 1947: 70).

The four main periods represented in the Mount Carmel caves site are the Lower Palaeolithic, the Middle Palaeolithic, the Upper Palaeolithic and the Epipalaeolithic (Figure 2). Holocene finds, from the Neolithic to the historical periods, are also present in the site but are less dominant. Thus, the site has long been recognized as a yardstick for the study of the prehistory of the southern Levant.

The Lower Palaeolithic period is best represented at Tabun Cave (Figure 4), with some occurrences at Jamal and possibly also at Skhul (Figure 2). The earliest lithic assemblage in Tabun Layer G was defined by Garrod as Tayacian (Garrod and Bate, 1937).
This small assemblage encompasses a few hand axes and flakes and was later ascribed to the Acheulean, but its exact character is still unknown. The Acheulean industry of Tabun Layer F is characterized by the presence of hand axes and scrapers and constitutes one of the rare occurrences of this culture in a cave site in the Levant (Goren-Inbar, 1995).

An impressive and long Acheulo-Yabrudian sequence, presenting seven metres of archaeological accumulations, was found in Layer E containing all the characteristic facies of this unique Levantine culture: Acheulean, Yabrudian and Amudian (Jelinek, 1990). Tabun Cave is one of the very rare sites where all three industries were found (Copeland, 2000). While the lithic assemblage ascribed to the Yabrudian facies is dominated by thick scrapers and some hand axes, within the Acheulean facies hand axes are well represented; the Amudian facies, found in one-metre thick accumulations at the top of Layer E, is typically a blade-oriented industry (Garrod and Bate, 1937; Jelinek, 1990; Shimelmitz, 2009). In this regard, it is worth mentioning Jelinek’s suggestion that the entire Lower Palaeolithic of Tabun Cave should be regarded as a single cultural sequence (coined the Mugharan Tradition) based on the similarities in lithic technology (Jelinek, 1982a, b).

The Middle Palaeolithic is represented by a long Mousterian cultural sequence characterized by the widespread use of Levallois technique at Tabun Cave, the later part of which a Neanderthal burial was uncovered, and at Skhul Cave with its ten burials of early modern humans (or Early Anatomically Modern Humans; EAMH). Meagre evidence was also uncovered at the bottom of the el-Wad Cave sequence. The Tabun sequence is the only one in the Levant where the three main variants of this cultural complex were unearthed, designated Tabun D, Tabun C and Tabun B type industries, differentiated by their techno-typological characteristics, constituting the key sequence for the Middle Palaeolithic of the Levant (Garrod and Bate, 1937; Jelinek, 1982a; Copeland, 1975, 1990; Bar-Yosef, 1998; Figure 4; Table 1). Jelinek (1982b) delineated the general breakdown of the various assemblages, while Shimelmitz and Kuhn (2013) have recently studied the Tabun D industry in more detail.

The Upper Palaeolithic was found only at el-Wad Cave. The lithic assemblages here were attributed to the Levantine Aurignacian and provided essential data for delineating the Upper Palaeolithic sequence of the Levant (Garrod and Bate, 1937; Weinstein-Evron, 1998; Belfer-Cohen and Goring-Morris, 2003). The Epipalaeolithic period is represented only by the Natufian (c. 15,000-11,500 years BP), a culture of complex hunter-gatherers on the threshold of agriculture that culminates the prehistoric sequence.

**Human evolution**

A large number of human fossil remains have been found at three of the four caves and adjoining terraces of Nahal Me’arot. These can be roughly separated into three groups. At Tabun Cave, the complete skeleton of a Neanderthal woman, known as ‘The Woman from Tabun’ was discovered by Dorothy D. A. E. Garrod in the 1929 to 1934 excavation (Garrod and Bate, 1937).
At Skhul, 11 skeletons of early modern humans were uncovered by Theodore McCown between 1929 and 1934 (McCown, 1937; McCown and Keith, 1939). While most Levantine Neanderthals are currently dated to c. 50-60,000 years BP (Table 1) and the dating of the Tabun remains is still enigmatic, the Skhul skeletons are dated to c. 80,000-120,000 years BP (Grün et al., 2005). The third and largest group of human remains (at present numbering over 110 individuals) was unearthed in the Natufian cemeteries of el-Wad (Garrod and Bate, 1937; Weinstein-Evron et al., 2007; Weinstein-Evron, 2009).

The presence of both early modern humans and Neanderthals in the same cave complex is exceptional. It is important to emphasize that in the southern Levant the securely dated Neanderthals are later than early modern humans (in Western Europe, where early modern humans are absent, Neanderthals are succeeded by fully modern humans). The occurrence of these two human types within one geographical region and the same Middle Palaeolithic cultural complex, the Levantine Mousterian, is unmatched anywhere in the world. The caves of Mount Carmel represent the southern extremity of the Neanderthal range (also found at Amud and Kebara caves; Table 1) as well as the northernmost known remains of early Homo sapiens, which are mostly found in Africa (Figure 5). This situation is unique to the Nahal Me’arot site and as such, is of outstanding significance to the study of human dispersals and evolution (for example, Henry, 2003; Klein, 2009). Significantly, recent DNA studies suggest that, given the timescale of the split between non-Africans and sub-Saharan hominins (Fu et al., 2013), this is also the most likely place where Neanderthals and early modern humans first met and interbred, thus accounting for the 1 to 4% of Neanderthal genes present in non-African humans (Green et al., 2010; see also Lohse and Frantz, 2014 and references therein). Both fossil human types are key specimens in the debate concerning the demise of Neanderthals and the origin of Homo sapiens, as summarized in, for instance, Klein (2009). Together with Qafzeh Cave in the Lower Galilee (some 35 km east of Mount Carmel: Figure 1; Vandermeersch, 1981). Skhul exhibits the earliest ritual burials discovered to date, sometimes including grave goods, as well as collections of marine mollusks and ochre (McCown, 1937; Vanhaeren et al., 2006; Bar-Yosef Mayer et al., 2009; d’Errico et al., 2010; Salomon et al., 2012).

The Natufian remains are significant for the data they provide concerning demographics, pathologies and ways of life (for example, Bachrach et al., 2013) of these local groups on the threshold of agriculture. Important insights into symbolic and religious aspects of this culture are offered by the rich and varied artistic manifestations, as well as the varying burial modes and the wealth of associated artefacts and decorations found within the burial contexts.

**Palaeoenvironmental reconstructions**

The many palaeoenvironmental fluctuations registered in the site’s geological and anthropogenic, as well as the zooarchaeological and palaeobotanical sequences (Bate, 1937; Jelinek et al., 1973; Weinstein-Evron, 1994), have been related to both regional and global climatic changes (Jelinek, 1982a, b) that encompass fluctuations in humidity, as evidenced by changes in the rich faunal and floral assemblages and sea-level fluctuations.
Multi-disciplinary research, strengthened by studies of present-day parallels, highlights the various palaeoenvironmental changes and their relationship with the main sociocultural processes and human impact on ancient environments (for instance, Jelinek, 1982a; Jelinek et al., 1973; Bar-Oz, 2004; Lev-Yadun and Weinstein-Evron, 2005; Weissbrod et al., 2005; Weissbrod et al., 2013; Weinstein-Evron et al., 2013a).

Natufian el-Wad: the transition from nomadic hunter-gatherers to complex, sedentary communities

The Natufian site of el-Wad Cave and Terrace, the paragon of this unique Levantine entity, was the first Natufian base camp to be explored within the culture’s Mediterranean ‘core area’. The culture was largely defined by Garrod, following her 1929-1933 excavations at the site (Garrod, 1932; Garrod and Bate, 1937; Belfer-Cohen, 1991; Bar-Yosef, 2002; Weinstein-Evron, 2009). The length and extent of the excavations at el-Wad (both cave and terrace) make this one of the most intensively excavated Natufian sites, which has yielded rich assemblages of material culture including hundreds of thousands of flint items, dozens of stone tools made mainly of basalt, numerous bone tools, art and decorative items, ochre, as well as a wealth of vertebrate remains and mollusks (Garrod and Bate, 1937; Weinstein-Evron and Ilani, 1994; Weinstein-Evron et al., 2007; Bar-Oz et al., 2004; Weissbrod et al., 2005; Yeshurun et al., 2013, 2014a; Rosenberg et al., 2012). This key site incorporates the complete Natufian sequence – from its earliest appearance to its final stages, documenting the transition from hunter-gatherers to sedentary communities on the threshold of agriculture (Garrod, 1957; Weinstein-Evron, 2009; Weinstein-Evron et al., 2013b). As characteristic of large semi-sedentary or sedentary Natufian hamlets, the site displays stone-built architecture, rock-cut installations and numerous graves (Figure 3).

The Natufian cemeteries of el-Wad contain more than 110 individuals, interred in a variety of burial modes (Garrod and Bate, 1937; Weinstein-Evron, 2009). This is one of the richest and most diverse Natufian burial grounds ever found, testimony to the complex social organization of the last hunter-gatherer society and the various adaptations it underwent prior to the adoption of agriculture (for example, Wright, 1978; Byrd and Monahan, 1995). In many respects, the extensive Natufian occupation of the site signals the transition from Palaeolithic to Neolithic ways of life, from plant gathering and animal hunting to cultivation and herding.

History of research

The outstanding archaeological value of the site of Nahal Me’arot was first realized in 1928. The government of the British Mandate over Palestine had decided to construct a new deep-water harbour at Haifa, for which the cliffs of Wadi el-Mughara were considered a potential quarry. As the Department of Antiquities was already aware of the potential historic significance of the area due to the plain visibility of the caves themselves and the ‘flints and flakes in large numbers [which] cover the slopes’ (Richmond, 1928), Charles Lambert, Assistant Director, was dispatched to investigate the site. Three weeks of trial excavations at el-Wad Cave during November 1928 yielded a wealth of flint and bone implements, querns, beads, stone structures and human remains (Weinstein-Evron, 2009). The most striking find was a bone sickle haft, carved in the shape of a young animal, which was the first example of Stone Age art to be published from the Near East. As a result of this first sounding, the British School of Archaeology in Jerusalem together with the American School of Prehistoric Research concentrated their efforts on the Wadi el-Mughara caves and embarked on seven seasons of excavation from 1929 to 1934, headed by Garrod and McCown. It was in these formative years that Garrod established the cultural yardstick, which provided the general chrono-stratigraphic framework for the prehistory of the Levant (Garrod and Bate, 1937). Dorothy M. A. Bate constructed the first
palaeoenvironmental curve ever drawn for any prehistoric site in the world (Bate, 1937).

In the years that have elapsed since the onset of excavations at the site, it has been subject to continuing scientific exploration and research. Worth noting are Jelinek’s (University of Arizona) and Ronen’s (University of Haifa) excavations at Tabun (Jelinek, 1982a, b; Jelinek et al., 1973; Ronen et al., 2011; Figure 4). The extended history of research at el-Wad includes a trial excavation on the terrace (Valla et al., 1986) and the ongoing excavations of Weinstein-Evron and colleagues in the cave and on the terrace (Weinstein-Evron, 1998; Weinstein-Evron et al., 2007, 2013b; Figure 6). Jamal Cave was examined, too, and was found to yield Acheulo-Yabrudian lithics older than c. 220,000 years (Weinstein-Evron and Tsatskin, 1994; Weinstein-Evron et al., 1990a; Zaidner et al., 2005).

Archaeological, anthropological and environmental investigations at the site are among the earliest systematic, multidisciplinary studies carried out. Historically, the excavation and analysis methods have always incorporated all major scientific breakthroughs and advanced technologies in the archaeological sciences and have thus been at the forefront of archaeological practices. This is best expressed by numerous publications dealing with the site, which appears as a key site for studying the chrono-cultural sequence of the Levant and the global scheme of human evolution in most textbooks.

Natural and environmental values

Nahal Me’arot/ Wadi el-Mughara, with its rudist reef and the multiple caves within it, is a natural landmark clearly visible from the coastal plain, which parallels its western slopes and is of regional geological significance (Bein and Sass, 1980). This reef, a typical Upper Jurassic – Lower Cretaceous era phenomenon, is formed by rudist bivalve mollusks. A geological phenomenon
unique in its size and exposure throughout the Middle East, it provides important insights into the geological history of the area and the formation processes of its caves.

Situated on the low western slopes of the mountain (Figure 7), the caves provide an expansive view of the coastal plain and Mediterranean Sea to the west and a large variety of environmental settings. Incorporating the Mediterranean maquis, the nearby stream bed, coastal fresh water and saline marshes, and the coast itself, these rich settings provided the essential subsistence resources for the prehistoric inhabitants of the region. Because of this ecotonal setting (Figures 7, 8), the site is crucial for an in-depth understanding of various biotopes, the changes they underwent over time and their relationships to human-environment sustainable development, bio-diversity management and ecological conservation.

Past and ongoing research

Like prehistoric and anthropological research at large, since the first multi-disciplinary excavations and until today, research at the site of Nahal Me’arot has been subjected to ever-growing detailing and fine-tuning of the body of evidence, both through additional excavation and revisiting of old data and archives. Their synergic effect results in an increasingly more comprehensive reconnaissance of various aspects of this important sequence, as well as the defining of new research goals. Naturally, the ongoing research benefits from similar undertakings in other Levantine sites (and beyond), but in this report I will focus mainly on the research carried out at the site itself.

The classic sequence of Tabun cave was researched through renewed excavations by Jelinek (1982a) and Ronen (Ronen et al., 2011) resulting in a considerably more detailed stratigraphy (Figure 4) and chronology (for instance, Grün et al., 2005; Mercier and Valladas, 2003), as well as the geoarchaeological and palaeoenvironmental picture (Jelinek et al., 1973; Weinstein-Evron, 1994). With developing scientific techniques, various aspects of technological developments (Shimelmitz, 2009), palaeoenvironments (Tsatskin, 2000; Tsatskin et al., 1995) and human exploitation of the site (for example, Albert et al., 1999), were also elaborated. The temporal and taxonomic attribution of the various human remains was repeatedly reconsidered, in accordance with various models of human evolution in the Middle Palaeolithic, where the site plays a major role (Jelinek 1982b; Bar-Yosef and Callander, 1999; Rak, 1998; Kaufman, 1999, 2002; Stringer, 2011; Ronen 2012).

At el-Wad, renewed excavation projects were conducted repeatedly from 1981 (Figure 6; Valla et al., 1986; Weinstein-Evron, 1998; Weinstein-Evron et al., 2007; Weinstein-Evron et al., 2013b) with additional fine-tuning of the stratigraphy. Uniquely for this site, further detailing of the initial data was also achieved through a careful revisiting of the raw field-notes of both Garrod, the principal excavator of the site and Charles Lambert (Weinstein-Evron, 2009). Lambert conducted the trial excavation at the site in 1928 and his major contribution to the delineation of its stratigraphy and the unveiling of the Natufian culture was unacknowledged before. As clearly apparent from Table 2, his picture of the Natufian layer at el-Wad was much more complete than the one later published by Garrod, better conveying the narration and complexity of the Natufian culture at the site. Largely based on his observations, and together with a reinterpretation of Garrod's unpublished notes and various publications, an intercalation between construction and burial phases could be put forward, and several Natufian activity areas were identified during the main Early Natufian construction phase at the site (Figure 9).

An additional area is currently being excavated by Weinstein-Evron, Kaufman and Yeshurun in the north-eastern part of the terrace (Figure 9). The comprehension of its general picture, exhibiting a well-built curvilinear wall (Wall I), minimally 9 m in diameter, encompassing various smaller installations, such as Structure II (Figure 10a; Yeshurun et al., 2013, in press; Weinstein-Evron et al., 2013b) clearly benefits from the insights obtained through the detailed archival study and from the evidence unearthed at other sites, mainly in the Natufian ‘core-area’ (for instance, Valla, 1988; Hardy-Smith and Edwards, 2004). However, it is augmented considerably by the detailed mode of excavation and data-gathering and the in-depth taphonomic study of the faunal data. Thus, for the Early Natufian architectural complex defined by Wall I, various activity areas could be identified (Figure 10a; Yeshurun et al., 2013, 2014a). Preliminary results of phytolith analysis also seem to help differentiate between various site features (Portilo et al., 2010) and contextualizing other types of data is ongoing (for example, Rosenberg et al., 2012; Weissbrod et al., 2012, 2013). Significantly, the repeated nature of the Natufian habitation at the site was demonstrated through the super-position of at least nine living floors inside the Wall I complex (Figure 10b; Yeshurun, 2011, 2014, 2014a, b). The prolonged habitation at the site and its varying nature were also supported by a detailed dating programme (Weinstein-Evron et al., 2012b) coupled with a thorough FTIR study in order to determine the environmental factors that influenced the preservation of material for 14C dating of the site (Eckmeier et al., 2012). Significantly, the detailed dating and its careful contextual analysis helped support previous suggestions such as those regarding the stratigraphic affiliation of specific burials. It was demonstrated that no human remains can be linked to the Wall I architectural complex, enhancing the clear spatio-temporal separation between cemeteries and dwellings at the site (Weinstein-Evron, 2009).
The many Natufian burials and large skeletal assemblage were the subject of archaeological and anthropological research relating to both demographic and sociocultural aspects of this complex society (Garrod and Bate, 1937; Hershkovitz and Gopher, 1990; Belfer-Cohen, 1995; Byrd and Monahan, 1995; Bocquentin, 2003). The thorough archive study (Weinstein-Evron, 2009) indicated that the extant anthropological collection and resulting publications are clearly biased towards the group decorated burials of the Early Natufian. Our recent excavations at the north-eastern part of the terrace somewhat remedy the situation regarding the Late Natufian of the site. A restricted burial area was unearthed containing 10 graves, with 15 burials (Figure 11), comprising the largest assemblage of Late Natufian burials unearthed at the site to date (Weinstein-Evron et al., 2007; Weinstein-Evron, 2009). Its placing indicates some spatial arrangement of activities at the site even within the limited area excavated. Thanks to careful excavation and documentation an unprecedented number of children were unearthed, while similar burials may have been overlooked in other parts of the site (Weinstein-Evron, 2009). The anthropological and palaeopathological study of the remains (Bachrach et al., 2013) provides important insights into the life-ways of these late hunter-gatherers.

Insights into mode of subsistence of the Natufian inhabitants of the site were primarily obtained through archaeozoological studies. These highlight the high diversity of exploited biotopes and animal types, including ungulates, small mammals, reptiles, birds, fish and mollusks (for instance Bar-Oz et al., 2004; Weissbrod et al., 2012; Yeshurun et al., 2009, 2014a; Weinstein-Evron et al., 2007). Understanding site layout and function depends on both the reconstruction of its extent and its inner-organization. While detailed spatial analysis of the various data is essential for the latter, geophysical research has also proven instrumental in drawing up the eastern boundary of the Natufian site on the el-Wad Terrace. Based on a geo-electric survey (Weinstein-Evron et al., 2003a) it could be demonstrated that this in fact lay very near the Late Natufian burial locale, no more than 5 m to its east, towards the wadi bed. Together with the observed, limited spatial expansion of the burials, this may indicate that at least for this part of the site and this cultural phase, graves were dug at the edge of the settlement.

Future research in the framework of World Heritage

Future research should of course involve more of the same in-depth analyses conducted today, preferably encompassing additional sites or layers, with the introduction of yet more sophisticated research venues. Entailing an impressive list of Outstanding Universal Values (OUVs), the site can easily anchor a Prehistoric Mount Carmel serial nomination, within which
numerous other sites, exhibiting shorter sequences but equally demonstrating the various thematic OUVs, can be readily incorporated (for example, Sanz, 2009). Such thematic serial nominations (for example, Neanderthal/EAMH spheres; the Natufian) can be later widened to encompass the entire Levant and beyond. The easily defined geographic limits of the mountain and the fact that large parts of it are contained within either a natural park and/or a biosphere reserve makes it even more easily achievable.

For the early part of the sequence, Misliya cave, the only other site on Mount Carmel that contains both late Lower Palaeolithic (Acheulo-Yabrudian) and Early Middle Palaeolithic remains (Table 1) easily comes to mind. The site, located 7 km north of Nahal Me’arot in a similar setting, is important for the dating of the transition between these two periods, which marks a distinct technological and possibly also population change (Valladas et al., 2013; Zaidner and Weinstein-Evron, 2014). The rich faunal assemblage further contributes to an in-depth reconnaissance of human subsistence strategies and palaeoenvironments (Yeshurun et al., 2007; Yaroshevich et al., in press). Placed within a similar setting to Tabun cave (Figure 7), where faunal remains are rarely preserved, the observed patterns can be utilized to create a more reliable picture for the region as a whole and help reconstruct settlement patterns of its various groups (Yeshurun et al., 2007; Zaidner and Weinstein-Evron, 2014). The site also contains an impressive series of in situ hearths. Their study is still underway, but it can certainly benefit from those conducted for the later Middle Palaeolithic hearths of both Tabun and Kebara caves (Albert et al., 1999, 2012). Significantly, a detailed micromorphological study, coupled with phytolith analysis suggests the occurrence of bedding, as yet the earliest documented (Weinstein-Evron et al., 2012c). Additional studies of this nature still hold great promise to our understanding of prehistoric site-use and ways of life (Mentzer, 2012 and references therein). The later part of the Middle Palaeolithic is best represented in Kebara Cave, with its impressive Neanderthal remains (Arensburg et al., 1989; Bar-Yosef and Vandermeersch, 1991; Bar-Yosef and Meignen, 2007). Besides its importance for the understanding of the relationships between Neanderthals and early modern humans, it helps establish the faunal-based subsistence and climatic sequence well into the later Middle Palaeolithic and the Upper Palaeolithic (Speth, 2012, 2013; Speth and Tchernov, 2007).

Kebara Cave also nicely ties in the Natufian sphere. El-Wad is the only Natufian site on the mountain that exhibits the full Natufian sequence and is thus considered a major base camp of this culture, paralleling only Hayonim Cave and Terrace (Bar-Yosef, 1991; Valla, 2012) and Eynan (Perrot, 1966; Perrot and Ladiray, 1988; Valla, 1991, 1995). During the Early Natufian it is accompanied by Kebara, where a rich burial complex was discovered in the early days of research (Turville-Petre, 1932). During the Late Natufian, Nahal Oren may have constituted another important hamlet (Stekelis and Yizraely, 1963; Noy et al., 1973) while at Raqefet Cave mostly burial activities were documented (Nadel et al., 2012a, 2013). Each site has its specific characteristics and contributes significantly to our understanding of Natufian ways of life and symbolic realms. Together they may constitute parts of a more comprehensive ‘pan-Carmel’ Natufian system (Weinstein-Evron, 2009). The relationships among the components of this system and with other regions still remain an intriguing issue for future research (for example, Weinstein-Evron et al., 1999b, 2001; Bar-Yosef and Belfer-Cohen, 1999). When raw material provenance is concerned (Weinstein-Evron et al., 1999b) such studies can benefit from thorough geological mapping and dating (Ilani et al., 2001) coupled with detailed geochemical analyses and finger-printing (Gluhack and Rosenberg, 2013). Benefiting from all available, updated scientific techniques, nothing can replace the keen eye of the archaeologist in the field, as recently reinforced by the unique unearthing of vegetal imprints in mud veneer coating of several Natufian graves at Raqefet Cave (Nadel et al., 2013).

Settlement-pattern reconstruction and landscape archaeology can benefit from old and advanced analyses, as well as from updated syntheses of topographic, geomorphic, vegetational and climatic data (for example, Olami, 1984). Naturally, detailed archaeobotanical, zooarchaeological and
geoarchaeological data can help elucidate points in time and space that can be incorporated into a palaeoenvironmental curve of changing landscapes, biotopes and temporal palimpsests. Data from the later part of the sequence (for instance, the Natufian) are much more varied and detailed, and the increasingly better-dated sequences can help clarify such notions as the relationships between climate and cultural changes at, for example, the ending phases of this culture (for opposing views regarding the impact of the Younger Dryas see, for example, Bar-Yosef and Belfer-Cohen, 2002; Lev-Yadun and Weinstein-Evron, 2005 and references therein). The lower part of the sequence and especially the Lower Palaeolithic is much less known in this regard, because of the paucity of sites and the low preservation of organic materials. The rare occurrence of Lower Palaeolithic sites, essentially in caves (Tabun, Jamal, Misliya), may indicate that the ancient Lower Palaeolithic landscape had been eroded from the top of the mountain and its upper slopes. Occurrences of Lower Palaeolithic finds in talus underlying those with Middle Palaeolithic remains (Weinstein et al., 1975) may indicate repeated processes of erosion and down-sloping. Significantly, the many patches of Middle Palaeolithic breccias, habitually found at some distance below extant cliffs, mainly across the western slope of the Mountain, but also within some wadi channels (Olami, 1984) attest to a previously much extended cave-system heavily utilized by the Middle Palaeolithic inhabitants of the mountain. Reconstruction of the rate and tempo of the cliff back-cutting still requires detailed modelling that needs to take into account the underlying bedrock, the possible rate of uplifting (Zviely et al., 2009) and the physical properties of every site. Being probably non-linear, it can be sometimes anchored at certain, well-established points in time. In the case of Misliya Cave, for example, the last major collapse of the cave occurred during the Early Middle Palaeolithic habitation of the cave (Weinstein-Evron et al., 2012c). In Nahal Me’arot, the first postulated major roof collapse must have occurred after the Lower Palaeolithic habitation at Tabun, with other episodes during the Middle Palaeolithic following. As suggested by the geoarchaeological data, the last collapse that resulted in the chimney formed in the ceiling of the inner chamber of the cave, likely occurred at the end of the Middle Palaeolithic occupation of the site (Jelinek et al., 1973). Whether the face of the cliff had once been connected in a straight line with that of the southern bank of the wadi (Figure 1c) and together these had undergone similar processes of cliff retreat cannot be ascertained. Clearly, however, Tabun Cave originally may have had three chambers (as suggested by Garrod and Bate, 1937: Plate XXX). An additional chamber was postulated for el-Wad cave as well, based on the form of the cliff, the sharp westward descending bedrock and flowstone deposition immediately outside the present entrance to the cave (Weinstein-Evron, 1998).
As the caves are the result of prolonged karstic processes, deciphering their structure and the evaluation of the potential for further excavation, while avoiding unnecessary damage to these valuable sites should preferably resort to remote sensing. Geophysical studies have already proven reliable in assessing site extent, depth of archaeological layers and identification of specific features (Weinstein-Evron et al., 2003a) and are recommended prior to the initiation of additional excavations.

An additional issue of major importance for Mount Carmel and the Mediterranean Levant as a whole is the establishment of a detailed, continuous, well-dated palaeoenvironmental ‘master sequence’, at one key location. This can be achieved through a thorough isotopic research, similar to the ones conducted for other Levantine caves (Bar-Mathews et al., 1997, 2003), but using a local, long-term speleothem, as recently suggested for the one located in the back chamber of Sefunim Cave (Kandel and Shimelmitz, 2013), that may represent the last 300,000 years (Ronen, 1984).

Such a palaeoclimatic sequence can also provide the natural framework for a long cultural sequence, composed of the caves located nearby, practically within the same reefall cliff and together representing a sequence almost as long as that of the classical sequence at Nahal Me’arot (Figure 2). This composite sequence starts with Misliya Cave, with its Acheulo-Yabrudian and Early Middle Palaeolithic remains (Weinstein-Evron et al., 2003b) and continues with Sefunim Cave, set within a nearby wadi, some 0.5 km to the north-east of Misliya (Figure 7), whose sequence includes Late Middle Palaeolithic, Upper Palaeolithic, Epipalaeolithic and Pre-Pottery Neolithic remains (Ronen, 1984; Kandel and Shimelmitz, 2013). Sefunim is easily reached both from the wadi-bed north of Misliya and from a small plateau-like area above both caves. The nearby western face of Mount Carmel encompasses various other collapsed caves (Olami, 1984), some appearing as residual breccias, with mainly Middle Palaeolithic remains. Worth noting is the unique Middle Palaeolithic open air site in Nahal Sefunim (Lamdan, 1984) that probably constituted part of the same Late Middle Palaeolithic sociocultural system as the nearby Sefunim Cave.

Any such palaeoenvironmental curve can also be observed against the background of ongoing lithic research, especially that related to technological aspects of the various assemblages, as the one currently underway regarding the long sequence of industries at Tabun Cave. The strength of examining patterns of change throughout the sequence of Tabun Cave was already demonstrated by Garrod (1956) and more precisely by Jelinek (1977, 1982b). These, however, represent but a small fraction

![](image)

**Figure 11:** Late Natufian burials from the north-eastern terrace (after Weinstein-Evron et al., 2013b: Figure 12). a) plan of burials, with H101 (b) and the double burial of H108-109 (c). (b, c photo by D. Kaufman).
of the potential embedded in this long key-sequence. Our current study of Tabun Cave uses the material unearthed from both Jelinek’s and Ronen’s excavations which together create a 16 m long sediment sequence encompassing c. 100 distinct superimposed archaeological layers (Shimelmitz, in press; Shimelmitz et al., 2014a). In order to examine the evolution of technology and behaviour, more than 25 assemblages from this sequence were studied employing updated procedures of lithic analysis. This ongoing research will help shed new light on several research key-issues, such as the transition from the Acheulean to the Acheulo-Yabrudian, the reasons beyond the variability within the Acheulo-Yabrudian, the increased use of predetermined technologies (Shimelmitz et al., 2014b) and the Levallois technology in particular along the sequence, as well as the transition from the Lower Palaeolithic to the Middle Palaeolithic, now set around 250,000 years ago (Valladas et al., 2013).

Following the Early Natufian complex base-camp at el-Wad, during the later part of the Natufian, Nahal Me’arot seems to have lost its central role that passed to Nahal Oren, c. 3 km northward, with its impressive Late Natufian to Pre-Pottery and Pottery Neolithic sequence (Stekelis and Vizraely, 1963). It may have formed part of a Late Natufian site complex (Weinstein-Evron, 2009; Nadel et al., 2012b); during Neolithic times, it was accompanied by several other sites located along the wadi (Olami, 1984), on the enclosing slopes and cliffs (for example, Stekelis, 1942) and within a series of now submerged sites along the Carmel coast, dating from the PPNC to the Pottery Neolithic, (for instance, Galili et al., 1993, 1997). The location of such an impressive number of Neolithic sites (albeit of various phases) along the west to east transect of Nahal Oren may indicate some kind of elevation-biotope-economy-related settlement system. The onset of agriculture is still elusive in the Mount Carmel area, perhaps to some extent due to the incomplete data retrieved from the old excavations at the main site of Nahal Oren. Moreover, opinions still vary whether it started in parallel at different locations (for example, Riehl et al., 2013; Willcox, 2013) that may have included the Mount Carmel area with its stands of wild cereals (Zohary et al., 2012) or was a result of one event, in a rather restricted area (Lev-Yadun et al., 2000; Abbo et al., 2010, 2012) the influence of which later dispersed to the Near East as a whole, as well as to Europe and beyond. Significantly, the series of submerged Neolithic sites along the Carmel coast exhibits a unique preservation of botanical remains (wood, seeds, fruits) that, against the background of extensive archaeological, archeozoological and anthropological/palaeophatological research can considerably enhance our understanding of the various social and economic processes involved (for instance, Galili et al., 1997; Hershkovitz et al., 1991). This impressive series of sites in fact represents the early Mediterranean agro-pastoral-fishing villages (Galili et al., 2002). Through it one can practically follow the stages in the onset of the domestication of plants and animals, and hence the adaption of agriculture in the region. It can thus constitute an important epilogue to the story of prehistoric Mount Carmel, with a significant OUV in its own right.

While archaeological, anthropological and palaeoenvironmental research at the sites deepens, much thanks to the introduction of micro-archaeological techniques, the use of more evolved nano archaeological methods, such as isotopic and DNA research is still called for (for example Brown and Brown, 2011). DNA research may help highlight a variety of demographic issues, especially those concerned with transitions between different cultural phases and whether or not these involved human migration and various degrees of admixture between new-comers and local groups. For example, literature abounds with research concerning the dispersion of agriculture into Europe (for instance, Haak et al., 2010; Fu et al., 2012), but analyses of Mount Carmel populations are still lacking. Ancient DNA of Natufian populations can help decode the nature of the transition between earlier Epipalaeolithic cultures and the Natufian. Specifically, if this transition is considered a real departure from former ways of life, such studies can show whether the Natufian revolution involved the arrival of new human groups and from where, much as they have shed important light on the origin and possible contact of the first agriculturalist in Europe (Pinhasi et al., 2012 and references therein). At el-Wad and probably at other sites as well, such studies can help discern whether collective or near-by burials, such as the ones unearthed by us at the north-eastern part of the terrace (Figure 11), belong to specific families (for a similar notion based on pathological criteria see Smith, 1973), thus contributing to the understanding of the underlying social structure (for example, Wright, 1978). Contact between human groups, now reconstructed based on movement of raw materials (Weinstein-Evron et al., 1999b, 2001; Bar-Yosef Mayer et al., 2013) or stylistic motives (Bar-Yosef and Belfer-Cohen, 1999) can be thus more securely established and this will contribute significantly to our understanding of Natufian settlement patterns on Mount Carmel and beyond.

Similarly, isotopic research of human and animal bones may help reconstruct their dietary and ecological niches (for instance, Lee-Thorp et al., 2003; Al-Bashaireh and Al-Muheisen, 2011; Hartman, 2012) including anthropogenic niches, such as around sedentary Natufian hamlets (Tchernov, 1993; Yeshurun et al., 2009). Coupled with residue analysis, they can augment our knowledge of the relative contribution of faunal and vegetal foods at important stages of the adaption of agriculture. Plant isotopic research has also proven reliable in reconstructing past climatic changes and provenance of plant resources (Fiorentino et al., 2008, 2012). Detailed analyses of vegetal remains are still wanting in the southern Levant (Asouti and Fuller, 2013), but starch analysis has clearly demonstrated the crucial role of wild cereals in the subsistence of Epipalaeolithic groups in our region (for example, Nadel et al., 2012c; for the potential of such analyses for earlier periods see Hardy et al., 2012). The use of vegetal and other raw materials can be also perceived through detailed use-wear analysis (for instance, Lemorini et al., 2006; Weinstein-Evron et al., 2007; Groman-Yaroslavski, 2012). With in-depth charcoal and phytolith research (for example, Lev-Yadun and Weinstein-Evron, 1994; Portillo et al., 2010; Rosen, 2010) all these venues together can highlight the still poorly
comprehended role of vegetal food that, as much as animal resources, may have held an important role in the far-reaching social transformation of the agricultural revolution (for example, Zeder, 2008; Asouti and Fuller, 2013 and references therein; Hayden et al., 2013 and references therein).

Conclusion

The Mount Carmel Caves at Nahal Me’arot/Wadi el-Mughara constitute an important heritage site of human cultural and biological evolution within the background of palaeoecological changes, the recent history of cave use and the history of archaeological, palaeoenvironmental and palaeontological research. They have been the subject of multi-disciplinary research since the late 1920s and ever since the first groundbreaking exploration at the site and the establishment of this remarkable Levantine sequence, the research of the caves is characterized by increasingly in-depth studies of various cultural, biological, environmental and chronological aspects, and fine-tuning of the evidence.

Future research should consider preserving this important site while zooming in on additional facets (for instance, isotopic and DNA research), which will shed further light on the various evolutionary processes registered in its unique sequence. Broadening the research sphere to include numerous other prehistoric sites on Mount Carmel may significantly enhance our reconnaissance of specific periods or features that fit nicely into the caves 'ladder of progress' (McCown, 1943), while preserving this valuable World Heritage Site.

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Western Europe
Early Human Occupation of Orce

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Introduction

The Early Pleistocene sites of Orce, namely Barranco León and Fuente Nueva 3, constitute an open window to the first human settlement in western Europe. These two localities are part of a richer fossil ensemble in a vast region of southern Spain, the former fluvio-lacustrine basin of Guadix–Baza, a region with dozens of archaeopaleaeontological sites. The site collection of the municipality of Orce is recorded around two main gullies and includes the mentioned archaeological sites as well as other strictly palaeontological sites, including the exceptional site of Venta Micena. The site of Venta Micena is the largest in Europe for its time, recording a very rich palaeontological record and it is the reference for the southern Europe late Early Pleistocene. This complex of localities has been recently protected under the Andalucian heritage law. The Orce sites are rich and complete enough to allow us to reconstruct the technological and palaeoecological behaviour of the first Europeans, and the environment and the ecology where these humans lived. Together with other European regions and sites, these localities draw a picture of human adaptation and migration in the Mediterranean region and the northern latitudes.
The sites of Orce: situation, completeness, complexity, geology and age

The archaeological and palaeontological sites of Orce appear in outcrops in the ancient Guadix–Baza fluviō–lacustrine basin, one of the largest European intramontane basins (Alberti and Bonadonna, 1989; Viseras et al., 2005; Viseras et al., 2006). This vast region occupied the highlands in the north–eastern Granada province (Figure 1). This basin is situated in the inner part of the Baetic Ranges, south of the Sierra de Cazorla and north of Sierra Nevada and has a long history extending to Miocene times. The Baetic Ranges, together with the North African Rif, form the western part of the alpine chains around the Mediterranean. The base of its sedimentary section corresponds to Miocene marine strata. This marine stage ended with the uplift of the base of the basin, 7 million years ago (Mya), when the region was transformed into a continental basin (Soria et al., 1998; Soria et al., 1999). A new phase began with the installation, 6 Mya, of a fluviō–lacustrine system with a lake in the eastern half of the basin, in the area of Baza–Huéscar (Baza Formation) and a system formed by a main stream and its tributaries flowing through the western sector (Guadix Formation) from Sierra Nevada to the lake of Baza (Figure 2). The lake was shallow, with a high evaporation ratio resulting in the salinity of water and the subsequent formation of gypsum strata that distinguishes the Baza Formation. The shores of both the lake and the stream system were characterized by the extended littoral plains occupied by a savannah–type landscape inhabited by big game like rhinoceros, hippopotamus, ursids, equids and their predators like sabre–tooth tigers, hyenas and, since 1.35 Mya, hominins. During flooding episodes the lake and the river system overflowed covering their margins and the deposits of animal activities. This phenomenon is the origin for many of the outcrops containing carnivore and hominin activity as it is, for the former, Venta Micena, and for the latter, Fuente Nueva and Barranco León (Figure 3).

All the mentioned phenomena have provoked the progressive infilling of the Baza lacustrine basin. In addition, there has been a new slight uplift of the southern ranges, Sierra Nevada and Sierra de Baza, leading to the migration of the river system to the north and the capture of the whole lacustrine basin by the Guadalquivir fluvial valley. This process, tentatively dated between 150 ky and 40 ky ago, is at the origin of the current landscape in the region, dominated by the drying and the erosion with the formation of gullies, typical of the Baza area (Figure 4).

In sum, the lacustrine system of Baza area, where the oldest sites are located, was developed during the final Miocene, the entire Pliocene and the Early and Middle Pleistocene. For these chronologies the whole basin constitutes one of the best records in Europe for the reconstruction of the palaeoecology, the evolution of landscape and that of the animal communities, including Homo. The mentioned sedimentation of the margins of the lake, constituted mainly of fine sediments, led to a very good preservation of the archaeological and palaeontological record. Furthermore, if we take the complete collection of sites in the basin we can reconstruct the complete evolution of the landscape, its ecology and human behaviour and adaptation to western Eurasia.

The region of Orce is well known thanks to three Early Pleistocene sites: Venta Micena, Barranco León and Fuente Nueva 3 (Martínez Navarro et al., 1997; Oms et al., 2000; Toro Moyano et al., 2011). Venta Micena (Figure 5), a site located in the lake marshes, has not yet demonstrated the presence of human behaviour, being currently known by its very well preserved palaeontological record, which allows complete knowledge of the European fauna during early Early Pleistocene times as it is the best preserved and largest site of its time range. It shows the interaction between several herbivorous, carnivorous and scavenger species, mainly the action of the hyena *Pachycrocuta brevirostris* (Arribas and Palmqvist, 1998). Barranco León (Figure 6) is located in the immediacy of the lake, in the margins of a small stream and recovers what is currently the oldest human presence in western Eurasia, together with that of Fuente Nueva 3 (Grün et al., 2010; Duval et al., 2012a, b). The site of Barranco León shows the human occupation of the margin of a stream, close to the lake, where human beings take advantage of different animal carcasses through the use of tools produced from flint blocks and limestone pebbles collected nearby.

Fuente Nueva 3 (Figure 7) is quite different in its ecology. It corresponds to a spot in the margins of the lake and close to a spring where people disarticulated several big game animals, like *Mammuthus* and *Hippopotamus*. In these two sites the record shows the competition...
between human and other scavengers, like hyenas, and the human capacity for becoming progressively the top of the food chain. The sites of Venta Micena and Barranco León are mainly formed by a single horizon showing the palaeontological and archaeological record. To the contrary, in Fuente Nueva 3, we count at least six fossiliferous stratigraphic levels. These levels are very different in quality. The main record comes from level 5, where a complete skeleton of *Mammuthus meridionalis* was unearthed in 2002 (Figure 8). This horizon contains a very rich record of mammals and hominin tools preserved as a palimpsest where it is difficult to distinguish single activities or interventions. By contrast, the other strata seem to preserve a smaller number of activities as to allow the singularization of each fossil association. The latter permits better knowledge of human adaptation.

The Orce Early Pleistocene sites have been dated using several methods. The first, to give us a general framework, is biostratigraphy. Using micro and macrovertebrates these sites have been attributed to three stages of palaeoecological and palaeontological evolution within the last half of Early Pleistocene, between 0.8 and 1.4 Mya (Martínez Navarro et al., 1997; Oms et al., 1999; Oms et al., 2000; Agustí et al., 2010; Blain et al., 2011; Martínez-Navarro et al., 2011; Oms et al., 2011; Agustí, 2012). Agustí et al., 2010, have identified three of the stages defined for the microvertebrates evolution in the basin in the Orce–Huéscar Early Pleistocene sites: the ‘Stages early Pleistocene II-IV’ represented respectively at Venta Micena (Stage II), Barranco León –Fuente Nueva 3 (Stage III) and Huéscar 1 (Stage IV). Stage II is characterized by a decrease in the species diversity and the dominance of the rodent *Allophaiomys ruffoi*. Stage III, to the contrary, represents an increase in the diversity that is characterized by the evolution of the genus *Allophaiomys* leading to the *A. aff. lavocati* while the more common species is the aquatic *Mimomys savini*, a sharp difference from the previous stages. Finally in Stage IV, the dominance of *M. savini* continues, along with the introduction of new invasive microtine species.

Beyond biostratigraphy, palaeomagnetism is another method that provides a relative scale of events and that has been widely used in the Guadix–Baza basin and especially in the Orce-Huéscar-Cúllar area (Figure 9). This method has provided secure proof for the Early Pleistocene age of the three main sites in Orce as they all present a reversal magnetic signal (Oms et al., 1999; Oms et al., 2000; Oms et al., 2011). More recently the magnetic and biochronological succession have been refined through the application of several radiometric techniques: cosmogenic nuclides, electron spin resonance and U and Th isotopes (Duval et al., 2011a, b; Duval et al., 2012a, b), providing an age of 1.3 Mya for the first human settlement of that region. The combination of all of these methods has provided a good knowledge base of the evolutionary series in the basin making the ensemble one of the best dated for human evolution in Europe.

The three mentioned sites constitute the better known record for the Guadix–Baza basin for Quaternary Palaeontology and human evolution. Nevertheless, the actual record is much larger. The Orce area also contains sites with palaeontological records belonging to the base of the Quaternary in the localities of Fuente Nueva 1 and Fuente Nueva 2. In the erosive depressions locally called the ‘Cañadas’ of Orce, many other sites like Barranco de los Conejos (Agustí et al., 2013) or Barranco del Paso also provide palaeontological fossils coming from Quaternary times.

With regards the Pliocene, the region of Guadix–Baza has many sites other than Fuente Nueva 1. In fact, a complete Pliocene sequence can be reconstructed as there are two localities from the beginning of the Pliocene in Gorafe and Baza, a third one, Huélago, from the Middle Pliocene. Finally, there are two more sites corresponding to the Gelasian, formerly the last Pliocene phase and today included at the base of the Quaternary, the aforementioned Fuente Nueva 1 and the site of Fonelas in the Guadix Formation. The latter, Fonelas P–1, is one of the main sites in the basin (Viseras et al., 2006; Arribas et al., 2009), whose palaeontological record contributes information to a time span poorly understood in Europe. This ensemble of sites...
constitutes the base for the knowledge of landscape and palaeontological communities previous to the arrival of humans to the European continent, attested in the main Orce sites already described.

Nevertheless, the record in the basin is more interesting especially for Middle and Upper Pleistocene times for those devoted to the evolution of people and the landscape in which they lived. The late Early Pleistocene and the beginning of the Middle Pleistocene are represented in the Orce area by two main sites presenting human activity: Huéscar 1 and Cúllar (Ruiz Bustos, 1984; Alberdi and Bonadonna, 1989). In the former, human presence is very scarce and the site is mainly interesting as a macromammal record to reconstruct the landscape in the final stage of the Early Pleistocene. On the other hand, in Cúllar the recovery of man-made and used tools is quite important and associated with a good collection of mammal fossils representing a community belonging to the early stages of the Middle Pleistocene.

A more advanced phase in the Middle Pleistocene is represented by the site of Solana del Zamborino. Contrary to the previously described sites, this site is located in the Guadix Formation, the fluvial environment that constitutes the western half of the basin, on the top of the same sequence whose basal levels holds Fonelas P-1. Even if recent works have proposed a more ancient age for Solana, it has been proved that it belongs to the middle part of the Middle Pleistocene (Botella et al., 1976; Scott and Gibert, 2009; Jiménez-Arenas et al., 2011). This site was described in the 1970s as an Acheulean locality, the first to be discovered in the region. The use of fire and a complex human hunting strategy have been proposed.

So far we have described the main open air sites in the Guadix–Baza basin, both in the eastern lacustrine and western fluvial region. Referring to this, in the margins of the basin there are two main cave sites that give key data to the sequence of human behavioural evolution: Cueva Horá (Darro) (Figure 10) and La Carigüela (Piñar). Both sequences contain Middle and Upper Pleistocene remains with human activity corresponding to the Acheulean and the Mousterian, in addition to the recovery of more recent findings from the late Pleistocene and Holocene.
Such a complete and complex sequence has recovered fossils from many palaeontological groups, including fish, amphibian and reptiles in addition to macro and micromammals. This completeness has allowed palaeontologists to reconstruct the whole sequence of micromammal evolution and then also the environmental changes during Miocene, Pliocene and Pleistocene (Agustí et al., 2010). It will also help archaeologists to reconstruct human behavioural evolution and adaptation parallel to landscape modification. This completeness and variety of sites have been the reason why many specialists refer to the Guadix–Baza basin as the Spanish or European Olduvai.

The palaeontological and archaeological record at Barranco León and Fuente Nueva 3

In this section we will discuss the Orce Early Pleistocene sites bearing human activity remains: Barranco León and Fuente Nueva 3. Barranco León (Figure 3) was originally located in the margin of a short stream flowing from Sierra de la Umbría to the ancient lake of Baza, some metres from the excavated locality (Oms et al., 2011). This section of the site combines levels recording the presence of the stream with other sections showing the flooding of that locality by the lake (Figure 11). The lake transgressions, along with the analysis of vertebrates, allow us to recover the climatic fluctuations in the region (Oms et al., 2000; Blain et al., 2011). Human presence in this sector is always related to the stream phases (Rodríguez Rivas, 2009). The occupation seems to belong to the use of a stream margin or even sometimes that of the dried channel itself. In sum, we have both the sediment of the margin of the stream and that of the river incision. Thus the preservation of the faunal and technological remains presents a double degree of conservation: on the margin sediments the record is in good condition while inside the channel many elements present a slight patina or erosion, showing a remobilization. We consider that remobilization to be short in time and space.

The position of Fuente Nueva 3 is quite different, as it was placed in the lake margin close to a spring that supplied people and all the vertebrates present in that landscape with fresh water (Figure 2). There the calcium carbonate diluted in water precipitated to form the sediments of the site and trapping the remains of hominin, carnivorous and scavenger activities, including macrovertebrates and lithic tools. The transgression and regression movements of the lake level with the presence...
of different kind of sediments depending on the proximity of water are also visible at Fuente Nueva. As has been stated, the fossils recorded at Fuente Nueva 3 have been described in several levels, which all present evidence of human activity.

In general, the macrovertebrate record recovered in both sites is quite similar as they come roughly from the same age, though there are some differences such as the lack of elephant remains in Barranco León that are dominant in Fuente Nueva. *Mammuthus meridionalis* was the pachyderm species present in Europe at that time and is largely present in Fuente Nueva, especially in Level 5 where a nearly complete skeleton has been recovered (Figure 9) (Martinez Navarro et al., 1997; Martinez, 2012). In Barranco León the dominant species is the hippopotamus, *Hippopotamus antiquus*, which is also present in Fuente Nueva 3. The rhinoceros, *Stephanorhinus hundsheimensis*, a giant form of Cervidae, *Praemegaceros verticornis* (Figure 12), two forms of Equidae, *Equus altidens* and *Equus sussenbornensis* and an undetermined form of *Bison* complete the record of megafauna of these two sites. The carnivorous species present in both localities are dominated by the hyena *Pachycrocuta breviostris*, accompanied by other groups like an undetermined form of bear, *Ursus* sp., a wild dog, *Lycaon lycanoides*, a jackal *Canis mosbachensis*, a fox, *Vulpes cf. praeglacialis*, a badger, *Meles* sp. and the big mustelid *Pannonictis cf. nestii*. This community represents the typical European fauna for the middle Early Pleistocene, after the big mammalian shift of the beginning of Pleistocene that brought fauna from both Asia and mainly Africa to our continent, completely changing its landscape.

From the beginning of the Pleistocene there is also the first record of human presence in Eurasia, in Dmanisi (Republic of Georgia) (Gabunia et al., 2000; de Lumley et al., 2002), with an age close to 1.8 Mya. In the sites of Orce a human tooth was recently published in the locality of Barranco León (Toro–Moyano et al., 2013). This remain is the oldest known human fossil in western Europe, with an age of 1.3 Mya. Human remains complete our knowledge about the macrovertebrate fauna of the Orce Early Pleistocene sites.

Even before the discovery of the *Homo* fossil tooth, the early hominin presence in the basin has been attested since the mid 1990s by the recovery of lithic technology in Barranco León as well as in Fuente Nueva 3. The lithic record in both sites is very large and constitutes the widest, most diverse and complete collection of Early Pleistocene human technology in Europe (Toro et al., 2010a, b; Toro Moyano et al., 2011). The collections of Barranco León and Fuente Nueva 3 are, as could be expected because of their proximity in time and space, very similar and can be considered as one ensemble, even if on biostratigraphic grounds Barranco León is slightly older than Fuente Nueva 3.

In both sites the tools are made of flint and limestone, always sourced from the vicinity of the sites. On the Sierra de la Umbría near both sites there are flint and limestone primary sources coming from Jurassic levels. Barranco León and Fuente Nueva 3 are placed in contact zones between the mountain ranges and the lake, close to sources, colluvia and streams that carry tabular blocks of flint and cobbles of limestone, the two usual sources commonly used as cores by human populations. The proportions of both rocks are different for each site: for Barranco León flint is more present (62%) than limestone (38%), while in Fuente Nueva 3 the situation is the opposite as we counted 63.2% of limestone and 36.8% of flint (Toro et al., 2010a). The reasons for the unbalance have to be in the kind of activities performed at each site and the differential use of each rock; the limestone was more devoted perhaps to activities of percussion and fracturing. For a better understanding of raw material exploitation, these two rock types have been described in depth for each site so up to three varieties of limestone and four of flint in Barranco León, and five of limestone and six of flint in Fuente Nueva 3 (Toro et al., 2010a, b) have been identified.

Prior to 2006, 1,292 lithic tools recovered at Barranco León whilst at Fuente Nueva 3,932 were recovered (Toro et al., 2010a). On the one hand, the Barranco León assemblage is composed by 171 untransformed blocks and cobbles (Figure 13) (13.23%), 33 cores and flaked matrices (Figures 14 and 15) (2.55%) and 1,088 flakes and debris (84.22%). On the other hand, the Fuente Nueva 3 lithic set comprises 421 untransformed blocks and cobbles (45.17%), 67 cores and flaked matrices (7.2%) and 444 flakes and debris (47.63%). This distribution tests the idea of a major fracturing activity at Fuente Nueva 3, with many more cobbles and fewer flakes than in Barranco León, where the main activity seems to be related to the flaking of flint blocks.

This is the only remarkable difference between the sites that relates to the palaeoecological organization of human activities in the territory. No other distinction can be traced between Barranco León and Fuente Nueva 3 on technological grounds: both localities present the same technological degree and the same flaking procedures to obtain the same kind of products. The aim of the flaking process in the Early Pleistocene of Orce 1.2 – 1.3 Mya was to obtain sharp–edged flakes without any interest in a special flake dimension or shape (Figure 16). The human population did not produce retouched or standardized tools either. Despite the large collection recovered at both sites there is not one clearly retouched flake. Some present scratches on one edge could be derived from the flaking technique or even attributed to the taphonomic processes.

The main flaking technique applied in Orce is the bipolar on anvil strategy generating straight angles of flaking and abrupt faces on the core and leading to the production of sharp–edged and small flakes (Figure 16). An orthogonal unidirectional technique on cores with quite identical characteristics to the precedent one is also represented, especially in the presence...
of straight flaking angles and in the obtaining of small and sharp flakes. For many times the application of the orthogonal knapping method is derived by generating multipolar, polyhedral cores (Figure 17), a kind of object that is not so common in the European Early Pleistocene. These characteristics bring the Orce sites closer together to the archaic Mode 1 localities in East Africa, the Maghreb and Levant in the early stages of human technological ability.

Orce describes both the palaeontological and technological record and it is time to evaluate the relationship between them. The zooarchaeological analysis of the fauna recovered in Fuente Nueva 3 and Barranco León indicates that humans were often the first predators of some of the prey described. This ability shows us the degree of the evolution of human behaviour in acquiring resources in competition with other carnivorous and scavenger species. Competition with the giant hyena *Pachycrocuta brevirostris*, largely present at both sites, is especially important. The site of Orce with its large record of palaeontological and archaeological remains can help us in researching this scenario.

**The significance of Orce in European human evolution**

The Early Pleistocene sites of Orce, Barranco León and Fuente Nueva 3 are the oldest localities in western Europe showing human activity. No other archaeological deposit in Europe can be traced to an older date. The Early Pleistocene human peopling outside Africa has its root in the population settled in the Caucasian site of Dmanisi (Republic of Georgia) 1.8 Mya (Garcia et al., 2010). The human fossil record and the technological remains suggest a very primitive accession of people to Eurasia because of the archaic characteristics of both human anatomy and technology (Gabunia and Vekua, 1995; Gabunia et al., 2000; Lordkipanidze et al., 2007; Mgeladze et al., 2011). This population has to be the foundation for human settlement in Asia and in Europe.
In western Europe (Figure 18) we have a sharp chronological distance with the Dmanisi record since the first record we have is that of Barranco León and Fuente Nueva 3 along with Atapuerca’s TE9 level. Other sites older than one million years are Pirro Nord (Apulia, Italy) (Arzarello et al., 2006), Monte Poggioio (Emilia Romagna, Italy) (Peretto et al., 1998; Falguères, 2003), Pont–de–Lavaud (Indre, France) (Despré et al., 2006; Despré et al., 2011) and Lézignan–le–Cèbe (Hérault, France) (Crochet et al., 2009). Slightly younger than one million years are the sites of Vallonnet (Alpes Maritimes, France) (de Lumley et al., 1988), Vallparadis and La Boella (Catalunya, Spain) (Martínez et al., 2010), Happisburgh 3 (Norfolk, United Kingdom) (Parfitt et al., 2010) and Atapuerca –TD6 (Castile and León, Spain) (Carbonell et al., 1995; Bermúdez de Castro et al., 1997; Carbonell et al., 1999). This collection of sites constitutes the background for the evaluation of Orce’s importance and the knowledge we can gain about human palaeoecological adaptation and early migrations.

The wave of migration that arrived to the Caucasus at 1.8 Mya doesn’t seem to have reached western Eurasia before 1.4 Mya. This migration occupied at the least the Mediterranean region, as the sites of Pirro Nord, Atapuerca and Orce seem to show. It was slightly before 1.0 Mya that people reached northern latitudes in the French Massif Central site of Pont–de–Lavaud. The population there demonstrated to have adapted to the Happisburgh ecology around 0.8 Mya, dominated by conifer forest in one level and heathland in the older one. At that time people were present in different geographies: the fresh environment of Happisburgh, the Mediterranean seashore and the highlands of Central France and Spain; in fluvial, lake and seashore ecosystem and always using Mode 1 technology. This presents the population’s ability of adapting to different ecosystems.

The time span covered by these sites has also been enough to record slight evolution in the technology displayed by European sites in the last half of Early Pleistocene. It is clear that the whole technological record includes knapping systems belonging to the Mode 1 techno–complex and what has been described is a diversity in some of the characteristics expressed temporally. Barranco León and Fuente Nueva 3 show us the basal technology for Europeans, displaying reduced diversity of knapping methods including bipolar–on–anvil, orthogonal and polyhedral. This record is large enough to provide good knowledge about the technological stage, to be sure that the lack of standardized or retouched tools could be taken as a clear trend of that stage. Another important site is that of Pont–de–Lavaud where the diversity described in Orce is reduced to the bipolar–on–anvil method. We are facing variability inside the same techno–complex, far from the trend we see in the more recent sites, especially Atapuerca –TD6, where we found the first retouched tools. Although these are very scarce they have been described together with the use of big flakes as cores (Carbonell et al., 1999). This behaviour can clearly be taken as an evolutionary trend inside European Mode 1, a tendency that comes to a dead end as it has no connection to the more recent Mode 2 or Acheulean, introduced in Europe some 0.6 Mya.

To understand the whole process the Orce record gives us data to understand the variability during the first stages as well as the initial point for the subsequent evolution. The completeness, the richness and the diversity of sites in Orce is, up to now, something unique for European Early Pleistocene archaeology.
Science and heritage
Socialization of the evolutionary process: natural and human heritage; the evolution of landscape and human behaviour

A general proposal

Science is a social issue and has a civil duty to the society that makes it possible. The research at Orce is exceptional for having accomplished such a social project of developing a complete action of science socialization and our team is committed to achieving such a project. In this case, the science to be socialized is the science of evolution in every one of its domains, landscape, palaeontology including humans and human behaviour.

Socialization must not be confused with a simple diffusion of knowledge or dissemination of a project result. To the contrary, in our case, it has to be devoted to introducing the notion of evolution to the society. The audience has to receive scientific data, interpret it and familiarize themselves with it. At last the general public has to think about the human past, about the influence of the past in our current lives and how understanding past phenomena can help make present–day decisions. Orce will be used as a social tool, an educational resource and lastly as an instrument for the social and economic development of the region.

In many cases, the socialization of sciences devoted to the past suffers from the lack of information that society requires to understand human behaviour. We have to instead take advantage of this in order to transfer both the knowledge and the methodology in order to achieve them. Didactics must be partly committed to a kind of ‘making of’, introducing the way in which knowledge has been acquired. In short, didactics must also be dedicated to the rules of science and its own limits.

The aim is to allow the public to gain new information for themselves through different stimulating activities and processes. It is better to propose a hypothesis for understanding the empirical data and to generate the necessary empathy for them to be introduced both in the scientific method and in the past way of life in the Guadix–Baza region 1.3 Mya.

Orce can be developed as a cultural tourism destination where the public, both adult and children, can experience special, exciting, intriguing and interesting events that helps them appreciate and disseminate its importance. Beyond the concept of cultural tourism, the project aims to create a way for the public to learn and think about the past and present conditions of humankind, evolution of human behaviour and our relationship with the environment.

The potential of the Orce region

The Guadix–Baza region, as has been stated, possesses some of the richest sites for Quaternary Palaeontology and for human biological and behavioural evolution in Europe including the earliest human presence in western Eurasia. The region of Orce is also outstanding because of its special landscape. Where there was a large lake during the Pleistocene today is a rather arid, badlands–like area (Figure 19), while to the north there is a rich nature reserve, Cazorla–Segura–Las Villas (Figure 20), a very important natural heritage for the whole area. A project committed to evolution in all of its domains also has to be interested in the dissemination of the process leading to the transformation of the landscape and the installation of the current environment.

The lake of Baza was part of an important European intramontane lacustrine basin formed during the Miocene, and which lasted to the Pliocene and the main part of Pleistocene. Surrounded by the Sierra Nevada mountain range to the south and the Sierra de Cazorla to the north, it consisted of two main parts. To the west, a fluvial–alluvial system in the Guadix area led the streams from the northern slopes of Sierra Nevada to the lake that was situated to the east, in the Baza–Orce area. The former saline lake, around 40 km long, has suffered a slow and long sedimentation of its margins, just where paleontological and archaeological remains of Pleistocene daily life are being today being recovered. This slow process can be reconstructed for public understanding through different types of imagery that can be situated in detached places of the region where the space of the former lake can be easily perceived. The kind of sedimentation observed in the palaeontological and archaeological sites documents the rise and the fall of the level of the lake. In places such as Barranco León, the reduction of the size of the lake has provoked the placement of small streams sometimes used by our ancestors. This is a key feature to be disseminated.

For this reason the project has proposed placing informative posters in every site emphasizing its main features (Figure 21).

During the sedimentation of the lake, the changes in the Guadalquivir basin, north of Sierra de Cazorla, and the uplift of the mountain ranges in the south have produced upstream erosion that entered the former fluvio–lacustrine basin of Guadix–Baza, creating the Guadiana Menor River and capturing the endorheic basin. This process took place in the final Pleistocene. From
then on, the Orce region began its current history marked by the lack of permanent water streams in its main part, dominated by gullies and temporal torrents.

This history is an essential part of Orce heritage to be disseminated and socialized as a singular evolutionary process of the many places that can be observed here. We then envisage using special features to show the public how the landscape evolves, allowing us to connect such landscape evolution with that of mammals and humans in adaptation to ecological changes. In sum, we are preparing activities and resources to make possible a complete reconstruction of landscape evolutionary trends in the region.

Moreover and beyond the landscape and Pleistocene archaeology, the nearby municipality of Galera possesses an impressive Bronze Age site belonging to the El Argar culture, a fortified citadel in the highs of the village. It also faces on the other side of the valley an Iron Age necropolis, corresponding to the Iberian culture. This heritage is already preserved and presented to the public audience by means of site valorization and a local museum in the village of Galera. All in all, the educational and heritage plan for Orce has to take into account all the richness and potential it offers, working side by side with the aforementioned natural reserve and protohistoric sites to generate a synergy that could benefit everyone.

**Specific protection, development and educational programme**

Different actions have been carried out in order to ensure the protection, and the social and cultural use of the Orce sites. In July 2012 the regional government of Junta de Andalucía approved the classification of the three Early Pleistocene sites of Orce and the surrounding area as a ‘Bien de Interés Cultural’, the Spanish protection status to ensure its preservation as national heritage. It is the first step for the sites to be protected and socially used for educational and cultural purposes. It ensures the protection of the excavated sites, the fossil bearing outcrops and their fossil content. The protected area goes far beyond the currently known sites, enabling future scientific work throughout the region showing Pleistocene outcrops and will also permit its preservation for social and cultural purposes.

This is the most significant and recent action in terms of protection, but the policy for a valorization of Orce sites has been going on for a long time, considering other important steps such as the creation in 2002 of a local exhibition centre in the village of Orce. The exhibition centre is accountable to the Granada Archaeological Museum and preserves the whole Orce Pleistocene fossil collection (Figure 23). The collection and the sites themselves deserve to be developed by this exhibition. In future, it must be transformed into a new and independent museum institution to improve its museographic, educational and training purposes. Classifying the sites has been the first step to achieving this. In the meantime, the scientific team has proposed educational and cultural activities for the valorization of the sites.

We have proposed different actions to be used as tools to accomplish the objectives of socialization. Workshops for children have been prepared including visits and activities, covering a wide range of areas in order to cover different needs and expectations. The proposed activities must be quite diverse: the approach to evolution and to the sites must be changed as per the audience; it cannot be the same for the general public and a school group, for example.

Site visits and one specific visit to the exhibition in the Orce Museum have been planned. All of the visits must be informative and evoke the public’s empathy in the difficulties of daily life in the Quaternary, whilst using adapted language to promote
comprehension of the main steps of human evolution and the place of Orce sites in history. The question of language has long been a bone of contention in the socialization of science as it is hard to find the compromise between clarity and general audience requirements, and the specificity of terminology in science. We have to keep in mind that the specific concepts must also be disseminated. Site visits are especially interesting during annual fieldwork when visitors have full access to archaeological and palaeontological methodologies (Figure 24).

The second part of the socialization project is made up of activities for children. Workshops have been planned for primary and secondary school children. All of them take into account the current academic curriculum established by authorities. This way, we ensure workshops are attended and that the activities are taken maximum advantage of.

There are two types of workshops: one is experimental and the other is a ‘research workshop’ in which children reproduce the research activities carried out by scientists by manipulating some of their research tools and archaeological materials in order to ‘discover’ data or to explain empirical information through hypothesis proposal. In this kind of workshop school children develop manual abilities as well as methodological procedures. The experimental workshop is, in contrast, more committed to reproducing daily Pleistocene tasks such as flaking activities. Both types of workshop are adapted to the specific group and are useful for children’s growth.

Finally, it has to be stressed that, for improved use these activities must be carried out in accordance with a school methodology that pays attention to educational objectives, the content developed and the abilities sought. This policy is built on in order to achieve a level of quality of the mentioned activities. In order to properly guarantee this, all the planned activities are, of course, subject to a quality survey among professors and the audience.

**Final remarks**

From the data gathered in this paper we have to consider the value of Orce region in four domains of heritage: human evolution, both in terms of biology and behaviour, evolution of the animal and vegetal communities, the evolution of the landscape and the history of humankind in all its temporal range. For landscape reconstruction and the socialization of geological research there are many areas where observation and interpretation points could be installed. In the field of vegetal and animal evolution including humans the region is very rich in outcrops that are already under work and whose heritage is being disseminated. This very old history of humankind can be added to the varied and complex archaeological record known in the region to build a comprehensive understanding of human adaptation to a changing landscape.

Such a complete conception of the whole heritage of the Orce region has to promote a multidimensional policy for heritage preservation and socialization that could allow for the creation of a knowledge–based economy in the region through the establishment of several touristic, educational and research facilities.

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*Figure 24. Visit to the site of Fuente Nueva 3. (® J. Mestre – IPHES, 1792–065).*
Bibliography


Introduction

For the last five million years of human evolution there have been vital punctuated moments of important and rapid periods of innovation and invention which have illustrated human resilience across times (Bicho 2013; Haws, 2012; Holling, 2001; Holling and Gunderson, 2002; Stiner and Kuhn, 2006; Stiner et al., 1999, 2000). These phases have frequently been called revolutions (Bar-Yosef, 1998, 2002; Mellars, 1989; Mellars and Stringer, 1989). They can be seen as moments of human adaptation to phases of environmental stress including: local or regional climatic decline or decrease in resources and economic or social pressures or tensions which directly impacted the demographic situation of the human community. In the context of the Panarchy and of the Adaptive Cycle Model (Holling, 2001; Holling and Gunderson, 2002) this would correspond to the Ω phase, a period of ‘creative destruction’ (Schumpeter, 1950 in Holling, 2001:396), of system breakdown characterized by the reordering of internal functional structures and networks (Bicho, 2013; Bradtmöller et al., 2012; Haws, 2012; Walker et al., 2006), followed by internal reorganization when innovation occurs, usually in pulses when potential is high and controls are weak, and when rapid reorganization and novel reorganizations lead to innovations and new opportunities (the α Phase). It is a time of high potential and ecological resilience and adaptation (Smit and Wandel, 2006), including that of social-ecological systems (Folke, 2006). It is, thus, a period of ‘fertile environment for experiments, for the appearance and initial establishment of entities that would otherwise be outcompeted“ (Holling, 2001: 396).

The earliest human adaptation to coastal ecologies is a case of human resilience ‘in action’, a definitive phase of innovation in human evolution. Recently it has been thought, particularly in the case of the adoption of marine diet, to be one of the key elements of modern behaviour and the emergence of human cognition (Bicho and Haws, 2008; Cortés et al., 2011; Manne and Bicho, 2011; Marean, 2011; McBrearty and Brooks, 2000; Parkington, 2001). The main reason, though not always explicit in literature, is the fact that very important nutrients for human health are singularly present in marine dietary resources such as shellfish and fish. It is the case with long chain polysaturated fatty acids, such as Docosahexaenoic acid (DHA) and Arachidonic acid (AA) present in the Omega 3 and Omega 6 series (Broadhurst et al., 1998, 2002; Carlson and Kingston, 2007; Crawford et al., 1999; Cunnane et al., 1993; Langdon, 2006; Parkington 2001; Uauy and Dangour. 2006) which are invaluable during pregnancy and early childhood, but are not produced in the human body (Broadhurst et al., 2002, Jensen 2006, Milligan and Bazinet 2008). These fatty acids occur naturally in aquatic plants and animals and may have played a critical role in the development and expansion of the human brain and retinal quality in the Pleistocene (for example, Bicho et al., 2011; Manne and Bicho, 2011; Marean, 2011).

More recently another hypothesis has been put forward: that of coastal adaptations as the trigger for more developed, pro-social behaviour, an evident hallmark of modern human behaviour (Marean, in press). Ethnographic and archaeoological data demonstrate that a commitment to temporally and spatially predictable and dense foods, such as those found in coastal ecological niches, results in reduced mobility, larger group size and population packing, smaller territories, complex technologies and increased economic and social differentiation. The effect is an investment in territoriality and boundary marking possibly inter-group conflict and, therefore, is an ideal context for the proliferation of intra-group cooperative behaviours beneficial to the human group.

In this paper I will focus on the so-called coastal paradox, conceptual definitions of coastal adaptations, the types of coastal exploitation by hunter-gatherer-fisher human groups and ecological aspects of coastal environments. I will also describe some of the early sites with coastal resources in the Iberian margin (Figure 1) and discuss...
the impact of coastal resources on human evolution, which illustrates the importance of coastal prehistoric sites for archaeological heritage.

Historical and theoretical framework

Ethnography and Archaeology of coastal resources

Archaeological, historic and ethnographic data unequivocally show that maritime and aquatic hunter-gatherers generally are characterized by a higher degree of sedentism, relatively higher population density and more culturally complex than land-adapted homologous groups (Bailey and Milner, 2002; Birdsell, 1953; Erlandson, 2001; Erlandson and Fitzpatrick, 2006; McCartney, 1975; Palsson, 1988, 1991; Renouf, 1988; Rowley-Conwy, 2001; Townsend, 1980).

There is also the idea in literature that coastal resources were not fundamental or even important in the prehistoric past and that rudimentary technology was sufficient to exploit aquatic resources. Over forty years ago, Washburn and Lancaster stated that ‘During most of human history, water must have been a major physical and psychological barrier and the inability to cope with water is shown in the archaeological record by the absence of remains of fish, shellfish or any other object going deeply into water or using boats. There is no evidence that resources of river and sea were utilized until late preagricultural period’ (1968:294). The idea of the exploitation of coastal resources no earlier than the very late Upper Palaeolithic was also defended by Yesner (1987), following the concepts of the Broad Spectrum Revolution (see Stiner, 2001 for and historical review) as defined by Flannery (1969) and Binford (1968). This hallmark of New Archaeology resulted in a constraining forty year-long paradigm frequently know as the Tardiglacial Paradigm (see Bicho and Haws, 2008, for general discussion on the topic).

Ethnographically, the idea that simplicity and archaic knowledge were enough for coastal adaptations probably stems from Darwin’s accounts of the Tierra del Fuego coastal hunter-gatherers, so well typified on ‘To knock a limpet from the rocks does not require even cunning, that lowest power of mind. Their skill in some respects may be compared to the instinct of animals...’ (Darwin, 1839:296-297). The same general perspective of ignorant coastal hunter-gatherers can be seen in the coined attribution of ‘lowest savagery’ by Lewis Morgan (1877) to the Northwest Coast American Indians. In the early 1900s Uhle (1907:31) stated that ‘...procuring the essentials of life by collecting shells in itself indicates a low form of human existence.’ Clearly, this is what Erlandson (2001) named the Gates of Hell, where big game hunting was thought to be the main driving force in human diet that provided the basis for human physical, cultural and technological evolution. Marine resources were perceived as limited, costly to harvest and process, poor sources of nutrition, unreliable and, in general, marginal or starvation foods, fallback resources that people relied upon only in times of terrestrial resource scarcity (for general discussion on this topic see Bailey and Milner, 2002; Bicho et al., 2011; Bicho and Haws, 2008; Erlandson, 2001; Erlandson and Fitzpatrick, 2006).

Osborn (1977:177) goes as far as suggesting that coastal resources were so expensive to harvest and process that humans in non-industrialized societies avoided their exploitation. Gamble (1994) does not include coastal environments as one of the top ten habitats used by humans in Prehistory. Claassen (1998) suggested that the fact that harvesting shellfish is primarily a woman’s task in many societies further marginalized the importance of marine resources in human economies. Moss (1993) documented a clear example of ethnographic bias towards shellfish by Tlingit men in American Northwest region: although shellfish were a basic staple of everyday life, when interviewed, an elderly man answered that they were not a major dietary supply for men. After having been shown vast shellfish remains present in villages and campsites, he acknowledged the importance of shellfish for the local diet. He explained that shellfish harvesting encouraged laziness, because they were easy to gather and it was a woman’s task; that men needed to work hard to be socially considered and shellfish harvesting was not considered hard work, yet men did consume shellfish.

To counteract this perspective, a group of experts believe in the abundance and diversity of coastal resources - what Erlandson (2001) named the Garden of Eden. According to Erlandson (2001:290), the example that best reflects this perspective is that of Sauer’s description of the sea’s importance in human evolution: ‘...the path of our evolution turned aside from the common primate by going to the sea. No other setting is as attractive for the beginnings of humanity. The sea, in particular the tidal shore, presented the best opportunity to eat, settle, increase and learn. It afforded continuous and inexhaustible diversity and abundance of provisions. It gave the ecologic niche in which animal ethnology could become human culture.’ (Sauer, 1962:45).

While data confirming human exploitation of coastal resources in early Prehistory has been in literature for some decades now, with examples from many coastal regions of the Old World (for example, Altena, 1962; Arambourg, 1967; Clark, 1974-75; Cleyet-Merle and Madelaine, 1995; Garrod et al., 1928; de Lumley, 1969; McBurney, 1967; Roubet, 1969; Singer and Wymer, 1982; Souville, 1973; Straus, 1976-77; Straus et al., 1981; Volman, 1978; Waechter, 1964), there has been a clear and strong
bias against the idea of a true importance of coastal resources and their use by early humans. Erlandson (2001:291) termed this the Coastal Paradox: if coastal resources are limited, of poor dietary capacity and thus marginal, how is it possible that they have supported and are the economic foundation for complex societies characterized by high density populations and elaborated material cultures? My view is that coastal environments present a double paradox: that listed above, in addition to the inconsistency of the fact that if coastal resources are the economic foundation for complex societies with large human densities and populations then why is the coastal archaeological record so poor, specifically in the context of early prehistoric times?

In general, aspects such as preservation, taphonomy and visibility have a strong impact on the archaeological record. Likely, the most restrictive factor for the preservation and visibility of coastal sites and coastal prehistoric human adaptations is the sea level changes and the position of archaic shorelines. The latter element is fundamental in understanding coastal use by hunter-gatherers, prehistoric or not. It seems that without artificial locomotion such as horse riding, hunter-gatherers have a distance limit of 10 km for inland transportation of edible shellfish (Bigalke, 1973; Meehan, 1982, in Erlandson, 2001:301), even if they process the shellfish and remove the shells at the coast (Bird and Bird, 1997). If the distance is more than that between logistical and residential base camps, then the skeletons and shells of coastal dietary resources (shellfish, fish and sea mammals) are left behind. The general consequence of this is that coastal resources will be found only within a 10 km radius from the ancient palaeoshore. Good archaeological examples are, among others, the sites of Vale Boi (Figure 2) in Southern Portugal (Bicho et al., 2013; Manne et al., 2012) and Pinnacle Point in South Africa (Fisher et al., 2010; Marean, 2010, 2011). For the last 120,000 years the sea level has remained considerably lower than today’s sea level of minus 60 to minus 120 metres; as a result the continental shelf extends considerably from the present day coastline. The submerged continental shelf exceeds 16 million km² (Bailey, 2004), or about 10% of the total current habitable land surface. This submerged platform, likely extensively used by Palaeolithic hunter-gatherers, guards an incredibly high number of archaeological sites, where one can find the early coastal anthropogenic record, now submerged and possibly, in some cases, still preserved underwater (Bailey and Flemming, 2008).

There are several possible exceptions to this scenario. The most important and relevant is the time of the Marine Isotope Stage 5e (MIS 5e), when the sea level was slightly higher than today by at least a couple of metres. Thus, the relic coastline of the MIS5e should hold, above water, a series of archaeological sites that can illustrate the early coastal use of Palaeolithic hunter-gatherers.

The second case for possible exception for the submerged scenario is that of the coastal uplift (Bailey and Flemming, 2008; Benedetti et al., 2009; Bicho and Haws, 2008; Haws et al., 2011), where tectonic active regions will push up the coastal sites, preserving them out of the water and making them visible for the human archaeological eye. A third possibility is that of areas with narrow continental shelves and very steep bathymetry. There, the distances to the Pleistocene shorelines are reduced, sometimes drastically, and evidence for coastal settlement and resource use may be found. It is the case of Southern Iberia (Haws et al., 2011, Bicho, 2004; Bicho and Haws, 2008; Manne and Bicho, 2011, Brown et al., 2011; Morales et al., 1998) and Southern Africa (Fisher et al., 2010). Still, the exceptions will be, in practical archaeological terms few and apart, and this is likely to be the main factor for such low numbers of early coastal Pleistocene sites around the world.

**Definition of terms**

Recently, Marean (2014) has argued that for the purpose of understanding and evaluating the importance of coastal resources and the value of coastal adaptations in human evolution it is fundamental to clearly and unambiguously define concepts such as ‘coastal adaptation’, ‘maritime adaptation’ and ‘systematic use of coastal resources’. The main reason for this argument is that if the exploitation of coastal resources is one of the hallmarks of modern cognition, then the scale of coastal resource use has to be frequent enough to be able to impact more or less continuously the human diet and to have direct results on overall health, including brain and retinal development, produced by the Omega 3 and 6 found in marine dietary resources. Also, the exploitation and harvesting of coastal resources, at least in certain areas of the Old World such as South Africa, require a
Systematic use of coastal resources is likely responsible for the presence of episodic bone elements at a site. Another important element representing a coastal economy is the presence of evidence of marine elements for body decoration (Stiner et al., 2013). These are very important for the attribution of archaeological sites to the different levels of coastal resource use and management.

Unfortunately, icthyological remains tend to be rare in early prehistoric contexts mostly due to taphonomic reasons: their visibility and the volume would suffice for the traditional archaeological eye to consider the presence of such types of shell as the most reliable indicator of coastal use. There are, however, other important remains (either present or under the form of proxies) that can indicate the use of coastal niches. Naturally, fish are one of these.

While the definitions seem straightforward, the problem is their application, that is, how to archaeologically identify systematic coastal resource use and coastal adaptation. Marean (2014) proposed to do so based on the presence or absence of shellmiddens and shell remains: the presence of a shellmidden, defined as a context where the sediment is shell supported, where shells are inter-fingered and the fine sedimentary matrix fills in the spaces among the shells, is indicative of the presence of coastal adaptation; the presence of shells, usually in large amounts although not making up a midden, but present with regularity and recurrently through the sediments are representative of systematic use of a coastal niche.

These definitions, not without problems among which are aspects of taphonomical alterations of shellmiddens and the use of other proxies for the use of coastal resources such as fish or marine mammals, can be applied in a preliminary approach for the attribution of archaeological sites to the different levels of coastal resource use and management.

In the past, the main element considered representative of a coastal economy was the presence of shells from edible species. These, of course, are highly visible in the landscape and at each archaeological site. They also tend to accumulate fairly rapidly and thus, create large middens such as those from the Mesolithic of Muge in central Portugal (Bicho et al., 2011b, 2013b) or the more recent examples from the Brazilian coast, the so-called Sambaquis (DeBlasis et al., 1998, 2007; Gaspar, 1998). If not for any other reason, the visibility and the volume would suffice for the traditional archaeological eye to consider the presence of such types of shell as the most reliable indicator of coastal use. There are, however, other important remains (either present or under the form of proxies) that can indicate the use of coastal niches. Naturally, fish are one of these. Unfortunately, ichthyological remains tend to be rare in early prehistoric contexts mostly due to taphonomic reasons: their bone density is very low and destruction is usually fairly even, if they were abundant. Another important element is the presence of marine mammals, including a wide variety of cetaceans and pinnipeds. Although these are large in size, they tend to be rare in European Middle and Upper Palaeolithic sites. While fish and shellfish occur as a direct result of purposeful gathering, harvesting or fishing, marine mammals can be present at a site even if no hunting took place; shore scavenging is likely responsible for the presence of episodic bone elements at a site. Another important element representing a coastal economy is the presence of evidence of marine elements for body decoration (Stiner et al., 2013). These are very important for the confirmation of so-called modern behaviour (for example, d’Errico et al., 2005; Stiner et al., 2013; Vanhaeren et al., 2013), but clearly do not have any impact on diet. Still the fact that they are present (and usually recurrently and with regularity), indicates that the coast was frequently and likely systematically used.
Ecology and biomass production in Western Eurasia: the case of the Iberian Peninsula

Europe, with only c. 10 million square kilometres, is the world’s second smallest continent by surface area, corresponding to 2% of the Earth’s surface and about 6.8% of its land area. The extremely long European coastline of c. 89,000 km forms, in geographical terms, a peninsula. With the exception of Oceania, Europe has a short latitudinal range when compared to the other continents. Nevertheless, the spectrum of biomes is incredibly high for such small territory: from tundra in the Arctic Circle to dry steppe in the south-east and Mediterranean woods and dry open land in the south-west. The altitudinal range is also steeply marked, and the complete geographical set provides an extremely rich ecological mosaic with a vast territory of temperate territories well suited for prehistoric hunter-gatherer adaptation (Finlayson, 2008). Iberia, and specifically the southern section of the Peninsula, was likely a special land during most of the Pleistocene due to its almost unique location marked by climatic conditions that were not nearly as rigorous as in other regions of Europe, or even as northern Spain or south-western France during the same period.

Since MIS6 in Southern Iberia, the range of faunal species available for both food and daily activities was likely fairly constant (Brugal and Valente, 2007; Haws, 2012), and may, in fact, have increased in certain times of cold-peaked climatic periods, as the region might have served as a refugium for many species due to the movement of the climatic latitudinal gradient southwards of the polar front. During those periods, the landscape was certainly more open with sparse vegetation well adapted to aridity and lower temperatures in warmer periods, but nevertheless better suited to humans overall than most of the European continent. Iberia, even in those harsher climatic phases, formed a highly diverse ecological mosaic, with a strong hold for a pronounced resilience of both animal and botanical species throughout the last 150,000 years and might have served as an ecological cul-de-sac (Bicho, 2013; Gómez and Lunt, 2007; Haws, 2012).

Perhaps because of climatic and environmental constraints, and the rather limited view on Neanderthal cognitive capabilities before 1990s, Neanderthal hunting and diet in Europe was traditionally seen as one of limited spectrum. Only in the last thirty years did Neanderthals ‘learn’ to hunt. In fact, Neanderthals went from scavengers to specialized hunters in just a couple of decades (Burke, 2000). The interesting aspect of this new perspective is that all over Europe data seems to provide us with a scenario of an almost exclusively medium to large mammal dietary prey for Neanderthal populations (Patou-Mathis, 2000), from Eastern (Burke, 2000) to Western Europe (Boyle, 2000). Perhaps this stems in part from the theoretical framework based on the idea of late subsistence intensification in the Upper Palaeolithic and from the application of the general Optimal Foraging Theory concepts (for example, Hill et al., 1987; Jochim 1988; Winterhalder, 1981, 1986).

A shift in theoretical paradigms was seen in Palaeolithic research in Iberia, with both the receding date of resource intensification including coastal elements from the Late Upper Palaeolithic to the Middle Palaeolithic (Bicho et al., 2013; Bicho and Haws, 2008; Cortés, 2011) and the introduction of Nutritional Ecology models to the human diet (Hockett, 2012; Hockett and Haws, 2003, 2005) instead of those models based purely on energetic grounds (in other words, Optimal Foraging Theory). These two aspects gave space for an altered perspective on the importance of coastal settings for human evolution in Iberia.

Nutritional ecology models argue for a diverse diet as the only healthy form for the human species. It includes a large variety of essential macronutrients (fats, carbohydrates and proteins) and micronutrients (non-caloric vitamins and minerals) that provide a healthier life and an increase in fertility and a marked decrease in mortality of neonates, infants and juveniles. This essential nutrient diversity is given by a range of groups of species (and not only by a variety of species) and includes three or more groups such as ungulates, lagomorphs, marine mammals, shellfish, fish, birds, fruits or plants (instead of, for example, red deer, aurochs, ibex, and roe deer, species all in the same group). Two examples of essential micronutrients, previously mentioned, are docosahexaenoic acid (DHA) and arachidonic acid (AA) present in the Omega 3 and Omega 6 series (Broadhurst et al., 1998, 2002; Crawford et al., 1999; Cunnane et al., 1993; Parkington 2001; Uauy and Dangour, 2006). These are fundamental during pregnancy and early childhood for the development and expansion of the human brain and retinal structure but are not produced in the human body (Broadhurst et al., 2002; Jensen, 2006; Milligan and Bazinet, 2008). They occur naturally, however, in marine plants and animals. Thus, an important source of essential nutrients for brain development is edible marine resources, among which mussels and limpets produce the highest amounts of AA and DHA in shellfish (Brazão et al., 2003; Gardener and Riley, 1972) and are highly abundant and easily harvested in the southern Iberian coast - they are also very common in many southwest Iberian Palaeolithic sites. What might have made the difference and such a long survival for the Neanderthal community and an early coastal anatomically modern human adaptation in Southern Iberia was the resource availability and high coastal biomass productivity that allowed a more diverse and better diet for those populations (Bicho and Haws, 2008; Hockett, 2012).

One of the main reasons for this richness and increased biomass, mostly marine, is a natural phenomenon known as Upwelling. The upwelling phenomenon is the upward movement of deep, cold waters to the surface induced by wind flow parallel to coastal cliffs. These waters are extremely rich in nutrients, resulting in a type of phytoplankton called diatom blooms (Margalef, 1978), which is at the lowest level of the marine trophic system. The modern southern Iberian Atlantic coast is well-known...
for its rich marine fisheries. The characteristic upwelling dynamics of the Southern Iberian Atlantic coast generates a highly productive marine ecosystem off the coast between Gibraltar and Nazaré (Fiuza, 1982, 1983; Abrantes and Moita, 1999; Loureiro et al., 2005). This phenomenon is responsible for the large amounts of fish and shellfish present on the Southern Iberian coast.

There are two different systems of upwelling: the equatorial and the coastal. The first type is characterized by a general surface water deflection pole ward from the equatorial line. Naturally, the deep cold waters replace the westward moving surface waters as well as the nutrients, turning these areas into the most productive marine biomass regions in the world. This takes place in Peru, for example, and is due to the differences in atmospheric pressure between the terrestrial and marine milieus and the shape of the submerged land shelf. The result is that there seems to be a direct correlation between land aridity and the intensity of the upwelling.

The coastal upwelling, present in southern Iberia, results from the direction of the coastal northern wind (in the northern hemisphere and opposite direction in the southern hemisphere). The surface water moves offshore when the wind blows parallel to the coastal cliffs and cold deep nutrient-rich water rises to the surface. This is known as the Ekman transport (Mann and Lazier, 2006; Pond and Pickard, 1983): the top water layer deflects to 45º right from the original wind direction; each lower layer will undergo the same effect, causing the so-called Ekman spiral up to a point where the lowest current is pushing the water in the opposite direction of the surface water. Theoretically, the Ekman transport takes place at 90º to the right of the wind direction in the northern hemisphere and impacts the top 100 metres of depth. This is the case of the southern Iberian Atlantic coast, particularly in the Cape of Sagres. Other regions in the world similar to these are California and the Skeleton Coast of Namibia.

The upwelling system today along the Southern Iberian coast tends to be mostly seasonal and more intense in the spring and summer months (Fiuza, 1982, 1983, Sousa and Bricaud, 1992; Loureiro et al., 2005) during which winds blow mostly north along the west coast (Loureiro et al., 2005) and west off the south coast (Figure 2).

When there are upwelling water peaks on the west coast, these tend to merge with the local upwelled waters from the southern coast of Algarve including those from the run off from the Guadiana river (Sousa and Bricaud, 1992) and frequently reaching the Gibraltar strait, even in winter months (Folkard et al., 1997). More rarely, upwelled waters present plume-like offshore extensions, with more than 200 km in such locations as the Nazaré canyon, the Tagus estuary, and the Capes of Sines and São Vicente, respectively in Extremadura, southern Alentejo and Algarve (Fiuza, 1983; Sousa and Fiuza, 1989). The Iberian southern coast is characterized by an upwelled water band with 20 to 50 km of width.

In the last decade, Abrantes and colleagues have studied the variability in upwelling conditions and the biological productivity off the coast of Portugal (Abrantes, 1988, 2000; Abrantes, et al., 1998; Lebreiro et al., 1997). They were able to produce a general scenario pertaining to at least the last 200,000 years for the Southern Iberian coast based on two marine cores located off northern Portugal (KS11 – Abrantes, 1990) and off southern Morocco (M12392 – Abrantes, 1991).

The highest biomass productivity in southern Iberia took place during MIS 6, MIS 4 and the Last Glacial Maximum. During Tardiglacial times the upwelling intensity dropped to levels around three to seven times the modern values. With the beginning of the Holocene, the productivity decreased to numbers similar (or even lower) to those of today with the possible exception of the 8.2 K cold event (Barber et al., 1999; Grafensteing et al., 1998; Mcleromott, et al., 2001). The pattern of high intensity upwelled conditions during cold phases has been confirmed by other data, such as phytoplankton, CaCO3, barium and carbon alkenones (Pailler and Bard, 2002; Thomson et al., 2000).

In summary, Iberia was a highly diverse ecological mosaic due to the marked altitudinal and latitudinal gradient and the relationship of its geographical position to the southern extreme of Europe. The result was likely the biological function of a cul-de-sac and, thus, a perfect region for the development of a pronounced resilience of both animal and botanical species.

Southern Iberia was particularly different from the rest of the European continent due to its geomorphologic characteristics of high coastal cliffs. That, together with wind patterns, developed an important climatological and environmental facet, fundamental in the late survival of Neanderthal populations and the adaptation to new ecological niches by the newly arrived anatomically modern humans, some 33,000 years ago: the upwelling. This system, many times stronger than it is today, powerfully increased the regional marine biomass, creating the perfect landscape for coastal use and coastal adaptation at least during the last 150 thousand years.
**Iberian Palaeolithic sites**

There is a small group of early occurrences of the use of shellfish on the European Mediterranean coast. These include the sites of Terra Amata (France) dated to 300-230 Ka with shellfish and fish remains possibly associated to an Acheulean coastal located multicomponent site (de Lumley, 1969; Villa, 1983). A similar situation is that of Lazaret cave, dated to MIS6 (Cleyet-Merle and Madelaine, 1995). In either case, the number of coastal remains is fairly low and there might be questions about the direct association with the artefacts (Erlandson, 2001; Colonese, et al., 2011).

Outside of southern Iberia, there seems to be two Middle Palaeolithic sites that include shellfish remains in association with Mousterian artefacts – that of Ramandils, in France, a cave site located at 1,500 metres of the modern shore (Gerber, 1973), where more than 300 shellfish fragments were reported (Cleyet-Merle and Madelaine, 1995); and the cave site of Moscerini, in Italy, where Stiner (1994) reported over 3,000 shell fragments dominated by mussels and limpets and where burning was very common. A much later Middle Palaeolithic site where shellfish remains were found is Grotta Breuil in Italy (Stiner, 1994).

Coastal dietary remains become more common in European sites outside of Iberia after 40 Ka, already in early Upper Palaeolithic contexts. It is the case, among others, of Riparo Mochi in Italy (Kuhn and Stiner, 1998; Stiner, 1994, 1999) or Castanet shelter in France (Cleyet-Merle and Madelaine, 1995).

Non-dietary marine shell remains used for ornamental reasons are very common, particularly in the early Upper Palaeolithic sites of Turkey (Stiner et al., 2013), Italy and France (Alvaréz Fernández and Jorís, 2008) even when located a certain distance from the coastline. Some of these ornamental artefacts are also present in Iberia, but much earlier in Middle Palaeolithic times – that is the case of the Los Aviones and Antón caves in the Mediterranean region of Murcia (Zilhão et al., 2010).

In Iberia (Figure 3), the earliest site with evidence for marine exploitation is Bajondillo, near the shore of Malaga Bay (Cortés et al., 2011). Here, at three Middle Palaeolithic layers dated to c. 150 to 145 Ka ago, there is unequivocal evidence of the exploitation of shellfish (Figure 4). A total of close to 2,000 shell fragments from c. twenty different species were collected from a very small excavated area (less than 5 m²). There is also clear evidence of burning and intentional breakage in the shell assemblage. On the other side of the Malaga Bay, there is a cave complex known as the Humo caves (Cortés et al., 2008). Although without absolutes dates, based on geomorphologic and palaeoenvironmental data, Cortés indicates that there are Mousterian layers of the same age as Bajondillo. One of these caves (Figures 5 and 6) has a large number of shell fragments on the exposed profile, but no data has been published on the faunal remains of previous excavations at these sites.

In Gibraltar, there are bibliographic references for the presence of large human accumulated shells at Devil’s Tower (Garrod et al., 1928) that included mussels and limpets as well as other sandy bottom species, thought to be dated between 125 to 50 Ka ago. The other two main sites in Gibraltar are Vangard (Figure 7) and Gorham’s caves (Figure 8). Both have long sequences, dated to between the MIS5 and later Pleistocene phases or even into recent Holocene in the context of Gorham’s (Fa in press; Finlayson et al., 2006). Both caves are located just above a rock shore platform, probably the results of the MIS5 high sea stand. Fa (in press) reports a relatively low number of shells from the recent excavations at Gorham’s (around 500 fragments of a total of two dozens species) that can be added to the 1,500 fragments reported by Baden-Powell in 1964. Perhaps more important is the common presence of pinnipeds at both Gorham’s and Vangard caves (Erlandson and Moss, 2001; Stringer et al., 2008), some with clear cut marks.
On the Atlantic Portuguese coast, there are two interesting sites that unfortunately did not render any faunal remains. These are the open air sites of Praia Rei Cortiço and Praia do Pedrogão. The latter, located near Leiria (Aubry et al., 2005) with a typical Middle Palaeolithic assemblage, was found on the limit of the intertidal zone, below the sand dunes, but in a poor state of preservation.

Praia Rei Cortiço (Figure 9) in Peniche, near the mouth of the Óbidos lagoon, was found during a survey of the Atlantic coastal strip (Benedetti, et al., 2009). It is a Middle Palaeolithic site, dated to MIS5 (Haws et al., 2011). The setting is identical to
that of Pedrogão: the archaeological horizon is on the limit of the wave action (Figure 10), but due to botanical preservation and sedimentological analyses, we know that the site was on a coastal lagoon environment. The similarity of the location of the two sites suggests that Praia do Pedrogão might also be dated to the same chronological phase of high sea stand of MIS5e. A similar situation seems to be that of the Furninha cave, just above a MIS5 limestone shore platform in the town of Peniche. The site was excavated in the late 19th century, and although with great care, no recent and reliable absolute date is available. However, there have been a few recent attempts to date Middle Palaeolithic fauna. Faunal remains are present in fair amounts, including shells, but unfortunately stratigraphic provenience is not clear since there are Chalcolithic occupations in the cave (Bicho and Cardoso, 2011).

Further north the site of Mira Nascente (Figure 11) is also located on the present day shore, but in an uplifted sand dune, some 30 metres above the sea level (Benedetti, et al., 2009; Haws et al., 2011). Dated to c. 40 Ka and with a beautiful Levallois assemblage, the site did not preserve any faunal remains. On the other hand, preservation of some use-wear traces on the flint artefacts (Figure 12) indicate that they were likely used to cut fish (Haws et al., 2011).

Also dated to the very late Middle Palaeolithic is the cave site of Figueira Brava, near Sesimbra. Dated to c. 35 Ka, it has various Mousterian levels with large numbers of faunal remains including shells (limpets and mussels), pinnipeds and cetaceans (Antunes, 1990-91, 2000a, 2000b). Further south, in the Arade estuary near Portimão in the Algarve, there is the cave site of Ibn Ammar (Bicho, 2004a, 2004b). Out of a small profile a few shell fragments (mussels, limpets, clams and cockles) were found apparently in association with a Mousterian lithic assemblage and a few mammal bones and tortoise remains.

Extensive shellfish collections are clearly present in Early Upper Palaeolithic sites in Iberia starting around 35 Ka ago, both in the Cantabrian Spain (Alvaréz Fernández, 2011; Gutiérrez Zugasti et al., 2013), as well as in the southern extreme opposite tip in the Sagres cape at Vale Boi (Bicho and Haws, 2008; Manne and Bicho, 2011; Manne et al., 2012). Limpets and mussels, among other species are present at the thousands in the Aurignacian of Cantabria (for example, the cave of El Cuco - Alvaréz Fernández, 2011; Gutiérrez Zugasti et al., 2013) as well as at Vale Boi (Manne and Bicho, 2011).

After the Heinrich Event 2 and with the development of the Last Glacial Maximum, shellfish became a standardized food all over the Iberian coastal settings. Perhaps the most famous cases are those of La Riera cave (Straus et al., 1981; Clark and Straus, 1986) and Altamira (Straus, 1976-77) in Cantabria, Parpallo, near Alicante (Pericot, 1942), and Nerja (Jordà, 1986; Morales et al., 1998) near Malaga. In Portugal the better documented cases are those from Vale Boi (Bicho and Haws, 2008; Manne and Bicho, 2011; Manne et al., 2012), Caldeirão (Callapez, 2003) and Picareiro (Bicho et al., 2003, 2006).

Fishing is also present, although not as common. There are a few examples of fish and cetacean remains in Lagar Velho (Moreno-García and Pimenta, 2003), Caldeirão (Zilhão, 1997) Coelhos (Almeida et al., 2004), Picareiro (Bicho et al., 2003, 2006), and Vale Boi (Manne and Bicho, 2011; Manne et al., 2012). Probably the most important marine fishing location during the Last Glacial Maximum in Southern Iberia is the cave of Nerja (Cortès et al., 2008). There are thousands of fish remains present at this site. This context clearly documents an intensive and specialized fishing centre during Solutrean times, as evidenced not only by the fish bones, but also by the common presence of fish hooks (Aura and Pérez Herrero, 1998), and represented in the parietal art of another cave in the region - La Pileta (Figure 13).
Final remarks

High coastal biomass productivity and resource availability might have had a strong impact in human adaptations of southern Iberia, including those of the Neanderthals and the first anatomically modern humans. Today, the coastal areas from Gibraltar up to Nazaré, some 150 km north of Lisbon, are well known for their marine resources, both fish and shellfish. The main reason for the high productivity of fish and shellfish off the Spanish and Portuguese shores is the characteristic upwelling dynamics of the south-western Iberian Atlantic coast.

Data from two marine cores, located off northern Portugal (KS11) and the Canary Islands (M12392), show that the highest biomass productivity took place during the Last Glacial Maximum, but beginning at the earliest with OIS 6 the productivity was many times higher than today. Simultaneously terrestrial plant and animal communities in Iberia had since long maintained their diversity and abundance (Haws, 2012). Thus the southern coast of Iberia would have been extremely attractive and a perfect set-up for both Neanderthals and modern humans since the Last Glacial-Interglacial cycle. This is evidenced at the site of Bajondillo near Malaga.

As coastal productivity increased due to higher upwelling conditions, a wide variety of abundant and easily collected resources, such as tortoises, shellfish, marine mammals and shore birds, would have been present. Although data are still scarce prior to c. 150 Ka, there are a series of archaeological sites after that date with a highly diverse fauna, including that of coastal niches. These include the caves of Salemas, Columbeira, Figueira Brava, Ibn Ammar (all in Portugal), and Gorham’s and Vanguard caves in Gibraltar. At these sites the presence of terrestrial and marine mammals, lagomorphs, mollusks, crabs, urchins, birds (including aquatic and seasonal species) and tortoises suggests a broad diet for Neanderthals and anatomically modern humans. The location of late Middle Palaeolithic open air sites on or near the present shore line, such as, among many others, Mira Nascente, Praia Rei Cortiço and Praia do Pedrogão, frequently in areas with a very steep bathymetry (and thus where the palaeoshore was certainly very close to the present coast line) also seems to suggest that the coastal environments were very important in the human adaptations from very early on.
But what is the importance and advantage of a diverse diet in a scenario of low demographic conditions? Recently, Hockett and Haws have suggested a Nutritional Ecology approach that can explain the importance of a broad spectrum diet in a set of low demography populations, including that of late Neanderthals in south-western Iberia (Hockett and Haws, 2003, 2005; Hockett, 2012). Diverse diets provide a large variety of essential macronutrients (fats, carbohydrates and proteins) and micronutrients (non-caloric vitamins and minerals) which enable a much healthier life leading to increased fertility and decreased infant and juvenile mortality. Essential nutrient intake influences maternal health before and after pregnancy, ensuring proper cell development and immune function of foetuses, neonates and infants. Exploiting different types of resources would provide a greater nutrient intake than simply taking greater number of species. For instance, terrestrial and marine mammals, shellfish, fish, birds, fruits or plants would represent a diverse diet due to the nutrient differences between each category. Exploiting a wide range of mammals (red deer, aurochs, ibex and roe deer), would be redundant in terms of nutrient intake. They also imply a higher risk of injury and failure than most coastal contexts and resources.

In contrast to most of western Eurasia, the more diverse suite of resources that were used by hominins in southern Iberia may have provided the mechanism by which late Neanderthal populations were able to sustain themselves while the new arriving anatomically modern human small populations were able to easily adapt even in times of both social and ecological stress (Bicho et al., 2013).

Based on the elements put forward above, it seems reasonable to argue that coastal environments were fundamental, at one time or another, for human evolution. If that was because of the dietary benefits for human health of a marine diet or because their use provided a favourable set-up for pro-social behaviour (or a mix of both) it is difficult to say, but it is clear that coastal adaptations are a hallmark of the development of human modernity and complex cognition.

The fact that coastal Pleistocene sites are so rare due to differing variables, mostly due to sea level rising, and that those sites such as, among others, Pinnacle Point in South Africa (Marean, 2011), Contrabandiers in Morocco (Dibble et al., 2012; Steele and Álvarez-Fernández, 2011) or Bajondillo in southern Spain (Cortés et al., 2011) have had, across the world, a high impact on the way we think about our human evolution and ancestry are fundamental to our history. Such sites and their history should be the object of a specific programme of World Heritage protection for their registration in the list of protected World Heritage monuments: they reflect a moment of our past that is essential for the rise and consolidation of our species around the world; because of their modern location near the shoreline these sites are in general in high risk of natural or anthropogenic destruction.

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Bibliography


Western Europe


Eastern Europe
Rock art from the Russian Far East: the Sikachi-Alyan Tentative World Heritage Site

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Introduction

The Russian Far East rock art sites are situated in the territory of the Khabarovsk administrative district. The most famous site with petroglyphs is Sikachi-Alyan, located about 60 km below Khabarovsk, on the right bank of the Amur River. Images are concentrated on the riverside basalt boulders, which are submerged in the water during floods.

The coordinates of the Sikachi-Alyan are a longitude of 135°39'00" and a latitude of 48° 45'00". The site is named after the local village inhabited by the Nanai people. In 2003 it was included in UNESCO’s Tentative List for potential inscription on the World Heritage List.

The petroglyphs are mainly deep grooves on basalt boulders; some are located on a rocky ledge of the bank’s terrace. Rock art motifs have been created here since the Stone Age; the anthropomorphic mask-images have a central place in rock art repertoire. Stylized imagery predominates in the area.

Local inhabitants had various contact with the cultures of adjacent as well as more remote territories and this is reflected in the complexities of the Amur petroglyphs.

In some cultural contexts, stones and rocks marked by special features became objects of worship. Particular places dominating in the natural and cultural landscapes may have their sacral essence additionally marked with rock art symbols. These places were most worshiped by the Siberian natives as habitats or areas of activity for ancestors or spirits. These animated surroundings have, for several generations and diverse peoples, borne an important cultural manifestation, with the relationship between people and the landscape expressed in rock carvings.

In the rock art region, researchers have been active for several generations and the main petroglyphs studies were anchored by Okladnikov (1968, 1971, 1981).

This important new information on local rock art appeared during rock art care projects. In the last decades, rock art projects in the area have been mainly focused on the documentation and protection of the petroglyphs, which are endangered by river activity, especially by ice drifting. Sikachi-Alyan is a ‘floating’ living system with the permanent moving of some boulders with petroglyphs. At Sikachi-Alyan it was instrumentally estimated that local boulders with rock art images may be moved by ice action at a distance of up to 55 m. Natural action may result in the appearance or disappearance of some images. Regular surveys at the riverbank have revealed new rock art surfaces, initially covered with river deposit.

Now the new concept of rock art management and public access is under consideration; it is focused on rock art protection and new cultural patterns in rock art display, recognition of its inherent value and increase in public awareness.

Figure 1. Sikachi-Alyan rock art site, Far East, Russia (Tentative List).
Photo: © Institute of Archaeology of the Russian Academy of Sciences.
Outstanding for its intrinsic character, cultural context and natural surroundings, the rock art site of the Russian Far East is the well-known Sikachi-Alyan (Figure 1). It is located on the right bank of the lower Amur River in the area of the ancient village (earlier the name of the village and site was Sakachi-Alyan) with indigenous Nanai inhabitants; in their language Sikachi-Alyan means ‘Boar’s Hill’ (Figure 2). This is an area of lowlands, protected by the Sikhote-Alin ridge from the glacial period and retained relic vegetation.

Petroglyphs are mainly concentrated along the waterside for a distance of 6 km, in the area of direct water activity of the Amur River, along the riverside on basalt boulders lying at the foot of a high terrace, on the sandy bank or, sometimes, even submerged under water (Figure 3).

Anthropomorphic mask-images of various shapes predominate in Sikachi-Alyan rock art. Many of them are elaborate, stylized and ornamented. The forms of the mask-images, their details and sizes are diverse: oval, egg-oval, heart-shaped, trapezium-shaped and combinations of several of these forms, some with strikingly pronounced contours and some without (Figure 4). Among other motifs, animals (elk, horse, tiger and boar), anthropomorphs, birds, snakes, cup-marks and concentric circles should be mentioned.

Basing his research on related materials from local excavations, the famous Russian archaeologist, Alexei Okladnikov, has dated Sikachi-Alyan rock art to a number of chronological periods from the Stone Age to the Medieval epoch with their particular set of motifs and distinctive style. According to Okladnikov (1971), the petroglyphs of Sikachi-Alian of the Stone and the Early Iron Age are made with deep grooves pecked with a stone tool and the early Middle Ages engravings or carvings were made with an iron implement. Epipalaeolithic strata (from the tenth millennium BC) includes primitive techniques and stylized images of horses, elks, forest birds and quite simple masks with eyes, mouths and nose including those with a skull.
Eastern Europe

like outline (Figure 5). Middle Neolithic strata of the fourth to third millennium BC embrace masks with elaborated details in geometric style (Figure 6). A similar trend to sophisticated stylistics was inherited in the Late Neolithic – Early Iron Age (second millennium – early first millennium BC). Decorative X-ray elaborated zoomorphs figures are attributed to the period (Figure 7). Terminal rock art carvings are dated from the fourth to the thirteenth century AD.

Okladnikov’s dating of the Sikachi-Alian petroglyphs is based on a comparison of styles and forms of images with archaeological finds of the Lower Amur area. The key basis for petroglyphs dating comes from the stylistic similarity of some local rock art mask-images with decoration of Neolithic ceramics (Figure 8) (Okladnikov, 1971, 1981; Shevkomud, 2004). According to Okladnikov, the peak of the Neolithic epoch of the Lower Amur (fourth to third millennium BC) rock art was characterized by masks with complicated geometric elaboration of their interior. This stylistic trend continued through the final Neolithic and the early Iron Age. This stage also includes images of elks in an X-ray style with a complicated elaboration of the body (Figure 7).

A series of ethnographical analogies to the petroglyphs of the lower Amur may be traced in the historical and modern traditional art of the Amur region (Okladnikov, 1981). Traditional ornaments on textile, birch-bark, fish-skin coats and other crafts repeat the basic rock-art themes of masks, figures of fish, birds and snakes in a stylized manner, as well as the treatment of spirals and other curvilinear widespread decoration (see Figure 2).

Historical background

Information about the rock art of Sikachi-Alyan first appeared at the end of the nineteenth century, in the diary notes of a Russian orientalist, Palladi Kafarov, who observed petroglyphs while travelling down the Amur River. Information treating rock art was further published in a local newspaper in 1895 by Vetititsyn and in 1899 by the American orientalist, Bertold Laufer (1899), who was a participant in an ethnological expedition to Amur, organized by the American Museum of Natural History. Petroglyphs of Sikachi-Alyan were also observed by Arsennov (1947) during an expedition to the mountains of Sikhote-Alin in 1908 and by many other researchers – Shternberg (1936); the ethnographer Lopatin and the Japanese historian Ruiu Torii studied the rock art at Sikachi-Alyan in the early twentieth century. The archaeologist Kharlamov described the location of petroglyphs and documented some of the rock art and collected archaeological artefacts here (Okladnikov, 1971, Laskin, 2009). In 1935 and then from the 1950s onwards, the petroglyphs were studied by an archaeological expedition of the Institute of Archaeology and Ethnography, the Siberian Branch of the Russian Academy of Sciences, headed by Aleksei Okladnikov (1968, 1971, 1981) and later on by Anatoliy Derevyanko (1980). This was the most important period of documentation and research at Sakachi-Alan. Rock art of Sikachi-Alyan and other sites in the area was analysed by Okladnikov in the monograph ‘Petroglyphs of the Lower Amur’ published in Leningrad in 1971, which was followed by English edition of ‘Ancient Art of the Amur Region’ (1981). Archaeological studies in the surroundings of the rock art site have been carried out by Galkovsky, Polumiskov, Ginsky, Medvedev and many others from the 1950s to the 1980s (Derevyanko and Medvedev, 1994, 1995, Laskin, 2009). A lot of new material on rock art, its interpretation and archaeological context were comprised by Brodianskiy (2011), Devlet M. (1997; Devlet E. and Devlet M., 2005), Masin (1994), Lapshina (2012), Medvedev (2001, 2011a), Okladnikova (1979), Shevkomud (2004) and other researchers (Figure 9).
In the last decades, rock art studies in the area have focused on documenting and extensively searching for new ways to preserve cultural heritage (Devlet E., 2008, 2010b, 2012; Laskin, 2008, 2009; Laskin et al., 2005; Medvedev, 2011b). A recent important endeavour is to produce a new concept of the site's development and management. In order to protect the site itself, in the last thirty years different organizations have proposed and discussed many options for creating different ethnocultural and scientific centres in this unique historical place (Gornova, 2000; Laskin and Dyminskiy, 2006).

In accordance with the Soviet decree from 4.12.1974. N° 624, the archaeological site received state significance and, on the grounds of the decree of the President of the Russian Federation from 20 February 1995, N° 176, the site is declared as an object of historical and cultural heritage of federal importance. Annually the site is visited by many Russians and foreign tourists. Rock art is the most favourable window into prehistory, the most attractive part of heritage for the public and may also be considered an important source for the maintenance and development of the local community and its indigenous population.

Though Russia embodies an enormous territory, variable and historical landscapes, it is not rich with UNESCO World Heritage sites. Besides Bahkir Ural (which includes the cave of Shulgan-Tash and the also well known Kapova Cave, with Palaeolithic paintings), among rock art sites Sikachi-Alyan is the only prehistoric site with open air petroglyphs in the Russian Federation included on the UNESCO Tentative List. It was submitted by the Permanent Delegation of the Russian Federation on 31 January 2003 for ‘cultural’ importance. Ancient rock art from Sikachi-Alyan is a unique scientific and cultural property not only for Russia but also for the whole world with its enigmatic and attractive aesthetics.

Rock art of the Russian Far East

In Russia there are a number of rock art areas with special stylistic features, and historical and natural backgrounds. Sikachi-Alyan belongs to the rock art tradition of the lower Amur and Ussuri River basin (Devlet E. and Devlet M., 2005), which has produced entirely original art, an independent centre of prehistoric creativity with longstanding diachronic concepts including rock art motifs and preferences in style.

Sikachi-Alyan, with several locations of petroglyphs, is not the only site in the region known for petroglyph studies in the Lower Amur rock art area. Besides two main clusters of Sikachi-Alyan petroglyphs at the Lower Amur and Sheremetevo on the Ussuri River with mask-images as predominant motif, there are also a number of smaller locations.

Sheremetevo near Sheremetevo village and the Chinese border is the second cluster with numerous petroglyphs in the area and includes a number of concentrations. Besides masks there are boats, cervids and figures of long-necked waterfowl. Among these are ducks, geese and swans often depicted with open beaks, with raised wings as though they are flying or floating and with extended necks. These are the only dynamic imagery. Snakes are usually depicted as helical, less often wavy. Masks of the area are similar with some from Sikachi-Alyan. Recent fieldwork has revealed interesting new manifestations – an exciting double mask (Figure 10) and a slightly treated figurative stone resembling the shape of a frog.

Figure 10. Rock art double mask from Sheremetevo on the Ussuri River. Photo: © Institute of Archaeology of the Russian Academy of Sciences.

Figure 11. Two horses (on the left) and a forest bird (on the right), Sikachi-Alyan. Photo: © Institute of Archaeology of the Russian Academy of Sciences.
Sikachi-Alyan Rock art: cultural context and landscapes

Sikachi-Alyan Rock art

The petroglyphs of Sikachi-Alyan constitute a unique heritage property with outstanding scientific, historical and artistic value. Rock art studies give the opportunity to trace the evolution of the art of ancient Amur inhabitants. This is also the most valuable source of the cognition of history and culture of the indigenous peoples of the region. Some zoomorphs and ornithomorphs are attributed to the archaic rock art tradition. There are static depictions of two figures of horses (elks-?) with massive bodies and on the boulder, and a forest bird is also carved in the same manner. Archaic petroglyphs are made using a rare relief technique with deep grooves that carved the images, making them stand out from the background, imitating bas-relief (Figure 11).

In general, the art of this area lacks the dynamics and expression that is characteristic for the best samples of the forest-zone (taiga) petroglyphs. A distinctive feature of the Amur-Ussuri region dominating rock art style is a tendency toward abstraction and ornamentation. A lot of decorative elaborated elements such as spirals, concentric circles and ornaments have been used as an essential indicator for some chronological periods.

Mask-images are abstract, conventionalized images of human faces, yet each possesses an individual, characteristic shape. One can argue that they were created to portray the spirit world. Outlines of the mask-images are diverse: they may have oval, round, heart-shaped, even trapezoidal or square shapes. A particular group comprises partial or incomplete masks having no external outline or internal filling. Ape-like or skull-shaped examples can be seen. The eyes designated on the mask-images are sometimes elongated, almond-shaped or round.

There are some variants with a row of teeth depicted. The top of the external contour of the masks is sometimes framed with radiating lines, as if the shape of beams were to constitute a kind of crown and it is possible that this is an attempt to portray hair or a halo. The head may also, on occasion, be horned. Mask-images are combined with cup-marks and circles, including concentric ones. The cup-marks are sometimes arranged in a particular combination of three. In this case, they may be partial masks with the two pits in the upper part designating the eyes and the one below indicating the mouth.

The internal details of the mask-images have different variants. Almost all of them have eyes, a nose and mouth, and many of them are filled with complex ornamentation, consisting of angles, triangles, arches or combinations of these. Some images have a halo of separate rays around them, which can be of different length and located not only on the top, but all around its contour. The larger masks can be up to 50-60 cm in length, while the smaller masks are about 10-15 cm long.

There are also relief images made by conjunction of two or three surfaces of natural boulders. This is a very special feature of local petroglyphs style (Figure 12), resembling those of Palaeolithic sculptured frieze at Roc de Sers.

Anthropomorphic figures drawn in a conventionalized manner are extremely rare and untypical for the art of the ancient Amur-Ussuri dwellers. Nevertheless, some of the most interesting examples are related to images in X-ray style.

There are also schematic boats with the crew shown in strokes and images of forest and water birds.

Zoomorphic figures are usually depicted in static postures, some are filled in with the same decorative elements as the masks and belong to the X-ray style. Two images of elk are noteworthy (see Figure 7, Figure 13). Their contour is realistically drawn with due attention to the true proportions of the body, but internal filling consists of decorative elements – spirals and curls.

An important composition of oddity is on the plane surface of a boulder, on the edges and side conjunctions. The animal is done in an X-ray style, with internal elaboration in the form of ornamental curl-spirals and concentric circles. A small stylized personage is shooting an elk with a bow. At the conjunction of surfaces there are X-ray anthropomorphs and a simple mask. This boulder is still considered to be the main place for performing rituals (see Figure 13).
Diversity in style and motifs, unique cultural manifestations and stylistics of images, long-lasting diachronic rock art tradition, particularity of natural environment and affirmation of the important place in traditional culture of the indigenous people make Sikachi-Alyan rock carvings exceptional.

Sacral landscapes and rock art interpretation

Inhabited by spirits

Some of the well known rock art locations present a combination and superposing of petroglyphs of different chronology and preferences of the same surfaces, cliffs and outcrops while nearby styles lack any rock art. The reasonable explanation supported by archaeological and ethnological data nevertheless is still the same. These places of certain landscape position and importance retained their value over several generations even of different cultures, unique features of surroundings and, natural environment triggering creative response as rock carvings. The particular landscape's developed importance was marked by ongoing rock art activity that transformed natural landscape into a cultural landscape.

For traditional cultures, mountains had spiritual and spatial coordinates: these were places of importance and even special semiotic status and were connected with landscape deities and spirits-masters, patrons of certain districts and later even with cults of saints.

Cliffs of special forms or rocks with caves, shelters, cracks, double tops, spiral-shaped and ledged configuration of cliffs, as well as narrow passes, crossings and passages became a focus for local inhabitants and required all types of comprehension: pragmatic, mythical, poetical or so on. They form a system of sacral space, mythological landscape and with its main coordinates they mark turning points in the universe.

A possible reason for worshipping certain elements of a landscape is that people are always impressed by stone's hardness, durability and reliability as an antithesis of change, death and disintegration. Ethnographic data from northern Asia confirms that cliffs could have been worshiped as embodiments of real ancestors, as symbolic substitutes of mythical forefathers or protectors of the tribal communes, as receptacles of the deities and various spirits, including spirits of ancestors and souls of living people. The transformation of a person into a stone is known in different cultural groups' folklore.

For some of the northern Eurasian indigenous people, stones and rocks with special landscape position became sacral places for rituals related to the success of hunting. In these landscapes, a stone or a cliff or a spirit believed to be contained in it were considered as a patron of hunting. To be supported by the patron, people had to share their game with stones. Stones or rock outcrops were interpreted as the children of Mother Earth and being connected to her body people perceived stones as live beings who were interested in receiving food as blood and meat. In this way, people and fetishes had the same interests.

Sometimes people worshiped a stone as if it were a container of an ancestor's spirit who would help them in their everyday lives. Stones embodied real ancestors and symbolically replaced mythical ancestors or patrons of clan associations, including both the spirits of ancestors and the souls of living people.
Besides the rock art at Sikachy-Alyan there are a number of figurative stones resembling diverse animals and anthropomorphs (a female elder, nine maidens, guards and so on), all of which are an important cultural manifestation in the landscapes.

**X-ray anthropomorphic and zoomorphic figures**

Enigmatic anthropomorphic figures in X-ray style with chests represented as though they were translucent, with signed ribs and vertebral columns (see Figure 13) are known in Sikachi-Alyan rock art. An important material for the interpretation of X-ray anthropomorphic images may be found in Siberian ethnographic records (Ivanov, 1954) on the shamanic view on the first ‘out-of-body’ experience and obtaining the gift of shamanizing.

A shaman had to pass an initiation in order to be able to receive visions from the spirits, have spirits-helpers and be recognised as a shaman in his community. Being the mediator between the world of the living and the world of the dead, a shaman had to be marked by supernatural powers and be experienced in mystic death and rebirth (Devlet, E. and Devlet, M. 2002b). Having ‘special bones’ was often considered a sign of his great vocation, as the most resistant parts of his body and material embodiment of his high mission. In different parts of the world this idea resulted in the similar anthropomorphic images in X-ray style (Devlet, E., 2000, 2001, 2002; Devlet, E. and Devlet, M., 2011).

The shamanic view on the initial trance state was connected to the dismemberment of the shaman's body by the spirits with a mystical experience of loss of flesh and contemplation of his own skeleton. This ‘out-of-body’ journey is shown in X-ray style anthropomorphic figures.

The most detailed description of body dismemberment as a part of shaman's initiation survived among the Yakuts (Direnkova, 1930; Ksenofontov, 1930; Popov, 1947; Alexeev, 1975). Reaching a state of ecstasy, neophytes suffered the torment of their head being cut, their body been torn at with iron hooks, the separation of joints, cutting flesh from the bones and so on. Experienced powerful shamans went through the process of being dismembered three times, whilst the weak only had to endure it once. This is supported by information about different stages of a shaman's initiation. Each stage was marked by attributes symbolizing status and can sometimes be traced in rock art anthropomorphic figures.

By dismembering and closely examining the shaman's body during an ordeal, the spirits aimed to establish whether all his bones responded to his high vocation. ‘Shaman bone’ is a material embodiment of a candidate's spiritual abilities. If it turned out that a shaman did not have a ‘special bone’, the shaman had to pay for this with the life of one of his relatives. A shaman's skeleton could be marked by a broken bone. Superfluous bone spirits could also take a candidate's muscular fibres into consideration. Loss of bone could also occur to a candidate shaman before the initial time of summoning the shamanizing. Some traditions saw the presence of odd bones in the shaman's skeleton as an obstacle in his election, whilst in others it was the contrary: the presence of a special shaman bone was required.

According to Siberian ethnological materials, the body of a candidate shaman was dismembered, the flesh cleaned off the bones and then divided between the spirits or scattered on all the roads. Then, the fleshless skeleton was reconsidered in the search of a shaman bone and the bones were counted. Finally, the old skeleton received new flesh. If the candidate's skeleton confirmed his high vocation, he became a shaman after his mystical death. The shaman himself sees the entire process of dismemberment and the reassembling of his body. He lies as if he is dead and through his eyes, sees the whole procedure of dismemberment of his body. The mystical death touched the shaman's body, but not his soul. The shaman lives, sees and feels the whole ordeal, at the same time that the spirits train his soul. The shaman then awakens as though he has been sleeping.

The dismemberment of a shaman's body may be interpreted not only as a terrible torment to be only overcome by the worthy, as the death of one status and rebirth into a new role, but also as a victim of the spirits. The experience of dismemberment brought a shaman into contact with the world below ritual death and initial chaos. It was an essential step that had to be passed in order to rid oneself of a mundane and profane essence, and to be reborn not only into a new role but a new life. Getting through the ordeal gave the shaman a new level to his abilities, allowing him to integrate the till recent chaotic experience of crises.

The initial trance experience is a transitive moment in a shaman’s life. A person who was previously completely normal receives special powers and abilities and becomes different to all other members of his community. These changes would cover a person’s physical essence as well as his mental nature. This idea stems from the common belief that after such an ordeal, a shaman was mentally rejuvenated, physically reborn and his soul trained by the spirits.
Rock art anthropomorphic figures in X-ray style represent the concept of the intermediate condition between death and revival, which later persisted in shamans' costume. The same idea survives in the details of a shaman's accessories, in the bone pendants attached to his shoulders, in decoration of skeleton-motifs for the breast or back textile attachments.

Zoomorphic motifs in X-ray style with elaborate bodies may come from anthropomorphic. Meanwhile the implication of elaborate style for zoomorphs in rock art may be another. Images with decoration of the body with spirals and vertical curls are quite numerous in Asian rock art. The interpretation may be seen in the tradition of cutting or painting solar symbols on the bodies of a victim. Spirals, circles, curls on the bodies of solar animal show divine status, indicating that the animal belonged to the Upper World (Devlet, E. and Devlet, M., 2005).

The myth of the living skull

Among the Amur petroglyphs a theme appears which is unique in rock art: that of a horse with a human skull attached to its body (Figure 14) and in local rock art tradition there are a number of images resembling skulls (see Figure 5). According to the Nanai myth, there lived a human head without a body, which always lay on a bed of planks. Once a steed came running up to it and neighed. The head began to rock and slid onto the horse's back, whereupon the steed neighed and rushed away, bearing the head downstream the Amur River. Having undergone various misadventures, the head finally turned into a hero (Devlet, E. and Devlet M., 2005).

The myth of a skull living independently of its body exists among peoples of the north. In the lower Lena region there is a story about the skull of a well known shaman, which continued to lead an active life after the latter's death and burial. A Chukchi story tells of a girl who found a skull in the tundra and brought it home. Afterwards she used to take it from the bag and they would smile at one another. This caused her relatives to flee the settlement in horror. The girl then began to cry and the skull left her to search for its body, returning soon afterwards as a handsome young man.

Finally, it should be mentioned that deciphering rock art's inherent meaning and symbolism is a complicated challenge; nevertheless, one may be optimistic with comprehensive ethnographic records. Ceremonial activity near rock art boulders probably involve acts of a shaman's penetration into the spheres of the universe. The pecking of images might be an important testimony bearing this information to contemporary society. Art helped overcome the incomprehensibility and randomness of nature, as well as mastering and understanding the natural world. Art orders and regulates incomprehensible phenomenon.

Rock art decay, conservation and management

In the Asian regions of Russia, rock art sites some years ago seemed to be an inexhaustible part of cultural heritage. However, a substantial portion of this corpus continues to be impacted by natural and anthropogenic factors of deterioration. Apart from the numerous natural processes involved in the decay of rock art, the most disastrous damage has been caused by economic
modernization, mainly by the development of hydropower station constructions on major rivers (Devlet E. and Devlet M., 2002a; Devlet M. and Devlet E., 2004). Excellent sites such as Oglakhti and Mugur-Sargol on the Yenisei River, painted and engraved sites along the Angara River, a tributary of the Yenisei, and many others have been partially or completely submerged. In such cases recording rock art images has, for years, been the main way to retain information for scientific studies. Another way to preserve rock art which is under threat of submergence is to remove the boulders with the engravings to museums. Such removals are the only way to preserve such cultural heritage for future generations, but there are very few examples of successful removals. Nevertheless, the museum display of such fragments outside their original environmental is disputable.

In the last few years, natural decay and direct anthropogenic influence has been responsible for changing environmental conditions and has been a major factor in the deterioration of rock art in Russia. I want to avoid negative comments and accounts on rock art conservation projects of the last century. All of these projects seem insufficient and irrelevant now but they were product of the time, being an attempt to suggest some activity instead of unmanageable decay and collapse (Devlet, E., 1999; Miklashevich, 2003).

The first attempt at the conservation of rock art was the creation of an open air museum in the Kemerovo region of Siberia on ‘Tomskaia pisantza’ in 1988. Having been recognized for 290 years, this site holds the ‘Tomskaia pisantza’ petroglyphs. These are situated on the banks of the Tom River and are engraved on schist type rock that is badly weathered and even vandalized. There has been a number of attempts to put a stop to the deterioration of the surfaces (by crack filling, impregnation of the surface, artificial varnishing and so forth). (Ageeva and Kochanovich, 2011; Miklashevich, 2011). The park includes the museum building, the rock art archive, reconstructions of ancient cemeteries, dwellings and ethnographic recreations (Martynov and Martynova, 1993). An important objective for the open air museum is the dissemination of knowledge.

Another long-term preservation project is addressed at the petroglyphs in the European north of Russia with famous sites in the vicinity of the White Sea. Being endangered by the construction of a dam in the 1970s, a covering for the rock art site of ‘Besovi sledki’ was built in the vicinity of Belomorsk. The dam created a threat to the preservation of this site and the measures taken were the only way that the site could be protected. Later, during construction, the plan was rejected and received strong criticism. Now the area has positive activities related to the Zalavruga rock art site, including preservation, sustainable management, promotion of public awareness and dissemination of knowledge efforts (Helskog et al., 2008).

Rock art care is a focus of activity for the Centre for the Preservation of Historical-Cultural Heritage in Irkutsh. Work at the Shishkino rock art site on the Upper Lena River started in 1987 and in 1992, work began on the Baykal Lake sites. The participation of researchers from various scientific disciplines and institutions opened a new stage of rock art protection projects in Russia (Bednarik and Devlet, 1992). The integration of international experience in the field of rock art preservation slowly and step-by-step led to the recognition of it being a multidisciplinary problem, covering questions of protection, legislation, public awareness, strategies of preservation and management, direct and indirect conservation measures, pressure of development and tourism, air pollution and environmental changes.

The last thirty years have seen a number of consequent rock care projects at Sikachi-Alyan, collecting much valuable information on local rock art. Considerable effort has been made in documenting rock art and understanding natural and anthropogenic influences and decay.

The interdisciplinary approach gave an opportunity to evaluate the state of the affairs, the, preservation of petroglyphs and methods and priorities in its conservation. The significant activity for rock art protection involved updating the site’s documentation, which resulted in discovery of ten new boulders with predominant mask-images of different forms and technique (see Figure 12), and also an image of an elk, which appears to be swimming.

Among important central narratives concerning human evolution, the rock art of the Amur-Ussury region may provide the opportunity to understand the changing of technology in the production of images on natural stone surfaces and to estimate the tools and material they have been made from (stone, iron and so forth). At Sikachi-Alyan the original methodology of the surface analyses was continued by the scientific team who initially worked out this technology for Pegtymel Arctic rock art and other sites with petroglyphs (Devlet E., 2010a).

The evaluation of the preservation has demonstrated that among the natural active factors of destruction were those of seasonal ice drift, seasonal fluctuations of the river’s water level, temperature changes and freezing, wind erosion and vegetation. The river moves masses of sand and silt deposits, which in turn, dislodge the stones located in the flood zone. The images on the stones, which were temporarily covered by water, are barely visible after its retreat because of the silt, which under the influence of the wind, sand and sun turns into a hard crust. The soil alluvium assists the active growth of plants and their roots increase the cracks in the stone. The dark surfaces of the stones help to increase the temperature change between
the shady and sunlit sides of the boulders by up to 30 °C in the period of high solar activity (from April to August), which creates a 24-hour cyclical tension in the stone and promotes the appearance of the cracks (Laskin, 2009).

The peculiarity of the Sikachi-Alian rock art site is the continual displacement of the boulders by the Amur River, with maximum movement during the process of the spring ice drift. Because of the great depths and speed of the current, ice plates up to one and a half metres thick come up against the basalt blocks and rocky ledges of the cape. At the same time, many stones easily overturn and get chipped from bumping against each other, shifting higher up or along the line of the drifting ice. As a result of this irreversible, recurring natural phenomenon, new images are found, while some that were documented earlier have now disappeared.

Field investigations from 2000 to 2003 were focused on the development of rock art protection projects and allowed a comparison of the current situation with drawings, made by Okladnikov, from the 1950s. Over a period of 50 years, more than 25 stones with petroglyphs were overturned or shifted from 0.2 to 55 m distance. New rock art was discovered, while some of the already documented boulders with images were missing (Laskin, 2009). In 2000 it became obvious that, at one of the locations during the last 50 years, about 10 boulders with petroglyphs had shifted from 2 to 10 m due to drifting ice. They were either moved or overturned, and several new carvings were discovered (Gornova, 2000). In June 2003, the level of the Amur River was very low (-75 cm), which made it possible to clarify the location of the petroglyphs. It turned out that large-sized stones were mostly untouched, but smaller ones, located in places of shallow water level, had been shifted from 3 to 20 m and even up to 55 m; many of them are now in an inverted or modified position (Laskin and Dyminskii, 2006; Laskin, 2009). Some boulders now are in a modified position, which prevents access to the cultural heritage.

The fact that boulders with images documented by Okladnikov could not be found, however, doesn’t testify to their loss; they may have simply been overturned. During his recording programme, Okladnikov had schematically drawn two surfaces with mask-images, based on information from local people but failed to reveal them because they were hidden with deposits or overturned. It gives ground to consider intentional relocation of some objects in danger from the frontline of the water and ice activity to a wreck-resistant distance on the same concentration. Among other urgent demands is finalizing the nice looking, reliable fencing of the area from the art and hidden in the bushes. Another pressing need is permanent access control, direct and preferably indirect prevention of visitors’ contact with decorated surfaces.

The rock art site has also been impacted by the following types of negative anthropogenic influence and destruction: modern carvings, fire making and trashing of the territory – the result not only of unregulated tourism, but also of the activities of the area’s local inhabitants. Fishermen tie the metal parts of their fishing nets to the boulders, fasten their boats, leaving deep marks on the stone. The peculiarity of Sikachi-Alian is that it is located in the village territory of the Nanai native people of the region and this site presents fairly unusual problems for Russia in terms of traditional ownership. Motifs similar to Sikachi-Alian petroglyphs to this day exist in the traditional rituals and ornamental art of Nanaicy, Ulchi, Nivkhi and Udegei (Smolyak, 1976) (Figure 15, 16; see Figure 2). Local people use the boulders for their everyday needs, putting their food and drink directly on the stones. The activity on or nearby some boulders visibly changes their surface. That is why the local inhabitants may be against the fencing of the area of cultural heritage. For local people easy access to the convenient places on the riverbank, short-term economic and everyday practical reasons may seem more important than the preservation of the site. This is the main reason for affirmative action in involving the local community into the practical management of the site. Perspective
of the guaranteed occupation and financial support forms positive attitudes and interest in the preservation of heritage.

But, contrary to what many people have assumed positive, rock art protection endeavours should follow new directions and new forms. In the last three decades a lot of things have changed in the area, among others the positive event of the construction of the cultural centre with the local museum (linked to the State Museum named after N. Grodekov in Khabarovsky) should be mentioned. The modern cultural centre in the village of Sikachi-Alyan (Figure 17) and the maintenance of a new local museum creates favourable conditions for visitors and might be a positive factor for local people to become involved in rock art care for the promotion of public awareness and the recognition of rock art as unique cultural heritage.

A non-commercial fund ‘The Historic Heritage of the Amur Region’ has focused on the dissemination of knowledge on rock art heritage, making informational signs and casts and exhibition copies of petroglyphs (by 2004, more than 20 silicone matrices of images had been made). Now they are part of an exhibition of the museum in Sikachi-Alyan and as a travelling exhibition to other cities. Made by modern technology, casts may be a source of information on local rock art and culture of the Russian Far East for distant access. Collaboration of the department responsible for cultural heritage protection and management with the fund resulted in the construction of interpretive points and stelae marking the borders of the site (Figure 18).

Russian specialists in rock art protection and studies are highly interested in the dissemination of knowledge and informational exchanges on the experience from projects that have already had fruitful results and high international respect (Hygen, 2011; Smith, Helskog and Morris, (eds.) 2012; Whitley (ed.), 2001). Promotion of these informational exchanges under auspices of UNESCO seems preferable. The local community of rock art managers and amateurs need much promotion of methodological support from international centres that are already experienced in rock art conservation and also the organization of visitor control in rock art open air sites to follow approved low-cost strategy, appropriate in scientific aspect.

Regarding the current stage of the protection of the site, the local authorities and scientific community's discussions resulted in understanding the priority of conservation management that should be implemented in new rock art protection and public awareness starting in 2013. There are a number of good arguments in favour of a new concept for rock art management and visiting patterns – despite the current consensus that rock art is a valuable part of heritage and a property of great interest. A recently discussed concept of Sikachi-Alyan rock art site visiting arrangements and design, sustainable management and maintenance follow Scandinavian patterns and demands of public awareness. The principle priority in the implementation of protection should be the keystones of this project in order for it to run smoothly. All the measures aim to protect the site and to guarantee its integrity and authenticity, to provide a comfortable, welcoming situation for visitors and to involve local inhabitants into the process of rock art care and related cultural activity and tourism. Ongoing studies of the sites produce new information that may gain ground to update cultural context.

Conclusion

Rock art motifs on the basal boulder reflect the complicated system of beliefs of ongoing ritual practice. Sikachi-Alyan and other similar rock art sanctuaries could be ritual centres for people from very distant lands who, generation to generation, came to the site on special occasions. Advanced studies should now bring together an important documentation base that may result in a historical reattribution of the site. Numerous facts on rock art techniques and understanding of prehistoric consciousness have resulted from preservation programmes on the rock art site.

Monitoring and ongoing research has contributed to the discovery of new images. The dissemination of knowledge through the publication of the results of the current project is essential for adequate information distribution. This can allow us to improve keeping and using the property as the scientific and culture educational objects for all humankind.
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Natural and Cultural Complex the Bashkir Urals

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Introduction

The natural and cultural complex of Bashkir Urals is located on the western foothill belt of the Southern Urals within the limits of the mountain – forest zone of Bashkortostan. Bashkir Urals occupies a territory of approximately 45 thousand hectares (450 sq. km) (Figure 1).

The majority of the Bashkir Urals complex is slightly affected by human-induced changes (the standard residential population density makes up 2.3 persons per square km) and consists of a specifically protected state natural park (wilderness area), Shulgan-Tash, and a part of the state entomological wildlife reserve, Altyn Solok. For more particulars on the latter topic, see below.

The eastern part of the Bashkir Urals complex is located at the junction of two massive wood biomes of European-type broadleaved forests and light-coniferous and Siberia-type parvifoliate hemiboreal forests with a grass layer. About 90% of the complex’s territory is covered with woods.

The land area of Bashkir Ural comprises a high diversity of wild landscapes: mountain river gorges, plateau-like summated plateaus, steep-sloped ranges, bottom-lands and water storage basins. Low anthropogenic influence, variety of land forms within the complex’s territory and the convergence of European and Siberian floristic and faunal assemblages have created conditions for the particularly high biodiversity of the complex. All of the above mentioned points have made the given area attractive for human inhabitation since the Middle Pleistocene and this defined the natural management of culture and traditions.

The most important object of the natural and cultural complex Bashkir Urals is the Shulgan-Tash Cave (Kapova).

Shulgan-Tash (Kapova) Cave

The Shulgan-Tash Cave in the Burzian district is one of the largest caves in Bashkortostan (Figure 2). The total length of explored passages together with the lower tier, filled with water, is about 3 km (Lyakhnitsky, 2006, p. 338). The most important part of the cave is the deepest lake-spring under a huge entrance arch, a place with brook Shulgan surfacing from it. Shulgan is the name of the cave, mountain, underground river and the lake at its entrance. It got the name of Shulgan Khan, the owner of the underworld and of the bottomless lake, from Bashkir epics. The Kapova Cave was named by the Russian population in the nineteenth century. Its rock painting was discovered in 1959 by the biologist, A. Ryumin (1961).

Archaeological research

Archaeological research at the site began in 1960 under the leadership of Professor O. Bader and continued intermittently until 1978. His expedition discovered, cleared and recorded five dozen images on the middle and upper floors (Bader, 1965; 1981; 1986). He dated images from stylistic analogies with the monuments of West Europe at the end of Solutrean, the beginning of Madeleine (Bader, 1965). The archaeologist, V. Shchelinsky, could more accurately determine the age of drawings.
V. Shchelinsky discovered the Palaeolithic cultural layer at 170 m from the entrance, near the ancient drawings of the hall of Signs (Figure 8). He studied the remains of the Palaeolithic site by excavating an area of 68 m². He discovered numerous pieces of ochre in a layer of saturated carbons and artefacts produced of stone and bone (Figure 3). The thickness of the layer was from 1 to 5 cm. This area also yielded a lump of limestone with a fragment of a realistic picture of an animal (perhaps a mammoth?). In the cultural layer several uncalibrated radiocarbon dates from fragments of charcoal were obtained: 14,680 ± 150 (LE 3443), 13,930 ± 300 (GIN 4853), 15,050 ± 100 (KN 5022), 16,010 ± 100 (KN 5023) (Ščelinski and Širokov, 1999).

Excavation 1 in the hall of Signs yielded 193 stone artefacts. Of these, 120 examples are flakes of limestone and calcite without treatment and evidence of use. The other articles are made on the blades of flint and jasper (Shchelinsky, 1989). In this layer there were personal adornments: three pendants made of thin platelets of bones, a pendant of slate pebbles and four beads from serpentinite (Figure 4). Among the decorations are numerous small mollusk shells, some with a perforated hole, components of a necklace. They were brought from the Orenburg or the Caspian region (Shchelinsky, 1997).

According to V. Shchelinsky, individual bones of large animals, lack of working platforms and traces of the production of tools, a large number of worn-out and broken implements, absence of residuals of manufactured materials, as well as a unique composition of jewellery shows that people did not live in a cave that served as their sanctuary, and only occasionally went to it for rites and offerings for a short period of time (Shchelinsky, 1997, 1989).

The material presented in Shulgan-Tash Cave was yielded in the 2008 to 2011 expeditions by the author during research of the first ledge of the Cascade Gallery. Researchers discovered a multi-layer Upper Palaeolithic site, which has two uncalibrated dates from the coal: 13 900 ± 190 (Ki – 15568) and 16710 ± 800 (Ki – 15967). From excavations of the aforementioned site we obtained a collection consisting of 1,705 items. Most of them are flakes and cut-away pieces of limestone and calcite. A collection of tools made of limestone and calcite (91 examples) consists of burins (Figures 5, 19, 22), scaled pieces (Figures 5, 14, 25), point-borers (Figures 5, 20, 24) and scrapers (Figures 5, 21). Here we also found three blades of jasper (Figures 5, 8). Two items are small cores, one of quartzite (Figures 5, 23), the other is a conical shaped core for microblades made of silicified shale (Figures 5, 13). Small flakes of limestone and calcite indicate that on the ledge of the Cascade Gallery there was a living area, which was used for manufacturing tools and for knapping calcite and limestone.

During archaeological excavations from 2009 to 2010 it was discovered that in the hall of the Dome there remained an area of a multilayer site containing a minimum of five cultural layers. The first cultural layer lies in the humous layer with charcoal and is associated with the use of the cave in the Early Iron age as burial place for of young people, specifically girls. (According
to anthropologists, in this hall the remains of four human individuals from twelve to eighteen years of age were found, two skulls belonged to females aged sixteen to eighteen). The lower four cultural layers are attached to the top part of the light-brown loam separated from the Holocene (post-glacial) deposits by a calcite crust.

All in all, in the 2 m² excavation we have found 3,159 items, including 2,800 stone and bone artefacts and 359 bones. A certain number of finds are cut-away pieces of thick calcite crusts or stalagmites and cut-away pieces of limestone – 3 to 11% of the assemblage. Flakes of calcite and limestone make up the remaining 87 to 90% of the assemblage. Flakes are mostly amorphous while striking platforms are smooth or natural. Individual examples are blades triangular in the cross-section (Figures 5, 15, 26). Very seldom one meets the regular cores (Figures 5, 16, 27). Among the wares of bone there is one pendant made of a drilled deer tooth (Figures 6, 5, 2) and three fragments of bone needles (Figures 5, 3, 4; 7). Six items were made of regular blades: a semiprime blade with retouching of dark-grey jasper (Figures 5, 10), an instrument with a spike on the blade of black flint (Figures 5, 9), the medial fragment of a backed blade (Figures 5, 1), a blade with retouch and a rounded base of grey jasper (Figures 5, 6) and the proximal fragment of a blade with a retouch on the right edge of a jasper item (Figures 5, 5), semiprime blade of black flint (Figures 5, 7). There are a nucleus of limestone with a bevelled striking platform (Figures 5, 16) and a double end scraper on a massive blade of limestone (Figures 5, 26). A core of limestone has a remounted part of a scraping tool on its base (Figures 5, 27). A large flake of limestone is mounted on the distal part of the burin spall (Figures 5, 30). At the excavation site, at a depth of 0.35 m into the Palaeolithic layer, we cleared a large oval plate (80 x 60 cm) which has an ochre stain of an irregular size 10 x 15 cm on the upper surface. Under the plate we found the jaw of a bison. Four limestone flakes were painted in ochre, with one object being produced by the chipping of its coloured part. Finds of clusters of ochre in the Palaeolithic layers provide evidence that the cultural horizons were associated with drawing pictures on the walls. Furthermore, a fragment of limestone with colourful images made with red ochre was discovered. Thus, the application of drawings would be produced repeatedly and some painted surfaces of the cave walls or slabs of limestone were cut away.

All this suggests that the chipping of limestone and calcite sinters was produced not for utilitarian purposes, but in most cases this was of symbolic nature and had been associated with ceremonies performed in the context of the painting of walls, as well as during painting pieces of calcite and limestone by ochre. Two excavations revealed traces of repeated visits to the cave in the form of several horizons of large deposits of coal and chipped pieces of limestone and calcite near the drawings.

In general, all stone tools excavated from one of the halls and the Dome hall (excavation 2) on the balcony of the Cascade Gallery have a common tradition, as evidenced by the presence of similar types of technologies and tools. This tradition is characterized by the following features: the difference in the size of tools; big tools coexist with small wares; the amorphous nature of semi-finished articles and tools, the basic material for tools is limestone, to a lesser extent calcite, very rarely – jasper and flint, no normal cores, semi-finished articles were obtained by simply chipping pieces of limestone and calcite from unprepared striking platforms, usually along the edges, often in different directions; blades of limestone and calcite are extremely rare; a large number of small tools.

The following types of wares have been singled out: a variety of burins, burinated becs, points, tools with a spike, shortened scrapers, atypical carinate scrapers, scrapers with a spike, microscrapers, micropoints, borers, backed blades, truncated blades.
side-scrapers, chopping tools, tools to split pebbles, needles, patches of bone and shell. This collection is well complemented with the material from the excavation by V. Shchelinsky and our findings in the hall of Chaos. All of these features fit into our understanding of the Ural monuments of the Upper Palaeolithic (Pavlov, 1996; Shchelinsky, 1989; 1996; Nekhoroshev and Girya, 2004).

It should be noted that the coarse nature of knapping the stone is complemented by the archaic nature of preparations and techniques for making tools. Along with single instruments on fragments of blades, massive flakes and fragments of limestone and calcite were widely used. Massive semi-finished articles would often be treated on both sides, widely using the technique of flattening the surface. Most formative retouching had features similar to the treatment of cores – a large vertical retouch. Among the tools archaic and large forms are present such as side-scrapers, chopping tools on large flakes, choppers, points. Along with this, in the collections of tools at each horizon there are representative series of small hand tools: points, scrapers and microblades. These products are in stark contrast to the blades made of jasper and flint, which are clearly mixtures of tool types and raw materials. Near Shulgan-Tash Cave the author investigated the multilayered Palaeolithic cave of Balatukay. Here limestone products such as prismatic cores, plates and tools were discovered. They are no different from the flint and jasper products of the Palaeolithic sites of the Southern Urals. So a technology of limestone industry depended on Upper Palaeolithic people’s level of skill. Certain primitive industry in Shulgan-Tash Cave was associated with clumsy men, not with the characteristics of raw materials. Moreover, the inhabitants of the cave could have chosen a more suitable material for making tools, such as quartzite and jasper pebbles from the bed of the non-freezing River Shulgan and from the Belaya River in its mouth. Thus, it can be concluded that these tools were made by boys, who were in the cave long enough in a ritual of isolation from the outside world.

Description of rock paintings

Altogether, about 200 images made in ochre and black pigment have been recorded (Lyakhnitsky and Solodeynikov, 2004). The figures are distributed at a distance of 200 to 300 m from the entrance on the middle and upper levels of the cave. On the middle floor the images are recorded in the Dome hall, the Marks hall and the hall of Chaos. On the top floor there is only one area decorated – that is the Hall of drawings (Figure 8).

Most of the drawings present geometric signs, basically quadrangles and trapezia, in which the top line goes slightly beyond the figures and is bent down. Trapezoid signs themselves are different and have different numbers of vertical or diagonal lines from one to seven (Figure 9). On the top tier most pictures are of animals and there is only one character in the form of a trapeze with ‘ears’, similar to the marks of the middle floor.

Most of the drawings were made in a similar manner: they are outlines, about 3 to 4 cm thick, are the same size and are plotted in a similar red pigment colour at the same height from the floor; of a similar style – drawings in profile with four legs. There are pictures with light toning inside the outline filling the head, mane, tail (mammoths, horses and a bison); there is a silhouette image (a mammoth) and one drawing (a rhino) with a cross-lined trunk. There is no fur on the mammoth image. All of the horses have small, narrow snouts, with rich manes, forelock hanging, with vertical stripes on the chest and rump, a pendulous abdomen, slightly concave back and elevated croup, with designation of an angular protuberance. Thus the analysis of the colour images, their style and content shows that the drawings of both tiers are generally homogeneous.

Near the transition from the Dome hall to the hall of Signs, on the right wall among several amorphous ochre stains, an oblique lattice pattern made with red ochre – Group III (Ščelinskij and Širokov, 1999) (Figure 10) has been fixed on a flat surface. After the pictures were processed digitally it was found that the image fully covers the composite image of an animal, that of an anthropomorphic figure and some symbol of red colour. According to Yu. Lyahhnitsky and A. Solodeynikov, this is an...
example of some destruction of the images. He points to the existence of at least two stages of the ‘designing’ of the sacred space of the cave.

Noteworthy is the fact that the distribution of pictures clearly manifests two areas: on the middle floor there are mostly symbolic images whilst the upper floor has mostly a collection of realistic animal drawings. This implies that the interior of the cave had some sacred significance and should be considered as a whole. It is no accident that V. Schelinsky wrote that part of the images in Shulgan-Tash Cave combined in compositions that reflected certain mythological ideas, and individual seats and halls with pictures are parts of the sanctuary that performed specific sacred functions (Shchelinsky, 1996, 1997). In other words, the space of the cave sanctuary Shulgan-Tash should be a ‘sacred path’ (Kabo, 1988), which, with its natural areas, noted differences in rituals and their mythological content. This must inevitably occur at a lower level by its status – reflected on the nature and details of the individual images on the walls, especially the placement of clusters of drawings.

In our opinion, this process is mainly reflected in the change of trapezoidal images as one proceeds deeper into the halls of the middle floor and the complexity of their topography. For example, we meet in two easily accessible decorated halls, the hall Dome and Signs dome the most common signs in the form of spots, dashes, trapezoidal symbols with ‘ears’ with no lines, with one or two lines inside (Figures 9, 1, 2, 7-10).

In the hall of Signs, to the left of the entrance arch, at a height of 3 m above the boulder clusters on the west wall there are poorly preserved images, Group IV (Figure 11). With the help of digital image processing carried out by A. K. Solodeynikov, a picture of an animal, painted in profile and turned to the right became clearer, with steep arched withers, having two short feet, with a small head and having no tail. Its muzzle and withers are filled with ochre that lightly tinted the body of the animal. In its proportions the animal is closest to the bison (Bader, 1974). Below, a rectangular geometric symbol is visible. To the right and above it there are two small trapezoidal signs with ‘ears.’ The special significance of this group was emphasized by its placement at high altitude (more than 3 m above the floor), indicating the possible use of some scaffolding when applying the images and signifying some premeditation in their placement.
Just a few trapezoids, medium sized with ‘ears’ and with the one or more lines inside are scattered on the western and northern sections of the wall, see Group V and VI (Lyakhnitsky and Solodeynikov, 2004; Figure 6) (Figures 9, 2, 7-10). On the triangular ledge wall, about 1 m above the cultural layer, a triangle is fixed with another triangle inscribed, drawn in red ochre (Bader, 1965; Figures 14, 6).

The presence of compositions and the placement of images in remote places, at high altitudes and in niches and crevices clearly show their symbolic placement. We conclude that, in general, the collection of drawings had been done in the same tradition and they were subject to a single plan. Presence of compositions is a feature of the cave sanctuaries in the Urals.

The compositions of the hall of Chaos

An interesting composition is situated in the end room on the middle tier of the hall of Chaos; a huge pile of boulders with a giant funnel in the middle. The panels with images are pictures of two horses and a trapezoidal plate with ‘ears’ between them (Figure 12). To the left of the group, another smaller trapeze has been cleared. Muzzles of horses are like a duck’s head. The upper horse has a trapezoid with horizontal lines reminiscent of a wing (Figure 13). The lower horse has two vertical lines on the body made of a dark pigment, perhaps in charcoal. This composition could symbolize the trinity of the universe, where the upper (winged) horse denotes the upper, heavenly world and the lower, the world of the underground (picture of an animal in the ‘skeletal’ style). The intricate trapeze could mean anything from the world of humans or be its symbol. The analogy of the mythologeme is present in the mythology of the steppe peoples of Eurasia (the Turk and Indo-European peoples) – this solar deity in the form of a (celestial) horse or a chariot, which moves across the sky during the day and at night it continues under the ground (Ivanov, 1991).

To the left of the composition there is a partly revealed anthropomorphic figure shown in a half-bent position. It has dislocated knees, as is typical of demonic characters in the Bashkir mythology.

Another composition is 12 m east of the first and is drawn on the ridge-piece of a vault, set at a height of 3 m above a cluster of stones and a huge funnel. In order to paint it the artist had to build a ladder or a scaffold. This shows the crucial importance of this group. There was a picture of a horse and a large figure of a humanoid creature that is drawn in a half-bent position. The head is large, evidently with a ‘beak’. Two arms and two legs end in bird claws or paws (Figure 14). This composition should be taken as a mythological scene of human’s birth or rebirth from a horse of a person – a mythical hero. Here, as well as in the composition ‘animal and a sign’, there is the principle of vertical placement of elements, which is a manifestation of...
the idea of vertical duality in mythological paintings of Palaeolithic hunters. This scene is clearly associated with mythology and rituals that clearly have initiatory content.

The ceiling’s ridge-piece passes into a sloping vault ending in an inclined tapering large crack. It is in this crack numerous drawings in a variety of shapes were found, such as drawings of trapezes, ladders, vertical rows of lines and so on. Moreover, many signs are organized by groups situated in vertical rows along deposit lines, starting from the ridge of the ceiling in the scene of the ‘horse and an anthropomorph’ (Lyakhnitsky and Solodeynikov, 2004; Figure 8). It is important to note that the distance between the groups of figures ranges from 1.2 to 7 m. On top of these deposits symbolic figures were made in the ancient epoch, as our study demonstrated, for which they had to make these areas level and dismantle the stalactites (Kotov et al., 2004). So, whitish incrustations from above were important as characters connecting the ‘top’ stage with iconic images in the inclined fissure (chink).

Images of the hall of Drawings

A striking illustration of the nature of the test initiation ceremonies that were held in a cave is an upgrade slope to the upper floor that represents a number of vertical ledges with a total height of about 30 m and, among them, the latter ledge has a height of 14 m and overhanging walls. During excavations from 2008 to 2011 we found that on the first ledge there are remains of a multilayered site left by contemporaries of the Palaeolithic sanctuary. This indicates participants of rituals used this very path to reach the upper floor (Kotov, 2009). The drawings are located at 100 m from the well in the first (and largest) hall on this floor. The drawings hall has a diameter of 50 m and a height of 30 m and obviously, it answered some ideas of the ancients about sacred space.
During the latest research, by using computer image-processing photographer A. Solodeynikov recorded on the east wall of this hall images poorly distinguishable to the eye. After being digitally image processed, the wall reveals 7 mammoths, 2 horses, 1 trapeze sign and 1 anthropomorphic image (Figure 15). This result was a colourful mural unveiled as a complex composition consisting of three parts, the boundaries of which were confined to the surface's topography. The style of image of all three groups demonstrates their unity and, therefore, some sequence of events. On the right side panel, in a narrow triangle formed by the right edge of the rock face and on the left formed by wide cracks, a horse with a ‘duck’s head’, under it a mammoth of the same size and a man in front of him, were painted in series, one above the other, another little mammoth being beneath (Figure 16). The first group represents a scene of confrontation between a man and a mammoth where a great horse is present. The horse protects the man's fight with large and small mammoths. The next group of animals moves along following a huge horse in the direction of the crack. Also shown are large and small mammoths (Figure 17). The semantic content of the group is a procession of animals led by the leader that is the horse in the direction of some border, which was symbolized by a crack in the wall. This boundary was associated with the horse image, which was marked by processed chipped calcite deposits as the front of the horse. The third group represented, in our view, the departure of animals out of a concealed space in which they found themselves. Moreover, one of the three mammoths located closest to the symbolic border is depicted while turning back and at the same time another mammoth is drawn rising above the other animals (Figure 17).

On the west mural the images are placed diagonally from the upper right to the lower left (Figures 18, 19). In the upper right corner there is a mammoth painted completely in ochre and its body is the only silhouette image in the cave. In the centre, a small and large mammoth are placed in a contour fashion. Above and behind the mammoth is an anthropomorphic figure. It is depicted with outstretched arms and legs, with its body tilted toward the mammoth, its head in the form of a round spot (Figure 20). The anthropomorphic image style coincides with the image of a man on the east panel. Over the little mammoth there is a short line of ochre. Undoubtedly, this group is a single stage. Here again are the same characters seen on the east wall – the big and small mammoths. On the left, at a considerable distance (about 1.5 m), the outline of a bull standing in profile is drawn. Obviously, the focus of this composition by ancient artists presented the final scene of mythological action where people pursue large and small mammoths. A human figure painted upon it signifies his superiority over his enemies.

Conclusions

As seen above, it can be concluded that the horse and the mammoth are two principal animal symbols in the local indigenous ancient peoples’ worldview, and it was they who left paintings on the walls. The horse, without doubt, was the central character in mediating the interaction of humans and animals in ancient totemic mythology. In addition, judging by the images in the hall of Chaos the horse was a benevolent being transforming man, the patron and founder, and therefore in the mythological world picture, the horse was the symbol of light, that is of the upper half of the Universe. It is not by chance that in the symbolic composition in the upper hall of Chaos the horse is depicted with wings on his back. The mammoth is actually man's enemy and thus also the horse’s. Therefore a mammoth, by the law of binary mythology, symbolized the lower dark world of the underground.

Other traces of ritual behaviour in the cave

Veneration of the cave as some producing substance may be signalled by traces of ritual cutting away of walls and cracking limestone. The first finds of cut away limestone pieces were made by the author in the hall of Chaos in a sloping chink under the drawings and the finds of chips stained with ochre indicate that limestone splitting was performed simultaneously with making symbols and was of a ritual manner (Kotov et al., 2004). Then, in 2008, near the eastern wall of the hall of images, negatives of large chips covered with calcite deposits were recorded at the edge of large blocks (Figure 21).

A larger portion of negatives with various chips, also coated with a calcite crust, was found in the immediate vicinity of the western panel in the same hall. This is another line of similarity of the Shulgan-Tash Cave sanctuary with the cave sanctuary in the Ignatievskaya Cave, where they also documented numerous sections of the wall with negatives of chips (Petrin, 1992).

In three small excavations the author recorded 3 to 5 cultural layers dating from the Upper Palaeolithic to the Mesolithic and 3,500 and more, and there found more fragments of stalactites, cut pieces and chips of limestone and calcite. The vast majority of these items do not have a functional purpose. Among them, there are no real cores and plates. The only explanation for this is that cutting off of limestone and calcite had some cult character. Besides, three hundred tools also made of limestone and calcite were found there: scrapers, cutters, needles and piercing cutters (Figure 5). Items made of flint and jasper are rare. Most of them had been made here by retouching coarse chips and debris. The presence of weapons indicates that Palaeolithic people lived in the cave for a while and had limited economic activity. It is important to note that the bones of large animals...
are rare and they were not used in cooking, but in the cultural layers chopped and burnt bones of rodents, and so on (the fox, hare, groundhog and so forth) are found. A strange choice of raw materials, lack of proper skills in manufacturing cores and blanks, the small size of tools suggest that the tools and stone items were manufactured by children in ritual isolation, and this was complicated by food restrictions. These features indicate the nature of the initiation rites performed in the cave for several hundreds, perhaps thousands of years. A similar situation with items made of limestone and calcite was recorded in the sanctuary Zapovednaya that is the Sacred Cave in the South Urals with traces of a cult of the cave bear's bones as old as 12,000 years (Kotov, 2012).

Mythology and folklore associated with the Shulgan-Tash Cave

Mythological representations that have been reconstructed based on semantic analysis of individual images and compositions in the Palaeolithic sanctuary Shulgan-Tash, find parallels in the rich mythological layer of Bashkir folklore that has many threads and plot characters associated with the Shulgan-Tash Cave. It should be specially noted that not a cave in Eurasia is so closely associated with so many stories, legends, epics and beliefs like the Shulgan-Tash Cave and Lake Shulgan are. In fact, the lake and the cave are the centre of the mythological picture of the ancient population of the Southern Urals – namely the ancestors of Bashkirs.

It is not by chance that Bashkir traditions have been preserved to this date, that stories about a hero's confrontation with the master of the underwater world and the exit of horses and herds of cattle from the Shulgan lake bottom. They all date back to plots of numerous variants of Bashkir epics about Zayatulyak and wonderful horses and bulls (epics Kara Jurga, Akhak Kola, Kongur Buga, Zayatulyak and Hyuhylyu), which in turn go back to the story of the mythological epic Akbuzat (Bashkir folk epic stories). The winged horse Akbuzat takes out animals for the hero in this epic and their exit is accompanied by a natural disaster. The young batyr is sure to look back when he has been forbidden to and some of the animals that have not yet managed to get out of water immediately dive back. Protection of the heavenly horse transforms the hero completely and as the result he is able to defeat monsters of the lower world in the epic Akbuzat and Ural-Batyr (Ural-Batur; Bashkir folk epic stories). It is important that in the Akbuzat epic the hero meets evil creatures that is divs, led by Padishah Shulgan cut away a huge cave close to the lake – a stall for the horse Akbuzat, that is the Shulgan-Tash Cave cited from (Bashkir folk epic stories). All of this may reflect the fact that these epics have been based on an ancient myth, which was reflected in the content of the colourful compositions of the ice era in the Shulgan-Tash Cave. This is another unique feature of South Ural Cave and it is necessary to note the fact that the elements of this mythology are widely present in Bashkir folklore and rituals. For example, caves and lakes like the habitat of Shulgan-Master of the underwater/underground world and the habitat of wonderful winged horse Akbuzat and other winged horses are still revered today. Here the souls of their ancestors and Ajdaha dragons dwell. It is believed that all Bashkir horses and bear sources of energy, hence the wealth that comes from the winged horses of the Shulgan breed. Beliefs recorded throughout the territory occupied by Bashkirs state Ajdaha-dragons or winged horses live in in lakes, springs and wells. The origin of elements of the landscape are associated with them. Even today, ancestral worship and cult of mountains and caves (Kotov, 2001a, 2002; Aminev and Yamaeva, 2009) exists.

In folklore there are preserved rituals of human sacrifice to the Master of the water source (Kotov, 2006). The epics Ural-Batyr and Akbuzat describe rites of sacrificing the most beautiful girls to padishah Shulgan – the master of Lake Shulgan (Bashkir folk epic stories).

There is evidence to show that these myths have historical basis due to the discovery of skulls and remains of young women from deposits from the fourth to third century BC in Shulgan-Tash Cave during archaeological research of recent years (Figure 22). In addition, local Bashkirs believe the stalactites, clay and water from Shulgan-Tash Cave possesses extraordinary healing properties. Numerous fragments of stalactites and stalagmites have been found in the medieval deposits of the Shulgan-Tash Cave (Figure 23). In Bayslantash Cave (at 45 km from Shulgan-Tash) stalagmite fragments were found in the layers of the Early Iron Age.

All of this suggests that religious use of Shulgan-Tash Cave in the ice age has shaped the mythology of the ancient population of the Southern Urals. It has become the basis of ancient chthonic mythology, which has been preserved in ancient epics. In light of all this, the Shulgan-Tash Cave requires careful preservation as a monument of national and world culture.

The territory of the natural and cultural complex has represented a model of balanced interaction with nature practically ever since the time of its first human habitation. Essentially, such types of minor forest products as livestock grazing, hay making, wild game hunting were developed. The terrain of the natural and cultural complex presents itself as a site preserving a unique ancient occupation and craft of the Bashkir people – wild-hive beekeeping as an outstanding example of human-environmental interaction. Wild-hive (log) bee-keeping originated on the territory of present-day Bashkortostan about one and a half thousand years ago. All the stages of bee-keeping development can be viewed within this context;
Bashkir honey, produced by the Burzyan wild beehive has been acknowledged to be the best in the world due to its taste and other peculiar properties.

Age-old traditions of national bee-keeping are sparingly preserved within the territory of the complex; among other factors, wild-hive beekeeping is being revived now. Forest beekeeping is an ancient and unique national traditional craft. Major efforts in genetic conservation of the Burzyan wild beehive are under way.

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The traces of the first humans in Eurasia

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Introduction

The period around 2.3-1.8 million years ago is a critical in the study of human evolution, being marked by both the emergence of the genus *Homo* and its initial dispersal throughout the old world. Fundamental to this period of time are the questions of why hominids first dispersed out of Africa and which hominids were the first colonizers of the Eurasian continent.

For a long time, scientists thought that the first hominid out-of-Africa migrants were *Homo erectus*, a species with large brains and a stature approaching human dimensions. The species was widely assumed to have stepped out in the world once they evolved their greater intelligence, modern human like body proportions and invented more advanced stone tools.

Our excavations of the extraordinary palaeoanthropological site of Dmanisi, Georgia, bring new knowledge about first evolutionary history of early *Homo*. Over the past decade, this site has yielded a treasure of a unique series of 1.8 million year old cranial and postcranial hominin fossils. Few palaeoanthropological research projects have had such a great impact on our thinking about human evolution. The discoveries document the first expansions of hominins out of Africa and into Eurasia, and demonstrate that this was neither due to increased brain size, nor to improved technology. The scientific work at Dmanisi re-shaped many hypotheses on early hominin phylogeny, palaeoecology and biogeography. The research presented new evidence on the evolutionary biology of early *Homo* and challenges the existence of different *Homo* linages in Africa.

The site and history of discovery

The village of Dmanisi lies some 85 kilometres south-west of the Georgian capital of Tbilisi. (Figure 1) In the Middle Ages, Dmanisi was one of the most prominent cities and an important stop along the old Silk Road. The region has thus long intrigued archaeologists, who have been excavating the crumbling ruins of a medieval citadel there since the 1930s. Excavations at the site were started by Professor Levan Mushelishvili and later continued for thirty years under the supervision of Dr Vahtang Djaparidze (Djaparidze et al., 1992). There then followed a period of ten years, during which the excavations were supervised by Dr Jumber Kopaliani.

The first hint that the site might also have a deeper significance came in 1983, when Georgian palaeontologist Absalom Vekua discovered the remains of a long-extinct rhinoceros in one of the grain storage pits. The holes dug by the citadel's inhabitants had apparently opened a window on prehistory.

The next year, during palaeontological excavations, primitive stone tools identified by Nugzar Mgeladze came to light, bringing with them the tantalizing possibility that fossilized human remains might eventually follow.

In 1991, the first international team was organized with the Römisch-Germanisches Zentralmuseum (Germany). Finally, on the last day of this field season, (24 September 1991) a human mandible was discovered underneath the skeleton of a saber-toothed feline. The results of study of this jaw (Gabunia and Verne, 1995), under the supervision of late Professor Leo Gabunia, provoked discussion in the scientific
world; a lot of scholars were sceptical about the age and taxonomy of the Dmanisi hominids (see e.g. Braner and Schultz, 1996).

Later in 1999, two human skulls were found (Gabunia et al., 2000a). This resulted in world recognition of the Dmanisi fossils. Since then, the site has yielded the richest collection of early *Homo* from one site, along with many stone tools and thousands of animal bones.

### Dating and geology of the site

Georgia is very rich with palaeontological and stone age archaeological sites. Today’s rainfall, seasonality and habitat characteristics in Georgia vary greatly with elevation and longitude. Eastern Georgia tends to be drier and have a more continental pattern, while in western Georgia the weather has a more Mediterranean pattern. The site of Dmanisi is in the south central region (Kvemo Kartli Province) at an elevation of 915 metres above sea level. The region around Dmanisi has a good deal of topographic relief with hills and valleys that would have enhanced the potential for a mosaic of habitats, and the fauna indicate there were both wooded and open areas. Dmanisi is an open air site on a promontory overlooking the confluence of the Pinazauri and Mashavera Rivers. These rivers have eroded through 80-100 metres of basalt since the early Pleistocene, leaving the site high above them today (Figure 2).

Scientists estimated the age of the fossils, which come from deposits that sit directly atop a thick layer of volcanic rock radiometrically dated to 1.85 million years ago. The fresh, unweathered contours of the basalt indicate that little time passed before the fossil-bearing sediments blanketed it and palaeomagnetic analyses of the sediments signal that they were laid down close to 1.77 million years ago, when earth’s magnetic polarity reversed, the so-called Matuyama boundary.

Furthermore, remains of animals of known antiquity accompany the hominid fossils – a rodent called *Mimomys*, for instance that lived only between 1.6 and 2.0 million years ago – and a second, 1.76-million year old layer of basalt at a nearby site caps the same stratigraphy.

The Palaeolithic site had accumulated in direct association with a lake, which was formed when a lava stream blocked one of the Dmanisi Rivers. Today the Dmanisi bone deposits lie over almost unweathered basalts, which extend over an area of some 5,000 square metres. Up to date, less than 10 percent of the site has been excavated. The fossiliferous deposits are up to 4 m in thickness and are covered by the remains of a medieval town and middens.

On top of basalt that dates to within the Olduvai subchron, there are two main strata, A and B. In the stratigraphic sequence developed by Professor Reid Ferring, (Ferring et al., 2001) several profiles have been exposed at the promontory, showing the presence of sediment following by volcanic ashes.
The A layers are normal and from within the Olduvai subchron, and the B layers were deposited immediately after this; they have reversed polarity and so post-date 1.78 mya. Between the layers there is an indurate crust of groundwater carbonates. This crust also contains fossilized fauna and stone tools. Its covers the entire area of the site and can explain the good preservation of bones and precluded any displacement of the bones or of stone tools from higher levels. Bones are accumulated in especially dense concentrations where the basalt is low lying.

Palaeoenvironment

In addition to the hominins, the Dmanisi fossil vertebrate assemblage is comprised 45 taxa of amphibians (1), reptiles (3), birds (3) and mammals (38). Dmanisi micromammals from Stratum B1 are typical Late Pliocene forms characteristic for the Villanian small mammal age. The large mammal association is transitional from Middle to Late Villafranchian. All of the large mammals that coexisted with Homo in Dmanisi are either purely Eurasian or taxa that migrated out of Africa a long time before Homo reached Eurasia. There is no evidence that any of the mammals migrated out of Africa at the time of the hominins occupation of the site, although some of the carnivore taxa had very wide distributions throughout Africa and Eurasia. There are no aquatic taxa at the site, in keeping with the sedimentary processes at the site. Important taxa that are common at virtually all African early hominin sites are not present including aquatic taxa like crocodiles and hippopotamuses. No monkeys nor suidae have been found. These taxa are nearly always present at African hominin sites (Gabunia et al., 2000b).

Palaeoenvironmental context of B 1 Stratum

Among the small mammals warm-steppic gerbils dominate (Parameriones aff. obeidiensis, 41%), followed by steppic hamsters (Cricetulus sp., 28%; Allocricetus bursae, 5%). The vole Tcharinomys aff. tornensis (15%) has no living equivalent but most probably was an ubiquitous species. Woodland mice (Apodemus aff. atavus, 7%) and fluviatile voles (Mimomys ploicaenicus, 4%) are very rare, as are insectivore (Beremendia fissindens). Both Parameriones aff. obeidiensis and Cricetulus sp. can be related to species that have been found in the younger Palaeolithic site of Ubeidiya. Therefore, the dominant elements in the B1 Stratum are steppic rodents with Levantine affinities. In contrast, woodland or fluviatile species are much less common (11%). The small mammal evidence points therefore to the prevalence of warm-steppic conditions in the immediate surroundings of Dmanisi during the deposition of B1 sediments. The only insectivore of the assemblage, Beremendia fissindens, also confirms this conclusion, since this venomous shrew was especially adapted to survive under unstable ecological conditions. The scarce arvicolid and murid representation would indicate the presence of wooded areas not far away from this steppic landscape.

All large mammal taxa known from Dmanisi (30, not including Homo) are represented in the B1 stratum. Their composition reflects a mosaic paaleoenvironment over a larger area around the site: woodland and gallery forests, bushland, tree savannahs, open grasslands and semidesert-like rocky terrains with shrub vegetation. Herbivores that need presence of woodland in their habitat, at least for cover or seasonally, are the dominant group in the assemblage (7 taxa, 49% of NISP) among them cervid remains comprise 37.3%. Especially abundant is the medium size deer Cervus (Pseudodama) cf. nestii (NISP-19.4%), the megaherbivores (Mammuthus meridionalis, Stephanorhinus etruscus, Palaeotragus) that are inhabitants of open woodlands and tree savannahs and whose remains make 9% of the fossil remains from B1. They are followed by typical open grassland forms (17.3%) – equids (15.9%) and boids from the antilopini tribe (1.5%). Inhabitants of the semidesert-like rocky terrains are represented by 1.5% (Capra dali, Gallogoral meneghinii sickenbergii).

The carnivore association is composed of woodland (Panthera onca sp., Megantereon megantereon, Lynx issiodorensis); dry savannah, steppe, thick bush or semi-desert forms (Acinonyx pardinensi, Pachycrocuta perrieri) and ubiquitous species (Canis etruscus, Homotherium cretadidens, Ursus etruscus). Carnivore remains are abundant (NISP-18.7%) and are dominated by Canis etruscus (NISP-10.6%) followed by felids (NISP-2.8%). The high frequencies of large mammals that need the presence of woodland versus the typical open grassland forms reflected in the small mammals may reflect the habitats and prey preferences of the different carnivores in the site and the wider area large mammal assemblages tend to sample. Still, the predominance of woodland to grassland inhabitants among large mammals unequivocally demonstrates the prevalence of a woodland environment with open spaces in the vicinity of the Dmanisi site (Veruka, 1995; Gabunia et al., 2000b).

Palaeobotanical data from Dmanisi provide a picture of vegetation patterns on two different scales (Messager et al., 2010a, 2010b, 2011). Dmanisi phytolith assemblages indicate local herbaceous ecosystems dominated by Poaceae. Fruit remains recovered in the Stratum B sediments belong to xerophilous taxa as well (Celtis, Boraginaceae) and indicate presence of a xeric meadow at the site. On the other hand, palynological analysis of coprolites attributed to hyena reveal a very rich spectrum of vegetation cover (45 taxa) over the wider region reflecting different altitudinal zones: high alpine probably subnival vegetation
belts (with \textit{Selaginella selaginoides}, \textit{Lycopodium alpinum}, \textit{Botrychium}), high mountain forests (with \textit{Abies}, \textit{Betula}, \textit{Pinus}, \textit{Fagus} and \textit{Vaccinium} in the undergrowth), middle mountain forests (broad-leaved trees \textit{Fagus}, \textit{Carpinus} and \textit{Ulmus}), low mountain forest (with the prevelance of \textit{Castanea} and \textit{Tilia} and with admixture of \textit{Quercus}), floodplain forests (\textit{Alnus} being the main component) and grasslands at lower altitudes and on the plane adjacent to the plateau (with a dominance of Poaceae, \textit{Chenopodiaceae}, \textit{Compositae}). The composition of the herbaceous species suggests that the climate of the lowlands differed radically from that of the adjoining mountains. Palaeobotanical evidence derived from the phytoliths and fruit remains is in good accordance with the micromammal palaeoenvironmental signal, while pollen data indicate the presence of a wide diversity of habitats in the Dmanisi area needed for the large mammals. Together the flora and fauna indicate that there was a mosaic of habitats of mixed woodlands and grasslands.

The species composition of the fauna is the first major evidence about both site formation and environments at Dmanisi.

This biome, together with the adjacent forest-steppe communities, created a highly productive ecotone, rich in animal and plant resources. On a larger scale, the Dmanisi site is situated in a region of bioclimatic diversity that is unique in western Eurasia. This ecological diversity manifests extreme regional relief (from sea level to more than 6,000 m), strong meridional and zonal climatic gradients, and fluctuating levels (and proximity) of the Black and Caspian Seas.

The presence of large carnivore coprolites indicates that super-predators were living directly at the site. Forty-five coprolites have been preserved; most are round and/or round with a pit - the morphology of hyena coprolites. Others are more elongated and may be coprolites of felids or canids.

In recent deliberations regarding the migration of hominins out of Africa, several mammalian palaeontologists have discussed the importance of associated African faunas and suggested that the dispersion of \textit{Homo} can be seen as part of a larger pattern of migration by members of the terrestrial mammalian fauna.

Nonetheless, \textit{Homo} at Dmanisi is present almost without other African taxa and this suggests \textit{Homo} was able to extend on their own. Even if in future some of the species are demonstrated to have simultaneously dispersed from Africa, the Dmanisi fauna cannot be considered to be a real extension of ‘Africa-ness’.

\section*{Archaeology}

The site is very rich with archaeological deposits, with more than 10,000 stone tools have been discovered in Dmanisi (Lordkipanidze et al., 2000, 2012; Mgeladze et al., 2010; Ferring et al., 2011).

\subsection*{Archaeological Materials and Associations in Stratum B1}

The archaeological materials associated with the thousands of animal fossils in Stratum B1 include a large number of lithic artefacts. These are best documented in the ongoing M5 excavations where, as mentioned above, the Stratum B1 materials are in the middle of Dmanisi’s stratigraphic sequence. Lithic artefacts in Stratum B1 have been recovered from every excavation and test unit thus far, although in earlier excavations, Stratum B1 was not recognized and those artefacts were considered to be part of Stratum II, now known to include parts or all of Strata B1, B2 and B3. However, over 900 lithic artefacts and unmodified cobbles from Block 2 have been studied over the past several seasons of excavation.

In both M5 and Block 2 samples the Stratum B1 assemblages are dominated by unmodified cobbles, but also include flakes, cores, battered or spalled cobbles and low proportions of flakes with retouch, some of which appears to be use related. The shift towards increasing cobble frequencies begins in the upper part of Stratum A, but the stratum A assemblages are obviously dominated by debitage (flakes) and cores. The Stratum B1 assemblages from M5 contrast with the preceding Stratum A materials with respect to indices of reduction intensity, as was suggested earlier by testing data of both the ratio of flakes to cores, and the frequency of flakes lacking exterior cobble or bedrock cortex (‘interior flakes’). Both have their lowest values in Stratum B1. This can imply shorter term occupations and less intensive use of cores, which is concordant with the geologic evidence mentioned above, that Stratum B1 does not represent much time. These patterns persist in Stratum B2.

The high percentage of unmodified cobbles in Stratum B1 is of considerable interest. While all of these have previously been called manuports (anthropogenically introduced materials) the data from coded cobbles from both M5 and Block 2 suggest that several alternative explanations need to be considered. Indeed, the interpretations of unmodified stones in assemblages from Africa has been the subject of considerable debate. Interpretations of such stones include naturally deposited materials (‘ecofacts’), pounding implements and also as cached materials, carried to sites to minimize the cost of acquiring stone
materials in future occupations. All of these alternatives indicate the difficulty in interpreting the presence of unmodified stones at archaeological sites. The hypothesis that some proportion of the B1 cobbles were deposited naturally cannot be dismissed, for there are many pebbles and cobbles that are too small for any conceivable function. The stones larger than 5 cm in length were measured and weighed and many of the smaller ones are probably colluvium, presumably derived from a terrace above the site, which has been completely eroded at the western part of the promontory, but is preserved on the north side of the Masavera gorge and upstream from Dmanisi (Figure 2).

While many battered or spalled cobbles are present, we cannot exclude the possibility that others lacking any traces were used for pounding activities including manufacture of stone flakes or breaking bones. In both Block 2 and M5, however, there are several very large cobbles (more than 3 kg in weight) that almost certainly must have been carried to the site, since there is no evidence in the B1 sediments to indicate sufficient energy to transport such large masses. These could have functioned as anvils for breaking bones or as hammers for breaking some of the many upper limb elements from large mammals mentioned above; use for mashing plant foods or as raw material for the manufacture of flakes are also possible functions. However, with ample supplies of cobbles in nearby gravels in both channels and terraces, the need to ‘cache’ cobbles for the latter purpose is unlikely, but nonetheless possible.

Feature B1.1 in the M5 block is a concentration of 45 large cobbles, cores and blocky material and seven flakes, found in a single square metre of Stratum B1a. Thirty-three of the stones from the feature are unmodified cobbles. These materials did not accumulate in a gully, but rather in a shallow depression that formed over a collapsed carnivore den. Numerous bones were buried by the roof fall, 20-30 cm below the dense concentration of stones. Although the sample is small, the unmodified cobbles are the largest items and could have been used as blanks for cores. Yet the raw materials of the natural cobbles are different than those used for cores. However, analysis of variance (excluding the flakes) shows no significant differences in the sizes of these objects (F=.290, df=3, Sig.=0.832). Thus, the explanation for this feature is difficult to define. The possibility that they were concentrated as possible missiles for protection from the numerous carnivores that lived at Dmanisi is another possible explanation.

By contrast, the numerous cobbles from the deposits containing the hominins in Block 2 are smaller than those from M5, but must have entered the pipe/gully system from nearby surfaces. Flakes, cores and battered pieces are also found with these cobbles, as in M5, and both manufacture and use of stone flakes, in addition to pounding activities, were carried out near the pipe/gully system. A lag deposit at the A4/B1 contact has not been seen in any profiles so far, so anthropogenic transport of the larger stones must be considered. The well-preserved bones there provide unequivocal evidence that the larger stones were not water transported. If throwing stones were used in an offensive manner, driving carnivores away from carcasses or dens, stones would be expected to be concentrated and associated with the bones, as in Block 2.

Dmanisi preserves a complex archaeological record of numerous reoccupations, which are registered in both stratigraphic and spatial concentrations of artefacts and faunal remains across all areas of the site. To date, almost 5000 stone tools have been found. While flakes comprise the majority of tools recovered, some cores and choppers have also been found. The raw material for lithic artefacts comes from nearby rivers. The difference in technology is not seen only in changes in composition of assemblages. Before the Dmanisi finds, experts believed that humans could not have left Africa before having developed an advanced technology such as the Acheulean, in which tools were symmetrically shaped, manufactured and standardized. The tools found at Dmanisi, however, are simple flakes and choppers according to much the same primitive Oldowan tradition that hominids in Africa were practicing nearly a million years earlier.

We also found abundant quantity of unmodified cobble manuports at Dmanisi. This could indicate that the manuports were used by hominins for more than just flake production and meat processing. There is the possibility that they were also thrown to chase carnivores away from the site.

Hominids

The Dmanisi site has now produced remains of several hominid individuals (five skulls, four of them with maxillas, four mandibles and one hundred post-cranial remains). This is the richest and most complete collection of indisputable early
Homo remains from any one site of comparable stratigraphic context. The Dmanisi sample comprises variation related to age (subadult D2700/D2735 with erupting M3s; adults D2280, D2282/D211, D4500/D2600; old individual D3444/D3900) and sexual dimorphism (Lordkipanidze et al., 2000, 2003; Rightmire et al., 2000).

Despite certain anatomical differences between the Dmanisi specimens, we do not presently see sufficient grounds for assigning them to more than one hominin taxon. Thus, the Dmanisi assemblage gives us a unique opportunity to study variability within an early Homo population.

Cranial Remains

Skull 5 from Dmanisi is an extraordinary find in many respects. It represents the most complete skull of an adult fossil Homo individual found to date (Lordkipanidze et al., 2013). The fossil is perfectly preserved and free of any deformation or fragmentation, which often occur during the process of fossilization. The mandible of the Skull 5 individual (specimen number D2600) was found in 2000. The cranium (D4500) was found five years later, at a distance of less than two metres from the mandible.

Skull 5 displays a surprising combination of features: it has a small braincase with a volume of only 546 cubic centimetres, which is roughly one third of that of a modern human. At the same time, it has a large and protruding face with massive jaws and large teeth, and thick brow ridges that overarch the eye sockets. This is a combination of features that was not known before from early Homo. Skull 5 thus provides significant new information on how the skull of adult early Homo looked.

Up to date, the anatomy of complete skulls of early Homo is mainly known from two adolescent individuals (one from Africa, another from Dmanisi). These individuals did not yet have a fully grown face at the time of their death. Also, the only well-preserved adult individual (another specimen from Dmanisi) had lost all its teeth during its lifetime, such that its jawbones were substantially reduced at the time of death (Lordkipanidze et al., 2005). Skull 5 now indicates that adult early Homo comprised individuals with larger-than-expected faces and smaller-than-expected brains.

The Dmanisi skulls have very low cranial capacity smaller one has 600 cubic centimetres near the mean for H. habilis. The biggest Dmanisis specimen has around 750 cc. Modern human braincases are about 1,400 cubic centimetres.

These specimens from Dmanisi exhibit characteristic H. erectus features, such as a heaping up of bone along the midline of the skull known as a sagittal keel and marked constriction of the skull behind the eyes. But they stop short of the classic morphology of that hominid in several ways: their small brain size, for example, which was about half that of a modern human. Specimen D2700 from a teenager, is especially primitive, resembling H. habilis not only in size but in the thinness of its brow, the projection of its face and the rounded contour of the rear of the skull. Some researchers propose that these fossils might represent a new species of Homo. Others suggest that the remains belong to more than one species, pointing to the enormous lower jaw known as D2600 that was unearthed in 2000. Experts vigorously
debate just how many species our genus, *Homo*, compromises. The bushiest representations of the Homo branch of the family tree contain up to eight species, a number of which were evolutionary dead ends. Other renditions appear as a streamlined succession of just a few forms (Margvelashvili et al., 2013). The fossils from Dmanisi categorized variously as *H. habilis*, *H. erectus*, *H. ergaster* and a new species, *H. georgicus*, could be compatible with scenarios of substantial hominin diversity. Alternatively, the anatomical range evident in the Dmanisi remains could just underscore how variable a species can be. Viewed that way, some pruning may be in order.

The Dmanisi hominins share a lot of cranial, dental and postcranial traits with *Homo habilis*, but also some similarity with later hominin such as *Homo ergaster*. The Dmanisi hominins represent descendants of African early *Homo* and ancestral condition for the *Homo* from Eurasia.

Post cranial remains

Overall, the locomotor biomechanics of the Dmanisi hominids appear to have been similar to those of modern humans (Lordkipanidze et al., 2007). The relative length and morphology of the hindlimb is essentially modern. However, Dmanisi hindlimb was not as derived as later hominins in this respect. Dmanisi hominids share morphological and functional affinities with *H. habilis* rather than *H. ergaster* in this regard. This suggests that the first hominin species to radiate from Africa did not possess the full suite of derived locomotor traits apparent in African *H. ergaster* and later hominids.

In many respects, the Dmanisi postcranial fossils resemble modern humans and the Nariokotome boy skeleton (the most completely preserved *Homo erectus/ergaster* skeleton from Turkana dated around 1.6 Ma). Dmanisi individuals' stature and body mass are smaller than the Nariokotome boy's. The larger adult would have weighed 48-50 kg and stood 147-155 cm tall; the smaller adult was approximately 40 kg and 143 cm; the sub adult, however, was 40-43 kg and 145-155 cm and its adult weight and stature must have been even greater. Estimates of relative brain size are in the range of Australopithecus, well below those of later *H. erectus* and modern humans.

We know so little about the behaviour of early hominids as our evidence mainly comes from stone tools. The edentulous skull who had lost teeth several years before death shows not only the earliest case of severe masticatory impairment in the hominin fossil record to be discovered so far, but also raises questions about subsistence strategies in early *Homo*.

The discovery of a toothless hominid in Dmanisi shows that this individual survived for a long time without consuming solid food that required heavy chewing. It is clear that he or she may not have been able to do so without help from other individuals, suggesting that other members of the group were sharing food with the toothless individual (Lordkipanidze et al., 2005).

We are not aware of any other fossil hominin that displays such extensive tooth loss and remodelling.

Therefore, it is conceivable that we have recorded one of the earliest traces of compassion in human history. We are looking at, perhaps, the first sign of truly human behaviour in one of our ancestors.
The site protection

The Dmanisi site combines unique traces of different archaeological periods. It is needless to stress the worldwide importance of this site. Architectural Studio Milou was involved in developing a master plan.

The site is rich in Medieval and Bronze Age artefacts, but it is the wealth of Palaeolithic finds that has put it on the scientific map.

On arrival, the visitor is directed around the central dig along wooden walkways, past Bronze Age burials towards a viewing gallery from where they can watch the archaeologists at work in the excavations. A nearby room shows films about the original discoveries, including interviews with scientists and historical information about the site, which helps visitors to put the finds into context.

The project to protect the palaeoanthropological site of Dmanisi and to present it to the public is part of a master plan for the development of the village of Dmanisi. The objectives of this master plan include improving the presentation to the public of the palaeoanthropological site and the mediaeval site; improving security at the palaeoanthropological site and its protection; planning for the development of infrastructure, research and the reception of visitors, while at the same time respecting the site; creating employment and other opportunities linked to the development of the archaeological site available to the residents of Dmanisi, for example, in the running of homestays or guesthouses.

In drawing up the master plan, one important consideration was how to organize and direct the visitor flow to the site in such a way as to ensure its protection and security.

The work carried out since 2005 by Jean Francois Milou and Studio Milou in Georgia, particularly at Dmanisi, has built on a close relationship with the National Museum of Georgia team and the research team at the Dmanisi site. The result has been the completion of the first phase of the project and the construction of a structure protecting the site and welcoming the public. This has been discreetly placed among the trees that surround the site.

The project consists of both a protective structure for part of the palaeoanthropological site and a space dedicated to presenting the site to the public. The Dmanisi site today is one where excavations are still being carried out and research is underway. This will be the case for many years to come, such is the enigma that aspects of the site still represent for the scientific community. The structure built as part of the project is thus both a place where researchers can work and one where members of the public can see excavations underway at the site itself. Dmanisi is a snapshot in time, like a time capsule that preserves an ecosystem 1.8 Ma ago.

This discovery placed Georgia on the map of modern palaeoanthropology and we can say for sure that Dmanisi has enormous potential to yield new discoveries in the 50,000 square m we know contains fossils stone tools and needs to be excavated.

Figure 11. Shelter designed by Studio Milou.
Bibliography


Eastern Europe


Perspectives on the Palaeolithic of Eurasia: Kostenki and related sites

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Introduction

The leading Palaeolithic archaeologist of the last century, François Bordes (1968), observed that there were three principal schools of prehistory: (1) French – stratigraphic; (2) Anglo-American – environmental; and (3) Russian – sociological.

The development of the Russian school was directly based on the Palaeolithic sites at Kostenki, where structured settlements and traces of large dwellings similar in form to those of Native American and Polynesian sites were found. From the early 1930s to the end of the 1960s, archaeological data were used to reconstruct family organization and marriage patterns in accordance with the ideas of Morgan and Engels.

At present, the Kostenki group (the Middle Don Basin, Voronezh District and the Central Russian Plain) (Figure 1) comprises 21 sites at Kostenki and five at the neighbouring village of Borshchevo. Ten of them are multilayered sites, containing from two to ten cultural layers and therefore actually contain nearly sixty occupations or settlements. Roughly forty of the latter are found in clear stratigraphic context, subdivided by sterile sediment and yield in situ remains of occupation, including dwellings, hearths, pits and associated debris.

While concentrations of Palaeolithic sites are not uncommon in areas that contain natural shelters, the density of open air sites at Kostenki is extraordinary and unknown elsewhere (including the famous Pavlov’ Hill in Moravia). It is difficult to explain the high concentration of sites at Kostenki, because adjoining areas appear to possess the same geographic features but lack Palaeolithic sites (Sinitsyn and Stepanova, 2012).

The Kostenki sites (Voronezh region) have long occupied a critical place in the Palaeolithic archaeology and Quaternary geology of Eastern Europe (Pavlov and Rogachev, 1982; Klein, 1969; Hoffecker, 2002a). Together with the Molodova sites in western Ukraine, they provide the most important stratigraphic sequence for this part of the world and the chronological framework for most Palaeolithic sites in the vast region that lies between the Carpathian and the Ural Mountains. The chronology of the Molodova sites, which was developed by Chernysh (1973, 1987) and Ivanova (Ivanova and Tseitlin, 1987) has been subject to some recent revisions regarding the middle time range of sequence (for instance, Haesaerts et al., 2003, 2004b), while new revisions to the Kostenki chronology pertain to the earlier periods.

The history of research

The initial discovery of the Palaeolithic at Kostenki (Kostenki 1) was made by I. S. Poliakov, whose excavations in 1879 demonstrated an association of extinct mammoth remains with human chipped stone tools. The concentration of large fossil bones at Kostenki had been known for many years before 1879 (Kostenki means ‘village of bones’ in Russian). In the early eighteenth century, upon the instructions of Peter the First, the academic S. G. Gmelin undertook a study of bones in Kostenki and identified them as elephant remains.

Most leading Russian prehistorians took part at the excavations at Kostenki: P. P. Efimenko, S. N. Zamyatin, P. I. Boriskovsky, A. N. Rogachev, and so on, thus making Kostenki a source for new ideas about the evolution and differentiation of the East European Palaeolithic.
In many respects, the history of chrono-stratigraphic and palaeocultural studies at Kostenki parallels the development of both Russian Palaeolithic archaeology and palaeogeography. During the 1950s and 1960s, as a result of field research by A. N. Rogachev (1956; 1957; 1964) in consent with geologists M. N. Grishchenko (1950; 1961; 1976) and G. I. Lazukov (1954; 1957a; b), Sawicki (1964) and A. A. Velichko (1963), archaeological layers at Kostenki were subdivided into three principal chronological groups on the basis of stratigraphic position (Velichko and Rogatchev, 1969; Klein, 1969; Hoffecker, 1987). Cultural layers in the loessic loams underlying the modern chernozem were assigned to the late (third) chronological group. Layers assigned to the middle (second) and earliest (first) chronological groups were those deposited in the upper and lower humic beds, respectively, subdivided by the volcanic ash horizon (Figure 3A).

During the 1980s, a radiocarbon chronology was developed for all three temporal groups (Pavlov and Soulierjytsky, 1997; Sinitsyn et al., 1997; Sinitsyn, 1999; Sinitsyn and Hoffecker, 2006) (Figure 2):

- chronological group I: 36,000-32,000 years BP
- chronological group II: 32,000-27,000 years BP
- chronological group III: 26,000-20,000 years BP (now 23-20 Ka)

At the same time, a number of new questions and problems arose, including the correlation of the temporal boundaries of the chronological groups with the past climate fluctuations as reconstructed by other studies (for example, oxygen isotope climate-stratigraphy). Especially important were questions concerning the age of the two older chronological groups and the dating of the volcanic ash horizon that separated them. After more than four decades of research, the primary stratigraphic subdivisions of these sites – loessic loams, upper humic bed and lower humic bed – remained unchanged, but debate continued regarding the absolute dating of the major units.

Seven of the Kostenki sites contain cultural layers of the earliest chronological group (I) (Figure 2): Kostenki 1 (V cultural layer), Kostenki 6, Kostenki 8 (IV cultural layer), Kostenki 11 (V cultural layer), Kostenki 12 (II, III, IV, V cultural layers), Kostenki 14 ('cultural layer in the volcanic ash horizon', Iva, ‘horizon in fossil soil with Lashamp excursion’, IVb-‘horizon of hearths’) and Kostenki 17 (II cultural layer), Borshchevo 5 (III, IV, V cultural layers). They constitute a total of sixteen occupation levels.

According to the widely published traditional point of view, the material culture of sites assigned to the earliest chronological group is represented by the Streletskian and Spitsynian cultures (Figure 3A) (Praslov and Rogachev, 1982; Boriskovsky, 1984; Hoffecker, 1988, 2000a; Anikovich, 1992, 1999, 2003; Amirkhanov et al., 1993; Cohen and Stepanchuk, 1999, 2000-2001; Djindjian et al., 1999; Chabai, 2003).

Sites of the middle chronological group (II) are more numerous: Kostenki 1 (III cultural layer); Kostenki 5 (III cultural layer), Kostenki 8 (II, III cultural layers), Kostenki 11 (III, IV, ‘northern locality’), Kostenki 12 (I, la cultural layers), Kostenki 14 (II, III cultural layers), Kostenki 15, Kostenki 16, Kostenki 17 (I cultural layer), Borshchevo 3, Borshchevo 4, Borshchevo 5 (II cultural layer) – a total of 17 settlements (Figure 2). Four coexisting cultural entities (Streletskian, Aurignacian, Gravettian and Gorodtsovidian) are recognized within the second chronological group (Figure 3A).

The most numerous are occupations of the recent chronological group (III), containing the following: Kostenki 1 (I, II cultural layers); Kostenki 2, Kostenki 3, Kostenki 4 (I, II cultural layers); Kostenki 5 (I, II cultural layers), Kostenki 7, Kostenki 8 (I cultural
Eastern Europe

Two important chronological markers were identified in the Kostenki stratigraphic sequence. The most important is the horizon of volcanic ash in the sterile loam horizon dividing the humic beds. 7 Kostenki sites contain a horizon of tephra: Kostenki 1, Kostenki 6, Kostenki 11, Kostenki 12, Kostenki 14, Kostenki 17, Borshchevo 5 (Sinitsyn, 2003a) (Figure 1). It holds considerable significance for Kostenki with respect to both internal and regional correlation of the sites. According to analyses carried out in the last quarter of the twentieth century, the age of the volcanic ash is about 38,000 years and it is connected to one of the eruptions of Campi Flegrei (Phlegrean Fields) in southern Italy, in other words, the CI-Y5 event (Melekestsev et al., 1984; Zubakov, 1986). This is confirmed by more recent analyses (Pyle et al., 2006; Giacco et al., 2006; 2008; Hoffecker et al., 2008; Wood et al., 2012) that place the age of the CI eruption at 39.3 Ka.

The other is a series of four magnetic excursions (Blake, Laschamp, Mono, Gotenborg), all identified in a ‘stratigraphic sondage’ without cultural layers (Pisarevsky, 1983; Zubakov, 1986; Sinitsyn and Hoffecker, 2006). The most important of these for the Kostenki chronology appears to be Laschamp (Gernik and Guskova, 2002; Guskova et al., 2012; Levie, 2006; Pospelova, 2005, Pospelova et al., 2008), which dates to 41 Ka (Nowaczyk et al., 2012), identified in profiles at Kostenki 12, 14 and 17 and probably at Kostenki 16.

For archaeology, these short-term events are an excellent means for the chronological correlation of cultural layers. Although the first is limited by the spatial distribution of CI-Y5 tephra, the palaeomagnetic events are global in scale.

Research at Kostenki has been undertaken by many Russian, European and American teams. Important contributions have been made by P. Haesaerts and S. Pirson (Belgium, Brussels), the group of J. Hoffecker and V. Holliday (USA, University of Colorado, University of Arizona), the dating programmes of T. Higham and K. Douka (UK, Oxford), M. Otte (Belgium, Liege), Ph. Ngist (UK, Cambridge), S. Sedov (Mexico, University of Mexico), J.-I. Svendsen, J. Mangerud and R. Leivlie (Norway, Bergen) D. Pietsch, P. Kuhn (Germany, Tübingen), L. Lisa (Czech Republic Prague) and so on. Of principal significance is the participation in field work at Kostenki of the group directed by A. A. Velichko (Institute of Geography, Moscow) from 1952 to the present day.

Current cultural and chronological classification of the Kostenki Palaeolithic

New archaeological materials obtained from the excavation at Kostenki 1, 12, 14 and Borshchevo 5 (Sinitsyn; 2004a; 2009; Haesaerts et al., 2004a; Ankovich et al., 2008; Lisitsyn, 2004) during the last decade and new analyses have led to significant changes in the traditional interpretation of the structure, cultural affiliation and chronology of the Palaeolithic at Kostenki (Sinitsyn, 2003b; 2010; Ankovich et al., 2007; 2008; Hoffecker, 2009; 2011a). Of primary importance is the sequence at Kostenki 14 (Markina gora), because only this site contains three cultural layers beneath the volcanic ash with diagnostic archaeological assemblages (Haesaerts et al., 2004a, b; Sinitsyn, 2003a, 2004a; Sinitsyn et al., 2013; Sedov et al., 2010; Sedov...
Eastern Europe

and Sinitsyn, 2012; Velichko et al., 2009; Panin and Nekrasov, 2013). Kostenki 14 provided the basis for modification of the traditional tripartite chronological scheme to a four-part model (Figure 3B) in which the lowermost unit has been subdivided into two groups: (1) Early Upper Palaeolithic (EUP) in the temporal range of 32-36 Ka (cal 36-40) with a typical European bi-modal structure comprising an Aurignacian of pan-European distribution and a series of local ‘transitional’ cultural unities (Streletskian in Eastern Europe); and (2) a more ancient ‘Initial Upper Palaeolithic stratum’ (IUP stratum) dating to 36-42 Ka (cal 41-46) represented by layers both at and below the level of the Laschamp magnetic excursion (41 Ka cal).

**Initial Upper Palaeolithic stratum: Spitsynean and IVb cultural layer of Markina gora**

Reasons for distinguishing IUP-stratum appear to be as follows:

- more ancient stratigraphic /= chronological/ position than EUP in local sequences;

The recognition of assemblages older than and distinct from both Aurignacian and ‘transitional’ cultures is an important feature of the cultural sequence documented at Kostenki in the last few years. These assemblages include the Spitsynean (cultural layer II of Kostenki 17 or Spitsyn site) and Layer IVb at Kostenki 14 (Markina gora). Uncalibrated radiocarbon dates of 36-37 Ka (Sinitsyn and Hoffecker, 2006; Holliday et al., 2007) should be considered the minimum age of these assemblages. The chronological position of these sites may overlap with the EUP assemblages, because their apparent place in the sequence of Upper Palaeolithic cultural development may or may not correspond to their chronological position, as in the case of the late ‘survival’ of the Mousterian in some regions.

**Spitsynean**

The Spitsynean industry is characterized by complete dominance of blade knapping technology based on uni- and bi-polar removal of blades from volumetric and semi-volumetric cores, a typical Upper Palaeolithic tool-kit (Figure 4), and a numerous and varied set of personal ornaments, including pendants on stone and fossil shell with holes for suspension made by bilateral drilling (Figure 5). A wide range of possible cultural affiliations has been suggested for this industry: J. K. Kozlowsky (1986) placed it in the Gravettian sequence and later (see Djindjian et al., 1999) in the Aurignacian (also see Anikovich, 1992); the excavator, P. I. Boriskowsky (1963), on the basis of its techno-typological features, placed it in the ‘Early Magdalenian’ group of sites. At present, the Spitsynean is identified as a separate cultural tradition of the Early Upper Palaeolithic (Rogachev, Anikovich, 1984). Nevertheless, both the technological and typological composition of the lithic assemblage seems to be more similar to those of the Magdalenian composition, than those of the Aurignacian and/or Gravettian.

**Cultural Layer IVb at Markina gora**

The artefact assemblage of cultural layer IVb (Figure 6) is also characterized by predominance of blade knapping technology employing various methods. Volumetric and flat uni- and bi-polar cores are identified, but the most numerous are cores on dolomite slabs morphologically similar to lateral burins. The technology of microblade production represents a separate method with some modifications reflected in the thick flakes and blades used as cores. The tools comprise end scrapers and burins of variable morphology, varied splintered pieces and items with concave and fluted working edges. Particularly noteworthy are several oval bifaces with plano-convex profiles. Also significant is the bone assemblage (Figure 7) containing a series of ‘mattock-like’ tools on bone, antler and mammoth tusk with ‘splintered’ extremities. The fragment of the head of anthropomorphic figurine, broken during the process of manufacturing, is the oldest known sculpted human image in the European Upper Palaeolithic. Especially intriguing is a bead with two holes on a Columbellidae shell (a tropical gastropod, the modern ecology of which is connected with the Mediterranean basin). Although some Aurignacian types of burins (burins buqué, burin de Vachona) are present as isolated artefacts (Figure 6, a, b), as a whole, the assemblage contrasts sharply to both the Aurignacian and the various ‘transitional’ industries.

A distinctive feature of the two assemblages in the IUP-stratum is the contrast in raw material procurement. All Spitsynean artefacts were made on high quality Cretaceous black flint, the nearest sources of which are known at a distance of no less than 150 km from Kostenki (Boriskovsij, 1963). Siliceous limestone (dolomite) of local origin appears to predominate in cultural layer IVb at Kostenki 14, although a wide array of raw materials, including a few pieces of Cretaceous black flint are represented in the assemblage. Both cultural traditions are assumed to represent highly mobile groups, but with varying orientation. The Spitsynean reflects use of distant, high-quality materials, while the occupants of cultural layer IVb at Markina gora emphasized the use of all available varieties of local raw materials.
Figure 4. IUP-stratum. 36-42 Ka (cal: 42-45 Ka). Spitsynean. Kostenki 17 (Spitsyn's site), cultural layer II. Lithic assemblage (according to Boriskovsky, 1963).

Figure 5. IUP-stratum. 36-42 Ka (cal: 42-45 Ka). Spitsynean. Kostenki 17 (Spitsyn’s site), cultural layer II. Personal ornaments.

Figure 6. IUP-stratum. 36-42 Ka (cal: 42-45 Ka). Kostenki 14 (Markina gora), cultural layer IVb. Lithic assemblage: a – busqued burins, b – Vachon’ burin.

Figure 7. IUP-stratum. 36-42 Ka (cal: 42-45 Ka). Kostenki 14 (Markina gora), cultural layer IVb. Bone assemblage, artistic and personal ornaments.

Figure 8. EUP. 36-32 Ka (cal: 36-41 Ka). Aurignacian. Kostenki 14 (Markina gora), cultural layer 'in volcanic ash'. Lithic assemblage.

Figure 9. EUP. 36-32 Ka (cal: 36-41 Ka). Aurignacian. Kostenki 14 (Markina gora), cultural layer ‘in volcanic ash’. Personal ornaments.
The Early Upper Palaeolithic: Aurignacian and Streletskian

Throughout Europe, the Early Upper Palaeolithic is characterized by a binary pattern, one component of which is the Aurignacian of pan-European occurrence, while the other is represented by a series of local ‘transitional’ cultures – in Eastern Europe by the Streletskian. Both Aurignacian and Streletskian at Kostenki are dated to 32-36 Ka (Cal: 36.2-41.5 Ka) (Damblon, et al., 1996; Sinitsyn, 1996; 1999; Sinitsyn et al., 1997; Sinitsyn and Hoffecker, 2006; Douka et al., 2010).

Assemblages assigned to the Aurignacian have been identified at three Kostenki sites: 1) the ‘horizon in volcanic ash’ at Kostenki 14 (Figure 8; 9); 2) cultural layer III at Kostenki 1 – both within the second chronological group; and 3) cultural layer II at Kostenki 1 in the loessic loams, but in a redeposited context. The assignment of all three assemblages is based on the techno-typological features of the Aurignacian techno-complex, including Dufour microblabes of the Roc-de-Comb variety (Hahn, 1977; Sinitsyn, 1993; 2003a; 2007a).

The Streletskian industry (Figure 10) is based on flake technology and contains a wide variety of bifacial tools (including the fossil directeur triangular point with concave base) (Bradley et al., 1995) numerous Mousterian tool types (mostly side-scrapers of various types). On the basis of the technology and Mousterian tool component, the Streletskian assemblages are traditionally identified as a ‘transitional’ industry with a problematic range of possible predecessors: Moldavian (Anikovich, 1983) and Crimea Mousterian (Anikovich, 1999; Anikovich et al., 2008), Central Russian Plain (Tarasov, 2006) and east Siberian (Gladilin and Demidenko, 1989).

The geographic distribution of the few indisputable Aurignacian assemblages in Eastern Europe includes Kostenki and Crimea (Suren 1-D) (Cohen and Stepanchuk, 1999; 2000-2001; Demidenko, 2000-2001; 2008; 2011; Demidenko et al., 2012; Vishnyatsky, 2004; Vishnyatsky and Nehoroshev, 2004). Streletsian assemblages have a more widespread area, including the Vladimir region (Sungir) (Bader, 1978; Bader and Lavrushin, 1998; Anikovich, 2005), Mid Urals (Garchi 1) (Pavlov and Indrelid, 2000) and the steppes of the Black Sea coastal area (Biryuchya Balka) (Matioukhin, 2012; Otte et al., 2006) and Vys (Zaliznyak et al., 2013). It suggests an adaptation of both cultural traditions to certain landscape-climatic and ecological zones.

The distribution of sites across various habitats, along with the exploitation of local raw materials indicate a high degree of mobility and adaptive flexibility for both the Aurignacian and Streletsian populations.

The Problem of the EUP-MUP transition: Gorodtsovian and Early Gravettian

As in all of Europe, the beginning of Middle Upper Palaeolithic (MUP), which is associated with the appearance of the Gravettian techno-complex, significantly alters the earlier bi-modal EUP pattern (represented by coexisting Aurignacian and ‘transitional’ traditions) which are estimated as the ‘Gravettian revolution’ (Hoffecker, 2011b).

One of the salient features of the Kostenki sequence is the Gravettian appearance in association with Gorodtsovian assemblages.
Early Gravettian

The assemblage of cultural layer II at Kostenki 8 (Telmanskaya site) remains the most ancient manifestation of the Gravettian in Eastern Europe. Its stratigraphic position in the Upper Humic Bed and radiocarbon date of 27 700 ± 750 (GrN-10509) (Cal: 31.7-33.0 Ka) may provide a possible upper limiting age.

Uni- and bi-polar flake production (in both macro lithic and microlithic form) are evident from the few cores, most of which are exhausted. The morphology of the blanks and tools on blades indicate the predominance of Gravettian technology (as opposed to Aurignacian blade technology). The typology of the macro-component is typical: burins of varying sub-types, including multifaceted (some of them undoubtedly are microblade cores); end-scrapers; perforators; and a number of notched blades. The micro-component is dominant: nearly 900 pieces or more than 40% of the tool–kit. Along with widespread Gravettian points and backed bladelets with abrupt and semi–abrupt retouch, bi–points, (quasi–) segments and trapezes are identified in the collection (Figure 11) (Rogachev, 1951; Litovchenko, 1969; Praslov and Rogachev, 1982). The bone assemblage and the personal ornaments while not numerous, are relatively diagnostic (Figure 12).

The composition of the lithic assemblage at the site, without obvious analogues in Eastern Europe, encouraged a search for parallels in other parts of Europe. Efimenko (1953; 1960) saw the closest analogies to this assemblage in the Gravettian of the western Mediterranean, specifically in ‘Menton’s grottoes,’ with the local cultural tradition known as ‘Grimaldian’ (Efimenko, 1956: 47–48; 1958: 446).

The primary significance of the Gravettian appearance in Kostenki about 27–28 Ka (Cal. 32–33 Ka) is its relationship to the broader problem of the origin of the Gravettian techno–complex and the fundamental restructuring of the Upper Palaeolithic world – replacing of the binary pattern of the EUP with a relatively uniform MUP organization. At present, it is widely believed that the transition occurred suddenly and simultaneously in different parts of Europe at roughly 30–28 Ka, and the question of where it appeared first is open to debate (Palma di Cesnola, et al., 1996; Goutas et al., 2011; Kozlowski, 2013).

Gorodtsovian

As a separate cultural unity, the Gorodtsovian was defined by P. P. Efimenko (1956) following the excavations at the Gorodtsov site (Kostenki 15), on the basis of an unusual lithic and bone assemblage, especially the presence of a ‘Mousterian’ component (Figure 13). Large ‘shovels’ made on mammoth bones with ‘nail–like’ heads of the haft were identified as a fossil directeur for this cultural entity (Figure 14). The emphasis on flake technology and high proportion of tools on flakes (which are predominant in cultural layer II at Kostenki 14), the numerous and variable ‘Mousterian’ tool types (up to 50% in cultural layer II at Kostenki 14 – Sinitsyn, 1996; 2000) and the relatively rich bone assemblages (Figure 15) – all of non–Aurignacian and non–Gravettian character – establish these assemblages as a unique east European cultural entity without analogies in other parts of the continent.

The specific sites included in the Gorodtsovian has been the subject of much debate: Kostenki 15, Kostenki 4 (I), Kostenki 14 (I, II) according to P. P. Efimenko (1956; 1958); Kostenki 15, Kostenki 12 (I or locality B), Kostenki 2, Kostenki 3, Kostenki 1 (II) and outside Kostenki, Karacharovo (Oka basin) and the Talitsky site (Tchusovaya basin, Mid Ural) according to A. N. Rogachev (1957; Gvozdoever and Rogachev, 1969). G. P. Grigorjev (1970) has confined the Gorodtsovian assemblages to sites of the second chronological group: Kostenki 15, Kostenki 14 (II), Kostenki 12 (I or locality B), Kostenki 16; A. A. Sinitsyn (1996) included all sites of the second chronological group of non–Aurignacian and non–Gravettian affiliation; M. V. Anikovich (1992) retains only the sites with the distinctive bone ‘shovels’.

Current debate over the Gorodtsovian concerns: a) taxonomy – restricting the Gorodtsovian at Kostenki to the second chronological group, most probably its upper portion; and b) the geographic distribution of the Gorodtsovian outside the Kostenki area, specifically the possibility of including the Talitsky site (Urals) (for discussion of the current debate see Grigorjev; 2001; Sinitsyn, 1997) and Mira (Ukraine) (Stepanchuk et al., 1998; 2004). There remain the problems of the origin of Gorodtsovian and its evolution.

As in the case of the IUP, the Gorodtsovian and Early Gravettian provide evidence of differing patterns of adaptation. The wide spectrum of raw materials used in the Gorodtsovian contrasts with the uniform material base of the Gravettian assemblage at Telmanskaya, which was imported from Cretaceous flint sources outside the Kostenki area.
Recent Gravettian and the problem of a hiatus

The current radiocarbon chronology for Kostenki indicates a temporal gap or hiatus between the cultural layers in the upper humic bed and the sites in the overlying loessic loams (Figure 3B). Its duration is estimated at roughly 4 to 5 thousand years: from 27–28 Ka to 22–23 Ka (cal: from 31 to 28 Ka). The archaeological data supports a cultural hiatus: both the Early Gravettian and Gorodtsovian traditions do not extend into the later period.

A principal feature of the Kostenki Palaeolithic is the great variety of cultural traditions in the interval 23–20 Ka (cal: 28–25 Ka). No other regional sequence of the European Upper Palaeolithic contains so many variants. The sites are found in a very tightly defined spatial and temporal context (corresponding to GS–4–3 – GI–3 in the Greenland ice core record) and the influence of climatic conditions on material culture probably was the same for all of them. The differences are found in all categories of material culture: technological methods and typological sets of both lithic and bone assemblages, personal ornaments, decorations on bone tools, art objects, dwelling constructions and probably funeral rites. This indicates that the variations cannot be accounted for in terms of functional differences among the sites and cultural tradition seems to be the most reasonable explanation for the variability.

At least four Gravettian varieties may be identified at Kostenki (Sinitsyn, 2007b). Neither the current radiocarbon chronology nor stratigraphy indicates any temporal distinctions among them; there is no evidence of more than one cultural layer of Gravettian affiliation in the loessic loams at any one site. The most reasonable interpretation is that all existed here simultaneously, at least in a geologic sense.

A separate problem is the coexistence of Gravettian variants with non-Gravettian sites, the most important of which are: layer I of Kostenki 8, layer I of Kostenki 4 (a complex of round dwellings) and sites of co-called Zamyatin archaeological culture.
Kostenki-Avdeev culture

The Kostenki–Avdeev culture remains a unique phenomenon represented at Kostenki by four sites and also by other sites outside Kostenki–Borshchevo. All sites are located in the Pokrovsky Valley: Kostenki 1 (I), Kostenki 13, Kostenki 18 on its left bank; Kostenki 14 (I) – on the right (Figure 2, III). The large and complex settlements are well known and probably were occupied for a very specific purpose. The basic camp (Kostenki 1 – Kostenki 13) reveals a characteristic habitation area – dwelling constructions (the first fully excavated, oval 36 x 14–15 m) (Figure 31) (Efimenko, 1954; 1958; Grigorjev, 1967; Praslov and Rogachev, 1982) with a line of hearths along a long axis and surrounded by series of semi–underground dwellings and storage–pits covered by large mammoth bones (Figure 16).

A triad of components, diagnostic for the Kostenki–Avdeev cultural entity was defined following the first excavation of Kostenki 1 (Efimenko, 1928), comprising an association of realistic female figurines, shouldered points of specific proportions and the so–called Kostenki knife, manufactured with the ‘Kostenki thinning technique’. Later, the number of diagnostic features of this most famous and expressive Palaeolithic culture of Eastern Europe, were increased (Figure 17) (Praslov and Rogachev, 1982; Gvozdover, 1953, 1961, 1998; Giria and Bradley, 1998), but the three ‘index fossils’ remain a fundamental set of defining attributes. Although all three are tied to the Kostenki–Avdeev phenomenon, for all practical purposes the presence of two of them are sufficient to assign an assemblage to it.

Principal significance has artistic and decorative assemblages (Figure 18), include numerous female figurines (Figure 19) and range of problems related to aesthetic sub-system of this cultural entity (Abramova, 1962; 1967; 1995; Gvozdover, 1995; Praslov, 1985; 1986; 1993; Kozłowski, 1992; Lakovleva, 1999; 2000; 2012; Dupuy, 2012; Sinitsyn, 2012).
Sites of the Kostenki-Avdeev culture outside of Kostenki

The triad of diagnostic features of the Kostenki–Avdeev culture was identified at the following sites:

- Avdeev, a site nearly identical to Kostenki 1–I in all respects: the organization of the features, lithic and bone assemblages, arts, ornaments and others (Efimenko, 1953; Rogachev, 1953; Gvozdev, 1961; 1995; 1998);
- Zaraisk. After the discovery of female figurines in 2005, the cultural attribution of this site became absolutely clear. A unique feature is a bison sculpture, carved in an unusual style. Also unusual is the question of the duration of occupation, on the basis of a wide range of radiocarbon dates and microstratigraphic evidence (Trusov, 1994; 1998; 2011; Amirkhanov, 2000; 2009; Amirkhanov, Lev, 2002; 2004; 2007; 2008; Lev and Amirkhanov, 2002);
- Gagarino. The site differs from Kostenki 1–I and Avdeev by some details of archaeological assemblage (Zamiatnin, 1934; Tarasov, 1979) and it may be more recent;
- Khotylevo 2. The site contains some features that distinguish it from typical Kostenki–Avdeev assemblages. They pertain to both the structure of the habitation area and the style of the female figurines, ornaments and decorative elements, including unique decorations on the cortex of some flint tools (Zavernjaev, 1974; 1978; 1991; 2000; Gavrilov, 2008; 2012, Praslov, 1995). The affiliation of Khotylevo 2 with the Kostenki–Avdeev culture remains more problematic than other cases;
- Berdyzh. Female figurines and Kostenki knives have not been identified at this site and a shouldered point of Kostenki–Avdeev appearance remains the sole argument for a connection to the Kostenki–Avdeev cultural tradition (Polikarpovich, 1968; Budko, 1972; Kaelitchitz, 1984; Kaelitchitz et al., 2010; Ksenzov, 1988).
Diagnostic components of the Kostenki–Avdeeevo culture are found in layer IX at Willendorf 2 in Lower Austria (Felgenhauer, 1956–59; Otte, 1981; Broglio and Laplace, 1996). The affiliation of other widely distributed sites containing shouldered points remains under discussion (Kozlowsky, 1969; 1970; 1986; 1998).

The range of problems concerning sites of this group is wide and embraces the full spectrum of issues related to the Upper Palaeolithic, because the relevant archaeological data are immense and highly variable. Ideas and opinions regarding the organization, chronology and differentiation of the Kostenki–Avdeevo culture (or Kostenkian) are equally wide and various: from the view that it is part of a larger Kostenki–Pavlov–Willendorf entity to its subdivision into a series of independent archaeological cultures; from the recognition of sites as contemporaneous (in a geological sense as isochronous) to efforts to arrange them in chronological sequences (Efimenko, 1958; Childe, 1956; Delporte, 1959; Grigorjev, 1970; 1993; Tarasov, 1979; Amirkhanov, 1998; Anikovich et al., 2008; Gavrilo, 2008; Soffer, 1985; 1987; 1993; Kozłowski, 1969; 1970; 1986; 1998; Otte et al.,1996; Hoffecker, 2002a, b).

Gmelin archaeological culture (Kostenki 21-III)

Despite the presence of some attributes that are common in the Gravettian techno–complex, the material culture of cultural layer III at Kostenki 21 appears to represent a separate cultural phenomenon. This observation is based on the lithic and bone assemblages, art objects, decorations and ornaments (Praslov, 1964; Praslov and Rogachev, 1982; Ivanova, 1985). Lithic ‘index fossils’ include shouldered points with proportions distinct from the shouldered points of the Kostenki–Avdeevo culture, but similar to those of the south European Gravettian and backed points similar to federmesser points (Figure 20). The bone assemblage contains a series of characteristic tools in association with diagnostic pendants and – unique for the East European Palaeolithic – engraving on stone slabs (Figure 21).

Alexandrov archaeological culture (Kostenki 4-II)

The most diagnostic features of this cultural tradition are:

- a unique type of long oval dwelling construction/habitation area/ (35 x 5.5 m and 23 x 5.5 m) excavated into the surface (20–30 cm) with series of hearths on a long axis (Figure 31);
- a lithic assemblage dominated by backed blades and points of typical Gravettian form and a very high content of splintered pieces associated with a low index of burins and end scrapers (Figure 22).

According to the excavator, A. N. Rogachev (1955), the complex of the lower occupation layer of Kostenki 4 has no direct analogues among contemporaneous sites in Eastern Europe, but recent studies reveal a similarity with the south European Gravettian (Zheltova, 2013).

Anosov archaeological culture (Kostenki 11-II)

The presence of round, shallow semi–subterranean dwellings (about 6 m in diameter), a unique lithic assemblage and figurative art (the most indicative of which are small zoomorphic forms (Figure 24), provides a basis for defining a specific cultural entity.

The lithic assemblage is characterized by numerous and variable series of truncations including concave; a relatively low index of burins (15%) and very low index of end–scrapers (less than 1%); tanged pieces in combination with other tools; symmetrical leaf points that are plano–convex and bi–convex in cross–section with partial bifacial retouch; the dominance of backed points and blades/bladelets (more than 50% of tool–kit) (Figure 23) (Rogachev, 1961; Praslov and Rogachev, 1982; Popov, 1983; 2002; Popov and Pustovalov, 2004). A characteristic feature of this group is the sub–group of tools with morphology similar to federmesser, along with typical Gravettian points and blades. The Gravettian backed points and federmesser types, widely discussed during the 1970s, are principal attributes not only for cultural layer II of Kostenki 11, but also for Kostenki 21–III, where the same tools also were identified.

Kostenki 9-Borshchevo 5 variant

This Gravettian variant is defined on a quantitative basis: the percentage of backed blades, often with truncated edges (Figure 25) (Lisitsyn, 2004).
Non-Gravettian assemblages of the youngest chronological group

Along with the Gravettian assemblages, some industries of non–Gravettian affiliation have been identified at Kostenki in the temporal range of 23–20 Ka (cal: 28–25 Ka).

Kostenki 8 (I)

The site yields traces of round dwelling constructions (nearly 6 m in diameter) excavated 50–70 cm into the surface with a central hearth. The skull of a cave lion (presumably crowning the roof) was found at one of them.

A variety of points, including bi–points (frequently with ventral modifications) and tools similar to Mousterian points dominate the lithic assemblage. A diagnostic type is a leaf point, sometimes tanged, with partial bifacial retouch, similar to projectile points of the Jerzmanowice type and/or points in sites of the Lincomben–Ranis–Jerzmanowice entity dating to the Initial Upper Palaeolithic of north–south Europe. Other characteristic features of the assemblage are a very low index of scrapers, a number of side–scrapers on flakes and splintered pieces (Figure 26) (Efimenko and Boriskovsky, 1953).

Kostenki 4 (I)

The archaeological assemblage is characterized by round dwellings roughly 6 m in diameter, intruding 50 to 10 cm into the surface, with a central hearth at centre; unusual but numerous and variable lithic and bone assemblages; a series of pestle–grinders on granite, quartzite and sandstone; a very important series of about 200 of grinding/polished tools on schist, and bi–convex discs and hatchet–look tools. Some of the discs have traces of use as retouchers (Rogachev, 1955).
The quantity of these tools shows that grinding/polishing techniques were widespread in this cultural tradition. According to the excavator A. N. Rogachev (1973), the pestle-grinders suggest 'complex gathering' and the preparation of vegetal resources for long-term storage by means of special tools. Additional support for this hypothesis has been provided by the analysis of the Kostenki pestle-grinders in Italy, which documented traces of starch on their surfaces (Revedin et al., 2009, 2010).

Backed microblades of non-Gravettian appearance (~400), burins (~250) and some scrapers (75) are predominant in the lithic assemblage. Especially diagnostic are the bifacial tools, unfortunately not common: a leaf point that is bi-convex in cross-section, a shouldered point of Solutrean appearance and discoid tools.

The site provides rich and variable collections of bone, ornamental/decorative assemblages and art objects, including both anthropomorphic and zoomorphic figurines. The unusual combination of cultural features is without close analogues and its cultural affiliation remains the subject of debate.

**Zamyatnin cultural tradition**

A group of sites, probably the youngest at Kostenki, are sometimes combined as the Zamyatnin cultural entity: Kostenki 2 (or Zamyatnin site, eponymous for this tradition), Kostenki 2, Kostenki 3, Kostenki 11 (Ia) and Kostenki 19 (Rogachev and Anikovich, 1984). Because these sites yield highly variable lithic assemblages, it seems best to characterize them as a chronological rather than a cultural group.

The most important is cultural layer Ia of Kostenki 11, which contains three dwelling constructions of Anosovsko–Mezin type, the most impressive form of Upper Palaeolithic dwelling (Figure 29), similar to the mammoth dwellings at Mezhirich, Gontsy and Dobranichevka in the Dnepr Basin.

The most diagnostic features of the lithic assemblages are the microblades of very variable morphology, distinct both from the Aurignacian and Gravettian and numerous splintered pieces. Burins, end scrapers and truncations are represented by types that enjoy wide distribution in the Upper Palaeolithic (Figure 28).

**Dwelling constructions**

Along with traces of oval dwellings containing a central hearth (typically interpreted as tents similar to the chum or yaranga found among northern foraging peoples), which are widespread in the Upper Palaeolithic, the Kostenki sites yield evidence of large dwellings that have been used as a basis for reconstructing the social organization of their occupants (Rogachev, 1970). They include: (a) large former dwelling areas of Kostenki–Avdeevo type with a central line of hearth surrounded by semi-subterranean ‘dwelling–pits’ and storage–pits; (b) elongated former dwellings on the surface with a similar central line of hearths, found in the lower cultural layer at Kostenki 4, and (c) large dwelling constructions (up to 8 m in diameter) composed of numerous mammoth bones and tusks of the Ansovo–Mezin type (Figure 31), reconstruction of which are found in many museums and archaeological interpretive centres.
Anthropological remains

Information on the physical character of the people who created the various cultures found at Kostenki is as limited as our knowledge of Palaeolithic people in general. Only nine cultural layers at Kostenki have provided anthropological remains, mostly comprising teeth. Of considerable importance are five burials associated with clear traces of funerary ritual (Guerasimova, 1982; Guerasimova et al., 2007; Klein et al., 1971; Klein, 1978; Zubov, 2004; Sinitsyn, 2004b; Pettitt, 2011). Reconstructions of the individuals represented by two of the skeletons were undertaken by M. M. Guerasimov (1955): Kostenki 2 – the most recent /22–23 Ka – Cal: 27 Ka / (Figure 32B) – a typical Cro–Magnon and Kostenki 14 – the most ancient /33 Ka – Cal: 37–38 Ka (Marom et al., 2012 )/ (Figure 32A) – described for many years as australo–negroid anthropological type (Debetz, 1955; see Yakimov, 1980 for an opposing view), but now assigned to a mtDNA haplogroup (U) that is common in Europe (Krause et al., 2010) and related to Aurignacian cultural tradition.

Cultural Heritage Museum

The discovery of a large structure composed of mammoth bones and surrounded by series of storage–pits at Kostenki 11 provided the basis for a museum, which was built around the exposed excavation floor and opened for the public in 1979 on the centenary of the first discovery of the Palaeolithic at Kostenki (Figure 30).

Natural events of particular meaning (heritage)

The Kostenki–Borschchevo locality provides evidence of a series of natural events, the most important of which is volcanic ash from catastrophic eruption at Phlegrean Fields in southern Italy (nearly 3000 km from Kostenki) at 39–40 Ka BP , one the most significant catastrophes in prehistory (Hoffecker et al., 2008; Openheimer, 2011), consequences of which remain the matter of debate.

Conclusions

The concentration of sites at Kostenki represents a unique phenomenon and remains without compelling explanation because the area does not seem to have possessed any features or attractions that are not found in adjoining areas along the Don River.

Although confined to a small area, the Kostenki sites represent a separate and unique locus of Upper Palaeolithic cultural development, because they exhibit a particular pattern of cultural evolution, comparable to other principal areas in Europe (for example, Mediterranean, Aquitanian, Moravian and so forth).
Kostenki yields evidence of the oldest known Upper Palaeolithic techno-complex (IUP stratum) in Eastern Europe, reflecting early movements of anatomically modern humans into northern Eurasia (42-44 Ka cal).

The earliest appearance of the Gravettian is identified at Kostenki at 28 Ka, simultaneously with the earliest manifestation of the Gravettian techno–complex in other parts of Europe (Masière, Geißenklösterle, Willendorf 2, Paglicci, and so on). In each area, the Gravettian emerges as a fully developed complex in the context of the later Aurignacian. Kostenki presents a more complicated situation owing to the additional presence of the unique Gorodtsovian cultural entity, unknown in other parts of the continent.

All major developments in the study of the East European Upper Palaeolithic have been tied to, and largely based upon, materials from Kostenki, which continues to attract both archaeological and natural–scientific research, now carried out in a number of international projects.

The association of unique cultural history (particular model of Upper Palaeolithic cultural evolution) and natural events (volcanic ash connected with CI eruption at Phlegrean Fields in southern Italy) at Kostenki invest it with special significance for cultural and natural World Heritage.

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Perspectives on the Upper Palaeolithic in Eurasia: the Case of the Dolní Věstonice-Pavlov sites

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Introduction

Since 1924, the sites of the Dolní Věstonice-Pavlov area, located on slopes of the Pavlov Hills in south Moravia (Czech Republic), have been continuously excavated by Karel Absolon, Assien Bohmers, Bohuslav Klima, Jiří Svoboda and others. Their central place on the map of Upper Palaeolithic Eurasia has been recognized since soon after the first series of reports by Absolon (1925, 1929, 1937) in the Illustrated London News, reporting ‘a discovery as wonderful as that of Tutankhamun’s tomb’, ‘an amazing Palaeolithic Pompeii’ or ‘the world’s earliest portrait’. More recently, Klima (1987) and Svoboda (1987) have reported on discoveries of early modern human burials, all in ritual contexts, Pamela Vandiver et al., (1989) on the origins of ceramic technology, Sarah L. Mason et al., (1994) and Anna Revedin et al., (2010) on evidence of plant consumption and James M. Adovasio et al., (1996) on earliest fibre technologies and origins of textiles. Palaeogenetical research of the recovered human fossils is currently in process (Fu et al., 2013).

These discoveries have greatly expanded the previous knowledge about early modern human adaptations, lifestyles and technologies in the newly colonized Eurasian zone. The new evidence is emerging continuously, both in the field and in laboratories, through multidisciplinary and international projects involving anthropology, palaeoethnology, geology, palaeoecology, genetics and a number of other disciplines. One of the current goals is to preserve these sites in the field and present them to the public in exhibits, in a way corresponding to their scientific value.

Early modern human migrations to Eurasia

One of the major questions in recent discussions about the early modern human expansion into northern Eurasia concerns the reason why. What was the attraction of this vast zone of steppes and parklands, prone to cold and dry oscillations of the glacial climate and occupied by well-adapted, robust and dangerous aboriginals – the Neanderthals.

We argue that the harsh, hyper-arid environment and desertification occurring in the Sahara before and during the Interplenioglacial (MIS3) could be the source of demographic pressures in the Mediterranean and may have served as a stimulus for the first penetration and later expansion of these populations further north. The complex pattern of population growth, as recorded in certain parts of northern Eurasia from the Middle Palaeolithic to the Early Upper Palaeolithic, provides a mirror image to that of the Sahara. One of the major attractions to any Palaeolithic hunter could have been the amount and size of large herbivore herds in the Eurasian zone. If attacked by organized hunting groups equipped with sophisticated techniques and weapons, large animal herds provided a good and a relatively secure source of meat, protein, fat, bone and skins.

Within a relatively short time-span between 50-30 kyr BP, we have documented a dramatic increase in the number of sites and repeated expansions of several new technologies, possibly of African and Mediterranean origin, such as the Levallois-leptolithic, backed blade and microblade technologies. However, northern Eurasia played more than the passive role of a new home for the invading modern human populations; it also stimulated new adaptive and behavioural patterns, complex hunting strategies, technologies and symbolism.

A major obstacle in formulating these scenarios is the lack of human fossils from secure Initial and Early Upper Palaeolithic (IUP and EUP, respectively) contexts. Current evidence on the Levallois-leptolithic technology (Emirian, Bohunician, Kara Bom) does not prove the anatomical identity of the producers – all we know is that this specific technology appeared at the right time at the right places. Therefore, association of this technology with modern humans has only the value of a hypothesis and should be treated as such. The expansion of the backed blade and bladelet technologies has some anthropological context, but the evidence is controversial; whereas the early backed points in southern and eastern Africa and the Uluzzian in southern Europe are likely products of the early modern humans, the Chatelperronian of western Europe is associated with the late Neanderthals. One of the interpretations of this dilemma could be the contemporaneity and mutual relationships between modern human expansions and Neanderthal acculturations.
The Aurignacian represents the first large pan-European entity clearly associated with modern humans. However, the Aurignacian techno/typology and complex symbolic behaviour (art) was not intrusive and was created in place, after the occupation of Europe (Conard and Bolus, 2008). During the following Middle Upper Palaeolithic (MUP), there is a wealth of modern human fossil remains and the anatomically modern character of this population is not in doubt (Figure 1). The question of Gravettian origins seems to be a complex one, where both the external impulses and local development trends are combined (Svoboda, 2007; Sinitsyn et al., this volume).

The Dolní Věstonice-Pavlov area, as a large settlement agglomeration of the time, located right in the centre of Europe, represents an illustrative case in these discussions.

Why this time and place?

The Mid Upper Palaeolithic and the Gravettian was a period when the strategic and cultural importance of central Europe increased, in accord with the changing cultural geography of the continent. In addition to the ‘traditional’ centres, located along the Atlantic coast in the westernmost parts of Europe, new cultural centres emerged in the eastern European plains (Kostenki, Sungir and others) creating a kind of a ‘continental balance’ between east and west (Figure 1). In the centre of Europe, the narrow Austrian-Moravian-Polish geomorphological corridor provided a natural communication axis connecting the Danube Valley in the south-west with the large open plains in the north-east, which was open to both animal herds and human communities. An axially ordered chain of Gravettian settlements follows this corridor.

In terms of palaeoclimatology, the Mid Upper Palaeolithic or later Interpleniglacial (MIS 3) was a period of climatic instability shortly preceding the Last Glacial Maximum (MIS 2). It is recorded as a sequence of short oscillations of air temperature in marine cores, in pollen sequences in terrestrial sediments and broadly correlated with loess deposition alternating with pedogenesis in central and eastern Europe (Haesaerts et al., 2010). In contrast to previously reconstructed uniform, cold, dry and treeless landscape, recent palaeoecological research emphasizes a mosaic vegetation pattern with a higher proportion of arboreal and thermophile elements, in both floral and faunal records (Rybničková and Rybníček, 1991; Slobodová, 1991; Beresford-Jones et al., 2011; Musil, 2010). The new reconstruction also corresponds with the abundance of large herbivore herds in such a landscape, as the archaeozoological evidence suggests an environment of considerable carrying capacity.

A strategic role in the Moravian corridor was played by the ‘gates’, places where valleys become narrow and slopes become steep. In Lower Austria, a typical example is the Wachau Gate on the Danube, with the sites of Willendorf, Aggsbach and Krems. Narrow valleys also occur along the Morava River, especially in the Moravian Gate, which opens a tectonically predestined passage between the Bohemian and Carpathian systems to Poland and is linked by the sites of Předmostí and Petřkovice at its southern and northern entrances, respectively. The sites of Dolní Věstonice – Pavlov lie in the southern plains near the present-day Austrian border, on the slopes of the impressive mountain chain of the Pavlov Hills (maximum elevation 550 m above sea level). This mountain emerges from the plains as a significant orientation point and, given its typically zoomorph shape, it probably also had some symbolic significance for past hunters (Figure 2).

On a microregional scale, the Dolní Věstonice – Pavlov area provides an ideal case study for investigating the relationship between the geomorphology of the Dyje River Valley and Gravettian settlement patterns (Figures 3-4). Although the individual archaeological sites vary in size and complexity, they create an almost regular chain at approximately the same elevation, 200-240 m above sea level and about 30-70 m above the floodplain. Almost all of the terrain investigated at these elevations has been found to show evidence of archaeological activity, so that new site locations may even be predicted based on the previous field surveys (with exception of the Pavlov III and Milovice IV sites, Slobodová et al., 2011a). Mid-slope locations, adjacent to the...
Eastern Europe

Figure 2. View of the Pavlov Hills skyline. © M. Frouz.

Figure 3. Map of the Dolní Věstonice-Pavlov-Milovice sites creating a regular chain along the north-east slopes of the Pavlov Hills.

Figure 4. A complex pattern engraved in a mammoth tusk from Pavlov I may represent one of the earliest ‘maps’. If so, the double circle would relate to the settlement, hatched areas to the mountain slopes and the meander to the Dyje River below. © M. Frouz.

Figure 5. Dolní Věstonice II, western slope, one of the settlement units with central hearth and surrounding kettle-shaped pits during excavation in 1987.

Figure 6. Pavlov VI, a single settlement unit with central ‘roasting’ pit, surrounding kettle-shaped pits and adjacent mammoth bones during excavation in 2007.

Figure 7. Milovice I, an extensive mammoth bone deposit below the site, excavation 1988.

Figure 8. Ethnoarchaeological research of current Nenets settlements in north-west Siberia helps to approach the spatial analysis of the Dolní Věstonice – Pavlov sites, 2012.
river, from which the valley floodplain and lower slopes can be controlled, are interpreted as optimal locations for mammoth exploitation. These strategic locations allow aerial views of animal herds and easy access to side gullies and blind valleys, which are interpreted as natural traps where selected individuals could be killed, as demonstrated by the frequent abundance of mammoth bones at such locations. In the current discussions questioning the role of humans in mammoth bone accumulations, this settlement pattern may be considered as one of the arguments for intentionality.

These sites also display a hierarchy ranging from large semi-permanent settlements with complex hearths, domestic constructions and an evidence of various profane and symbolic activities (Dolní Věstonice I and Pavlov I) to smaller sites of seasonal and episodic character (Figures 5-6). Some of these sites are accompanied by large dumps of accumulated mammoth bones (Figure 7) located either inside the settled area or separately in the adjacent gullies, sometimes in moist or watered locations (Dolní Věstonice I, II and Milovice I; cf. Klíma, 1969; Svoboda, ed., 1991; Svoboda et al., 2005; Oliva, ed., 2009).

In interpreting these settlements, ethnoarchaeological analogies from actual cold zones are widely implied (Figure 8, Svoboda et al., 2011b) and two extreme models are usually evaluated: that of a large and contemporary ‘camp’ versus an accumulation of successive short-term occupations. We basically agree that the largest sites are, in fact, accumulations or palimpsests of smaller ones (Verpoorte, 2001; Svoboda, ed., 2005). The question is however whether they are only this. Why are the art objects and burials restricted to aggregation places, places which, through archaeologist’s eyes, look like the densest clusters of anthropogenic sediments, charcoal and artefacts? It seems that these locations are not just archaeological summaries of the individual episodes, but that there was a pattern of human aggregation and centralized activities.

**Chronology**

The archaeological situations within the Dolní Věstonice-Pavlov area lie at the base of the last loess cover (Figure 9) with radiocarbon data covering several millennia (Jöris et al., 2010; Beresford-Jones et al., 2011). The cultural chronology allows a rough separation into the Early Pavlovian, Evolved Pavlovian and later Gravettian substages, but the majority of these sites and dates belong to the Evolved Pavlovian horizon, dated 27-25 ky BP or 30-28 ky cal BC (Svoboda, 2007). These dates lie within a relatively cold Dansgaard-Oeschger period (GS-5) recorded in the proxy record of air temperature in the δ¹⁸O NGRIP ice core. There is little evidence of the earlier Aurignacian occupation and no evidence of later Palaeolithic occupation. This means that advantages the Dolní Věstonice-Pavlov microregion were only appreciated by one Palaeolithic population with its specific resource exploitation and lifestyle.

**Site survey: locations, leading excavators and references**

*Dolní Věstonice I (Absolon’s site).* This complex of Gravettian settlements and mammoth bone deposits is located on a long slope in a vineyard in the easternmost part of the village’s cadastre. In the middle and upper parts independent settlement units were distinguished and interpreted as huts. Elevation: 200-235 above sea level. Excavation: 1924-1938 Karel Absolon; 1939-1942 Assien Bohmers; 1945-1946 Karel Žebera; 1947-1952, 1966 and 1971-1979 Bohuslav Klíma; 1990 and 1993 Jiří Svoboda. References: Absolon, 1938a, b; 1945; Klíma 1963; 1983.


*Dolní Věstonice III (Rajny).* Two smaller settlement units date to the Gravettian, one of them with an underlying Aurignacian layer and are located on a steep slope with vineyards between the sites I and II. Surface finds continue over the above field, all the way upslope and these are evidently Aurignacian. Elevation: 215-290 m. Excavation: until 1980 Bohuslav Klíma, 1993 and 2012 Jiří Svoboda, 1994-1995 Petr Škrdla.


Pavlov IV. Surface finds of artefacts in the valley south-east of the village. Elevation: 210-250 m. Ongoing surface survey.

Pavlov V (Děvičky). Surface finds of artefacts below the castle. Elevation around 360 m. Ongoing surface survey.


The man and mammoth relationships

The intensity of occupation layers and richness of artefacts, large hearths and related dwelling structures, variability in seasonal occupation over the year and time-consuming and delicate technologies (microliths, fine ivory carvings, textiles and so forth) suggest a relative sedentism or, at least, tethered nomadism. As a paradox, the strong cultural relationship among the sites along the Austrian-Moravian-Polish geomorphological corridor, long-distance lithic material importations and probable following the animals along the rivers, also suggest a mobility across the landscape at the same time. Thus we expect a flexible and less risky resource exploitation system controlling a larger territory and capable of supplies all throughout the year.

Although discussions are in course about the intentionality of mammoth hunting (Soffer et al., 2001; West 2001), this animal played a key role in human economy (Svoboda et al., 2005; Musil, 2010; Wojtal et al., 2012), accompanied by middle-sized animals such as reindeer and horse, together with smaller fur-bearing mammals such as wolf, arctic and common fox and also by hares, birds, fish and plants (Bochenski et al., 2009; Mason et al., 1994; Revedin et al., 2010). Extensive mammoth bone deposits, as a typical formative phenomenon at these Moravian sites, were located either inside the settlements or separately, in the adjacent gullies or on the slopes (Figure 7).

Various authors underline different aspects of the archaeological record and argue for mammoth hunting versus mammoth scavenging, reindeer hunting, net-hunting of smaller game or plant gathering. As early as the nineteenth century, the first large site of this type, with mammoth bone deposits, was excavated by J. Wankel at Předmostí. However, the authority of a visiting Danish scholar, J. Steenstrup, convinced Wankel that man was not contemporaneous with the mammoth nor did he hunt them. In his later works, Wankel accepted Steenstrup’s view that later hunters of the ‘reindeer age’ would have come
to the site to explore bones from earlier natural bone deposits. As soon as the larger and more systematic excavation was initiated at Dolní Věstonice in 1924 by K. Absolon, all doubts about man and mammoth contemporaneity disappeared and the idea of ‘mammoth hunters’ was widely adopted in both scientific and popular literature. However, L. Binford’s critical work concerning the pattern of human hunting in general and revision of the Moravian mammoth hunting by O. Soffer et al., (2001), raised further doubts about human capacity to hunt as large animals as the mammoth. We agree that the model of ‘mammoth hunters’ during the Palaeolithic should be considered and tested separately, from case to case.

- Recent archaeozoological analysis of the mammoth bone deposits in the Gravettian of Moravia and southern Poland show a certain preference for younger animals but no visible pattern in selecting particular type of bone and only few cut marks (Klíma, 1969; West, 2001; Svoďa et al., 2005; Oliva, ed., 2009; Musil 2010; Wojtal et al., 2012). Thus, our present arguments on the intentional human hunting of mammoth during the Gravettian may only be indirect:

- One of them is the spatial relationship of the sites to ‘mammoth environments’ such as the river valleys, to strategic locations and to side gorges that may have served as ‘natural traps’.

- Secondly, the faunal composition, in cases where the horse-and-reindeer component is restricted and the remaining faunal spectrum is dominated by smaller animals (hares, foxes, wolves, birds), would not have supplied sufficient food resources. Thus, the meat and fat content provided by the mammoth bone deposits must be calculated into the food consumption expected in such extensive and complex human settlements.

- Finally, the development and complexity of Gravettian technology and symbolism suggests that, if ever any Palaeolithic society would systematically attack as large animal as the mammoth, the Gravettians would represent one well equipped society in terms of material, knowledge and psychology.

The complex hunter-gatherers

Taking in account the complex, labour-expensive and successful character of the Gravettian, including apparent sedentism or semi-sedentism, evolved social structure, economic specialization and demographic estimations at these sites (reaching tens and seasonally even hundreds of individuals), one may consider classification of the Gravettians as ‘complex hunter-gatherers’ (Keeley, 1988; Arnold, 1993; Burch and Ellanna, eds., 1994). In a complex society, any ecological crisis may involve change of settlement and resource strategies, emigration or extinction (Halstead and Shea, eds., 1989). It also seems that the termination of human occupation in the Dolní Věstonice-Pavlov sites may roughly coincide with the gradual disappearance of the large herbivores from central Europe before and during the Last Glacial Maximum (MIS 2).

Technology and innovations

Technological innovation was one of the adaptive responses of the early modern human in the newly colonized northern zones of Eurasia. The artefacts from Dolní Věstonice-Pavlov sites witness a wide range of productive activities with stone, bone, ivory and perishable materials. Firstly, the lithic raw material supply was labour-expensive: even if various Moravian cherts were available in the vicinity of the sites (and widely used by the Early Upper Palaeolithic entities, for example), they were almost neglected by the Gravettians and a majority of the materials, flint and radiolarite, was imported from 100 to 200 or more km distances from north and east, following the geographic orientation of the Moravian corridor. Secondly, there is an evidence of fine and precise work in stone and ivory, and the sites are renamed for miniature lithic implements and ivory carvings. Finally, there is a high level of complexity of the chaînes opératoires, some of which were new and innovative in the Upper Palaeolithic context – polishing stone, production of ceramics, textiles and cordage.

The fact that baked clay figurines were produced in the Upper Palaeolithic at Dolní Věstonice I was recorded by H. Freising and K. Absolon as early as in the 1920s (Absolon, 1938a,b; 1945), during the 1950-1960s Klíma added another large collection from Pavlov I (Klíma, 1954) and last excavations at Pavlov VI showed that even small and episodic sites may include the same kind of activity (Svoboda, ed. 2011). Analytical results by Vandiver et al., (1989) clarify that the raw material was local loess, generally fired to temperatures between 500-800 °C. Microscopic observation also focuses on imprints preserved on the surface of the baked clay such as finger imprints, animal hair and textiles structures (Adovasio et al., 1996; Králík et al., 2008). This discovery of textile/basketry imprints in clay (Figure 10) opened discussions concerning, firstly, the very fact of weaving as early as the Upper Palaeolithic, then the variability of such technologies and finally their social meaning. Whereas Adovasio et al., (1996) recorded several types of textile constructions and cordage, additional photo documentation of the original pieces records predominantly regular rectangular patterns, usually in intervals of 1.5-2 mm, corresponding to textile structures
in the plain weave. Further perspectives of this research are provided by continuing photo documentation, by functional analysis of the related bone industries, but also a search for the rare textile patterns as recorded in the Upper Palaeolithic anthropomorph art.

In contrast to the Neolithic, when the technological principles of polishing stone had been used extensively for producing axes, ceramics for liquid container and textile for clothing, in the Gravettian their use was marginal, less ‘practical’ and in some cases rather symbolic.
Symbolic behaviour: rituals and art

Human communication, symbolic and ritual behaviour was, in fact, another adaptive response to the newly occupied landscapes and their climates, one not less important than any other technology. In Eurasia, there are a few places where a contextual approach to Upper Palaeolithic art may be addressed in full and the Dolní Věstonice-Pavlov area certainly represents one of them.

Symbolism occurred in Eurasia in two major stages. A few objects of decorative and symbolic meanings were associated to the Levallois-leptolitic and to the early backed blade industries and these may be, in fact, the first indications of spreading ‘modernity’ from Africa. Marine shells were collected, perforated and used for decoration, stone plaques were engraved and mineral ochre collected. At the same time, late Neanderthals of western Europe created simple items of personal decoration as well, be it independently or by acculturation. However, this first evidence of symbolism and ‘modernity’ (for example, d’Errico and Vanhaeren, 2007) represents just a humble prelude to the complexity of symbolic expression introduced later by the Aurignacian of western Europe and the Gravettian of central and eastern Europe.

The Gravettian art of Dolní Věstonice-Pavlov sites already shows a variability in terms of materials, techniques, forms and functions and may be classified along certain predetermined dichotomies: ivory carvings versus clay plastics, mobile art (that has been attached and carried around) versus static art (that fulfilled its role and remained in discard at place) and ‘long-term art’ versus ‘short-term art’.

Contrary to certain deep-cave sites of western Europe, the Gravettian open air settlements do not provide evidence for the separation of ‘sacred’ and ‘profane’ lives. This is especially true for the first ceramic production in south Moravia. Occurrence of the figurines, fragments and pellets correlates with the central settled areas, around hearths and, presumably, inside the hypothetical dwelling structures. There are either fragmented heads, extremities or complete bodies, anthropomorphic and zoomorphic (Figures 11-12). Humans are predominantly represented as females whereas the animals are mostly imposing and dominant species (mammoths, lions, bears, rhinoceros, capricorns, horses and owls). Some of them display intentional incisions, done while wet or deformations caused by thermal shock during and after heating. What does all this damage mean? One of the interpretations is a deliberate process where formation and destruction had ritual character and symbolic or magic meanings; another one is just a simple play (children’s fingerprints were identified in the clay). In any case, it seems that the processes was meaningful while the material was still wet and could be shaped. In this sense, burning the material into a hard shape equals a symbolic ‘death’.

The carvings in ivory are typical representations of the long-term art, requiring longer time to produce and showing polished surfaces from longer carrying around and other usages. They display a variety of zoomorphic, anthropomorphic and geometric forms (Figures 13-15), and especially the anthropomorphic symbols reached a sophisticated level of abstraction (Figures 16-18). Some carvings served for body decoration and supported the identity of their bearers (as ‘diadems’, pendants and other attachments, Figures 21-22). Others show notches for some kind of attachment or adjustment with organic materials. If attached to human bodies or forming part of interior scenes, these carvings became a part of everyday life.

In general, the art of Dolní Věstonice-Pavlov sites document a sophisticated play with complete and partial forms. These sites provided not only figurines but also separate body parts such as heads, legs, vulvas and breasts (Figures 16-19). Some of the stylized and reduced anthropomorphic shapes may evoke both female and male meaning – if female head and breasts are being transformed in shape of the male sexual organ (Figure 16). In this sense, the famous black ‘Venus of Věstonice’ may be viewed as a composition of male organ in the upper part and the large triangular vulva replacing the legs (Figure 20). As another example of a possible complexity of meanings, one of the engravings on a mammoth tusk (cf. Figure 4) is usually interpreted as a map of the Dolní Věstonice-Pavlov area (and has recently found a parallel in another tusk at Předmosti).

Mortuary behaviour: the burials

As early as 1892 the first male burial was found in Moravia, in the town of Brno, together with a larger masculine sculpture of ivory and an associated symbolic inventory. In 1894, an accumulation of more than twenty individuals, more or less fragmentary, was found at Předmosti. In both cases, the depositions were altered by postdepositional natural processes or human activities; the unique Předmosti collection has been destroyed at the end of the Second World War.

On the evening of 13 August 1986, skeletons of three young people were discovered at the top of the site Dolní Věstonice II. The central individual, of still unknown gender, was lain on the back, the right male on his belly and the left male also on his back, but slightly inclined towards the central person, with the both arms directed to his or her pelvis. Given the good state of preservation of the whole situation, it was clear from the first moment that the strange position had a meaning and a number
Figure 18. Dolni Véstonice I, stylized female breasts, used as a pendant. © M. Frouz.

Figure 19. Dolni Véstonice I, a vulva, modelled of clay. © M. Frouz.

Figure 20. Dolni Véstonice I, the Black Venus, modelled of clay. © M. Frouz.

Figure 22. Pavlov I, finely carved circles of ivory. © M. Frouz.

Figure 21. Pavlov I, typical 'diadems' of ivory, engraved with a complex geometric pattern. © M. Frouz.

Figure 23. Pavlov I, human teeth pierced and used as pendants. © M. Frouz.

Figure 24. Dolni Véstonice II, general view of the triple burial (individuals DV 13-15) during excavation, August 1986.
of possible answers were suggested. One of the questions was about a deliberate violence as a cause of the three simultaneous deaths. After a critical revision, however, as the soft tissues disappeared, it seems today that the damage recorded on the bones is postmortal – breakages on the skulls are due to pressure of the thick loess deposit, overlain over the bodies shortly after their deposition and a wooden log, interpreted originally as a mortal weapon, is just one of the numerous elements of a possible wooden construction protecting the burial. Of more interest are the central position and the still unknown gender of the individual in the middle. There is enough ethnographic evidence suggesting that such ‘between-gender’ personalities were believed to possess supernatural powers in the simple hunting societies.

In general, the sites of DV I, DV II and Pavlov I provided a sample of early modern human skeletons from ritual burials, including four adult males (DV 13,14,16, Pavlov 1), one female (DV 3), one sexually undetermined individual (DV 15) and a large number of human skeletal fragments and teeth dispersed in the cultural layers (Vlček, 1991; Trinkaus and Svoboda, eds. 2006; Trinkaus et al., 2010). The complete anthropological catalogue at Dolní Věstonice reaches up to file no. 64 and at Pavlov to file no. 33. The complete skeletons are as follows:

*Dolní Věstonice 3*, site DV I – upper part. Woman, 36–45 years, height 158−159 cm, minimum weight 56 kg, lying on side in crouched position, facing north-west, with red colouration of the skull and upper part of body, accompanied by ten perforated fox teeth.

*Dolní Věstonice 13*, site DV II – hilltop. Man, 21–25 years, height 168−169 cm, weight around 65 kg, lying on the left in the triple burial, on his back, slightly turned towards DV 15, oriented south to south-east, with colouration of the skull, with twenty perforated carnivore teeth and pendants of mammoth ivory.

*Dolní Věstonice 14*, site DV II – hilltop. Man, 16–20 years, 179–180 cm, weight 68 kg, lying on the right in the triple burial, on his stomach, oriented towards the south, with colouration on the skull, with three perforated wolf canines and pendants of mammoth ivory.

*Dolní Věstonice 15*, site DV II – hilltop. Individual of undetermined gender, 21–25 years, height 159 cm, weight 66–68 kg, the middle person in the triple burial, oriented towards the south, with colouring on the skull and pelvis, with four perforated fox teeth.

*Dolní Věstonice 16*, site DV II – western slope. Man, over 45 years, height 171 cm, weight 68–69 kg, lying in the foetal position on his side by a hearth, oriented towards the east, with colouration on the skull and pelvis, with four perforated fox teeth.

*Pavlov 1*, site Pavlov I – north-west. Man, 36–45 years, height 172–178 cm, weight 70 kg, evidently originally lying in a crouched position, but later disturbed due to the downslope movement of the sediment.

Contrary to Italy and France where burials have been recovered from cave sites, Moravian and Russian burials are deposited in the open air, usually in central parts of the large settlements. The human burials from the Dolní Věstonice-Pavlov area show patterns of uniformity in depositing complete human bodies, with a few additional artefacts, but covered by ochre, especially on the head and pelvis. In addition to the ritually buried skeletons, a considerably larger number of individual teeth and postcranial fragments were scattered over the central parts of the settled areas (Trinkaus et al., 2010). They may either belong to humans who never were buried ritually or be the remains of disturbed burials.

**Collapse of the Dolní Věstonice-Pavlov sites**

The collapse of this unique settlement agglomeration is related to impact of the Last Glacial Maximum (MIS 2) on climates and landscapes of the preceding Interplenioglacial (MIS 3) and, in consequence, on the complex hunter-gatherer’s society of the Moravian Gravettian. Advance of the Fennoscandinavian glacier southwards around 24 Ka BP evoked an interrelated system of climatic, faunal and floral changes in adjacent parts central Europe. Vast geographic zones, hitherto inhabited by Gravettian hunter-gatherer’s societies, were evacuated and the social system collapsed. The more specialized the resource exploitation strategy and the more complex the social structure, the stronger the consequences.

In any case, the Moravian corridor lost its importance as the main European communication axis. After the Last Glacial Maximum, large European cultural entities such as the Magdalenian and Epigravettian evolved in the west and the east of the continent separately. Areas like Moravia, lying just in the geographic centre of Europe, never regained their central role again – until the historical times and the present.
History and the current state of research

As early as 1659 we find first reference to enormous ‘Ante-Diluvial’ bones somewhere around Mikulov, but as late as a century ago, sites below the fields and vineyards on the slopes of the Pavlov Hills were still giving up only scattered bones, stone ‘knives’ or ‘flints’. At that time, major excavation projects were already underway in other parts of Moravia, at Předmostí and in several Moravian caves. A conceptual research at Dolní Věstonice, therefore, provided a good chance to make use of the previous experience and avoid the mistakes that came with too rapid excavation, inexact documentation and the dispersal of finds among private collections. Brno’s amateur archaeologists first contacted the renowned Vienna researcher, Joseph Bayer, who warned them against an amateur approach to such a promising and then practically intact site. Beginning in 1924 excavations in Dolní Věstonice were led by Karel Absolon, who conducted systematic research each year, already on behalf of an official institution – the Moravian Provincial Museum. Absolon amazed the world with a series of his unique discoveries until 1938, when south Moravia was occupied by the German Army. Absolon’s entire conception was innovative: not just a collection of artefacts or figurines, but a palaeoethnological reconstruction of the settlement and of its inhabitants as a whole. In addition to scientific publications, his discoveries were presented to the public at the Brno fairgrounds as a special exhibition Anthropos, today transformed into a modern pavilion in the nearby Pisárky park. Attaching such a pavilion to the Brno fairgrounds was a good strategic touch at that time, but from today’s perspective, a unique facility of this type would probably be more useful at an authentic archaeological site.

The importance of Dolní Věstonice was known to the German occupiers and to Dutch archaeologist, Assien Bohmers, whom they named to take over the excavation. Bohmers continued the excavation even during the middle of wartime, as the German Army stood as far as the Caucasus and Stalingrad. However, the end of the war had tragic consequences for the Moravian Palaeolithic research: many unique finds, especially human skeletal remains that were taken to the Mikulov castle for storage, were destroyed when the castle was burned. But the Black Venus and a number of other art objects remained in Brno and thus survive today.

After the war, leading Czechoslovak archaeologists began to plan an optimal strategy for future research in Dolní Věstonice. The lead was taken by the Institute of Archaeology, which became part of the structure of the Academy of Sciences in 1953, and this institution still continues in this task today. In addition, more systematic cooperation was established between various institutions and individual disciplines, especially in sciences. For several decades this research was led by Bohuslav Klíma. He expanded the fieldwork from Dolní Věstonice I to new sites Pavlov I and II and obtained additional collections of miniature clay plastics, ivory carvings and ornaments, and the first ritual burials of women (DV 3) and men (Pavlov 1).

Whereas the previous excavations had been more or less conceptual, prospective or systematic, during the 1980s the situation changed. When the artificial lakes were being constructed on Dyje River at the foot of the Pavlov Hills slopes, loess to build the dams was taken from two new, previously only guessed at sites numbered Dolní Věstonice II and Milovice I. As the industrial works progressed rapidly, the salvage excavation over a large area was under serious time pressure. At that time I joined the Bohuslav Klíma’s excavation at Dolní Věstonice, while excavation at Milovice was led by Martin Oliva from the Moravian Provincial Museum. The archaeologists’ efforts were crowned in 1986 with the discovery at Dolní Věstonice of a triple burial and a year later with the male burial.

In 1995, a newly-conceived Centre for the Palaeolithic and Palaeontology was founded as a part of the Institute of Archaeology of the Academy of Sciences Czech Republic (AS CR) and the field base at Dolní Věstonice has gradually been transformed into a depository and research institute. Besides a complete processing and publication of the already accumulated evidence, the Centre has undertaken further field research on previously-known and newly-discovered sites (Dolní Věstonice II, Ila, III, Pavlov II, VI and Milovice IV). The Gravettian layers continue to be uncovered and threatened by industrial terrain works, building activities and chance situations such as the 2009 incident when a road collapsed into forgotten cellars beneath the village of Milovice. In addition, the methodological progress and the application of new scientific methods require re-opening the sites and sections in the field, revision of the situations and new sampling. Furthermore, the Centre for the Palaeolithic and Palaeontology carries out archaeological and ethnoarchaeological research at Upper Palaeolithic open air sites in the Moravian corridor (Stránská skála, Předmostí, Petl’kovice), in caves and rockshelters in the Czech Republic (Moravian Karst, North Bohemian sandstones) and abroad (Africa, Siberia...
and so forth). Since 1994, the results are published as part of the interdisciplinary monograph series The Dolní Věstonice Studies (Studies in Palaeoanthropology and Palaeoethnology of Eurasia), which thus far consists of nineteen volumes. Finally, the Centre also organizes topical conferences.

**Site conservation, presentation and future strategies**

Dolní Věstonice and Pavlov are currently living, wine producing and expanding south Moravian villages and the archaeological sites serve either as cultivated fields or vineyards. Broader regional attraction is framed by the unique, monumental mountain chain of Pavlov Hills just above the sites, already claimed as a UNESCO Biosphere Reserve and by the nearby Lednice-Valtice Castle and parkland area listed on UNESCO World Heritage List.

In 1979 the Regional Museum in Mikulov, in collaboration with the Institute of Archaeology (AS CR) set up a modest exposition in an old city hall in the centre of the Dolní Věstonice village. Although extensively reorganized in 1997, a modern conception is still required to fit with the importance of these sites. In 2009, a system of informative panels was set in the field at the sites of Dolní Věstonice I-III and Pavlov I.

Given the municipal and private building activities anticipated by the regional development plan at Pavlov, the strategy of the Institute of Archaeology (AS CR) is to reserve selected zones for protection and others for construction under archaeological supervision. The sites of

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*Figure 26. Dolní Věstonice II, skull of DV 13 in situ.*

*Figure 27. Dolní Věstonice II, skull of DV 14 in situ.*

*Figure 28. Dolní Věstonice II, skull of DV 15 in situ.*

*Figure 29. Dolní Věstonice II, skulls of the individuals DV 13-15. © M. Frouz.*

*Figure 26. Dolní Věstonice II, skull of DV 13 in situ.*

*Figure 27. Dolní Věstonice II, skull of DV 14 in situ.*

*Figure 28. Dolní Věstonice II, skull of DV 15 in situ.*

*Figure 29. Dolní Věstonice II, skulls of the individuals DV 13-15. © M. Frouz.*

*Figure 30. Pavlov I. Project of future authentic museum and archaeopark. © R. Květ.*
Dolní Věstonice I-II and Pavlov I were proposed for protection as a National Cultural Monument in 2004 and were claimed by the government in 2010, with the perspective of creating an archaeopark at Pavlov in the future. Private house construction has been approved and is supervised archaeologically in the sectors south-east of the village.

In this situation, our main effort today focuses on realization of the Archaeopark project at Pavlov, in collaboration between the Regional Museum in Mikulov and the Institute of Archaeology (AS CR). We may use previous experience from another authentic field exhibit already opened at Předmostí in 2006 (Svoboda, ed., 2013). As for Pavlov, the new architectural project proposed by R. Květ combines a modern museum with authentic excavation area (selected part of the Pavlov I site) and with an experimental background around (Figure 30).

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Approaches to the Palaeolithic archaeological record in Eurasia
Neanderthal adaptation: the biological costs of brawn

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Introduction

Human beings today are a strikingly unique species. We practise an unusual form of locomotion, not matched in any other mammal; and adaptations to this obligate bipedalism permeate virtually every aspect of our biology. Our brains reflect a high degree of encephalization, particularly in the neocortex, which is reflected in the expanded, globular form of our crania. By contrast, our faces are relatively small and project only slightly forward from the front of our neurocranium (or cranial vault). Also, we lack the exaggerated anterior teeth (incisors and/or canines) that characterize most other primates. While these and other aspects of our biology are certainly defining features, the fact is that we are most distinctive in terms of our behaviour. The complexity of our behaviour clearly derives from the encephalization of our brains, but understanding in detail the biological underpinnings of complex behaviours is in itself a complex undertaking. Still, there is no doubt that the basis of human behaviour, including our most unique feature – culture, is strongly tied to the complexity of the human neocortex, nor is there doubt regarding the pivotal role of culture as an adaptive mechanism in humans, especially in modern humans.

Prior to the appearance of anatomically modern people, Europe, western and much of central Asia were inhabited by a human form that was very much like today’s humans. In terms of anatomy, the differences between them seem rather minor when measured in the context of overall primate diversity. Behaviourally, these pre-modern people exhibit a cultural complex quite similar to the first modern people in west Asia or Africa, while in Europe early modern human culture appears far more sophisticated. These western Eurasian pre-modern people were the Neanderthals, arguably the best known, non-extant organism in the fossil record. The recent sequencing of the draft Neanderthal genome demonstrates that these people are 99.7% identical to recent humans (Green et al., 2010), making them our closest relatives in the organic world. So despite the anatomical and behavioural distinctions, nothing has ever lived that is more like modern people than were the Neanderthals.

The Outstanding Universal Value of Neanderthals

It is this closeness to us that defines, in part, the Outstanding Universal Value (OUV) of Neanderthals. A fundamental aspect of the OUV of Neanderthals lies in documenting the biology and behaviour of the organism most like us, but there are other important issues that extend beyond this documentation. Understanding why Neanderthals differ from living humans provides a context for assessing the true uniqueness of what it means to be a modern human, both in terms of biology and behaviour. Furthermore, documenting what made it possible for modern humans to prevail over the Neanderthals after a relatively short period of overlap and contact is critical. Particularly in Europe, the ultimate prevalence of modern humans emphasizes the crucial role of cultural adaptations as effective buffers against the environment in ways that biological adaptations cannot match. Finally, the OUV of understanding Neanderthals lies in the recognition that even relatively complex adaptations can fail, including those that define very ‘advanced’ organisms like the Neanderthals. That recognition emphasizes an important reason for understanding the uniqueness, but also the vulnerability, of modern people.

An additional aspect enhancing the OUV of Neanderthals is historical. The discovery of a calotte and fifteen postcranial bones from the Kleine Feldhofer Grotte, a cave in the rugged and picturesque Neander Valley (Neanderthal) of what is now western Germany, was the first fossil hominin specimen to be recognized (Schmitz, 2006). This specimen initiated the ongoing debate concerning the role of these early humans in the ancestry of modern people, a debate that stands as one of the longest in modern science (Spencer, 1984). Actually, two Neanderthal specimens were discovered before the Feldhofer specimen. These were the child’s skull from Engis (Belgium) in 1829 or 1830, and the adult partial cranium from Forbes Quarry (Gibraltar) in 1848, but these were not recognized as Neanderthals until later (see Cartmill and Smith, 2009). In 1864, William King formally established the taxon Homo neanderthalensis for the Feldhofer specimens (King, 1864) and today the debate continues whether to recognize Neanderthals as a separate species (see Klein, 2009) or to classify them as the subspecies H. sapiens neanderthalensis (see Cartmill and Smith, 2009).
The final piece of Neanderthals’ Outstanding Universal Value is the demonstration that they are part of our ancestry, not entirely a closely related off-shoot of the later human family tree. Current evidence strongly indicates that the majority of the biology of modern humans, both genetic and morphological, derives from Africa and spread throughout Eurasia (and subsequently to other parts of the world) beginning around 100 kya (thousand years ago) (Pearson, 2013; Bräuer, 2008; Klein, 2009; Francis and Holliday, 2013; Smith, 2010; Cartmill and Smith, 2009). Some researchers have long argued that morphological evidence indicates at least some contribution of Neanderthals to modern populations in western Eurasia (see Ahern et al., 2013; Caspari and Wolpoff, 2013; Smith2013; Trinkaus, 2011, 2013 for recent discussions of this evidence). However, the morphological evidence has now been supported by genetic evidence (Green et al., 2010; Reich et al., 2010; Sankararaman et al., 2012; Prüfer, 2013), which demonstrates that Neanderthals interbred with both early modern humans and other presumably archaic peoples (e.g. the Denisovans). This interbreeding seems to result in only a small contribution of Neanderthals genes to modern gene pools, an observation also supported by the morphology (Smith 2010, 2013), but there are indications that these contributions are significant for the success of modern humans (Abi-Rachel et al., 2011; see also Prüfer et al., 2013). Also, given the demonstrable changes in European gene pools over the last few millennia (Brandt et al., 2013), it may also be that the original contribution of Neanderthals was somewhat larger that comparisons with recent modern Europeans demonstrate. In any event, the fact that Neanderthals are demonstrably a part of our ancestry contributes further to their Outstanding Universal Value.

Neanderthal geography and chronology

A critical mass of evidence indicates that Neanderthals emerged in Europe, having gradually evolved from earlier European hominins (Hublin, 2009, 2013a; Smith, 2010). These earlier Europeans were the Heidelbergs (Homo heidelbergensis or H. sapiens heidelbergensis) (Stringer, 2012) and they gradually exhibited more and more Neanderthal-like features over time (Hublin , 2010, 2013a; Smith, 2010). The first hominin sample to exhibit the full range of Neanderthal morphology derives from the German site of Ehringsdorf (Smith, 1984), dated to more than 200 kya (thousand years ago) (Street et al., 2006) and perhaps to c. 230 kya (Blackwell and Schwarcz, 1986). After Ehringsdorf, all European specimens are attributable to Neanderthals until the arrival of modern humans (Cartmill and Smith, 2009; Smith , 2013; Ahern et al., 2013).

The geographic distribution of Neanderthals, based on biological data, is illustrated in Figure 1. Not all Neanderthal fossil sites are included in Figure 1, but the range of the group is accurately represented. Perhaps the most significant difference between this and earlier distribution maps is the presence of Neanderthals much farther east and north than previously known. This is based on evidence of Neanderthal morphology in bones from Okladnikov Cave (Krause et al., 2007a) and genetic material from Denisova Cave (Reich et al., 2010), both in the Altai region of Siberia. In addition, archaeological evidence suggests the possibility that Neanderthals spread even farther north. At site of Byzovaya in the Polar Urals, lithics indicate the possible presence of Middle Palaeolithic peoples between 31 and 34 kya near the Arctic Circle (Slimak et al., 2011), some 500 km
Approaches to the Palaeolithic archaeological record in Eurasia

farther north than the Siberian Neanderthal sites. Mousterian artefacts associated with mammoth bones bearing cut marks also are known from the Russian Arctic at c. 37 kya (Pavlov et al., 2001). This evidence indicates the Neanderthal ability to deal with cold, inhospitable conditions might be even more effective than generally thought. Unfortunately it cannot be conclusively demonstrated that the people involved were Neanderthals.

The earliest possible dates for Neandertals in western Asia are based on thermoluminescence values from Tabûn Cave level C and stand at 170 kya (Mercier et al., 1995). No current dates in central Asia indicate the presence of Neandertals before 50-60 kya (Franciscus and Holliday, 2013). This, along with the relatively gradual appearance of Neandertal morphology in Europe, suggests that Neandertals initially emerge in Europe and subsequently radiate into their Asian range. A surprising indication of Neandertal spread in a different direction comes from North Africa. On the basis of morphology, it has long been suggested that Neandertals may have influenced North African archaic human populations (Simmons and Smith, 1991; Smith et al., 2012), but this claim has recently been bolstered by genetic evidence (Sánchez-Quinto et al., 2012). This indicates that Neandertals were able to traverse the Strait of Gibraltar, which would have been narrowed somewhat during glacial events but was never absent.

In Europe, Neandertals associated with Mousterian cultural materials persist until 32,400 radiocarbon years ago, as demonstrated by finds from level G1 at Vindija Cave in Croatia (Higham et al., 2006; Janković et al., 2011). Several localities yield Neanderthal fossils younger than 40 kya (Cartmill and Smith, 2009); and deposits containing Mousterian tools, but no Neanderthal fossils, are dated as recently as 28 kya, particularly in the southern portions of the Iberian Peninsula (see review in Klein, 2009). The most recent dates for Neandertal specimens in western Asia are ESR dates of 43-48 kya at the Amud Cave in Israel (Schwarz and Rink, 1998). In central Asia, dates are sparse. The most recent date associated with a Neanderthal fossil is from Mezmaiskaya in the Caucasus. A Neanderthal infant specimen here was once dated at less than 30 kya, but more precise dating yields an age of 39 kya (Pinhasi et al., 2012) or perhaps even older (Prüfer et al., 2014). Other dates, further east in central Asia, suggest a similar temporal pattern (Krause et al., 2007a).

Some late European Neandertals are also associated with what are termed Initial Upper Palaeolithic, not Mousterian, cultural contexts (Churchill and Smith, 2000; Hublin, 2013b). Seemingly secure associations between Neandertals and Châtelperronian levels at sites like Saint-Césaire and Grotte du Renne (Arcy-sur-Cure) in France have been challenged (Bar-Yosef and Bordes, 2010) but still are eminently defendable (Hublin 2013b). The Châtelperronian dates from c. 34 kya to 39 kya and contains tool types and other artefacts normally associated with the Aurignacian or later Upper Palaeolithic (see Klein, 2009). A similar situation may also characterize Vindija (Janković et al., 2011), but it is difficult to rule out artificial mixture in portions of this site. Other IUP cultures are known (Churchill and Smith, 2000; Hublin, 2013b), but only the Italian Uluzzian is associated with fossil hominins. The two deciduous teeth from the Uluzzian at the Grotta del Cavallo may represent the first presence of early modern people at 43,000-45,000 radiocarbon years ago (Benazzi et al., 2011). How Neandertals came to be associated with cultural markers more generally associated with early modern people in Europe is a matter of some debate. Possibilities include independent development by some late Neandertals as suggested by Zilhão (2006, 2011) and this garners some support by relatively early dates for the making of bone tools by Neandertals that do not mimic their stone tools (Soressi et al. 2013). This has been supported by relatively early dates for the making of bone tools by Neandertals that do not mimic their stone tools (McPherron et al., 2013). However, the relatively late appearance of these innovations during the Neandertal time span, as well as other factors, strongly suggest that this results from contact between late Neandertals and early modern people who entered Europe between 35 kya and 40 kya (Churchill and Smith, 2000; Hublin, 2013b).

Neandertals – a biological review

The biology of Neandertals is arguably better understood than that of any extinct organism. Not only do we have large samples of virtually every Neandertal skeletal element, but much is also known about both the mitochondrial and nuclear Neandertal genome. Studies of bone chemistry have given insights into their diet, as have analyses of dental wear and phytoliths preserved in dental tartar. Because many known Neandertal specimens are subadults, their patterns of growth and development are also well-documented. Finally, researchers are able to estimate aspects of Neandertal physiology based on the extent of biological information available for these early people.

Neandertal anatomy has been discussed in considerable detail in a number of recent publications (Cartmill and Smith, 2009; Klein, 2009; Condemi and Weninger, 2011; Smith, 2010, 2013; Harvati-Papatheodorou, 2013; Smith and Ahern, 2013). While some issues will require more specific references, these sources will provide the basis for the following discussion of Neandertal palaeobiology. Neandertals are distinctive anatomically; however, their differences from us have been exaggerated. In the late nineteenth and early twentieth centuries, Neandertals were often presented as ‘missing links,’ with specifically ape-like features generally emphasized (Boule, 1921). This is understandable, at least in part for historical reasons, but today it is clear
that Neanderthals are fundamentally no more ape-like than are modern people. Still, the reasons behind their differences from us give important insight into who they were and who we are.

Neanderthal bodies were powerfully built. This is reflected in the thick cortical bone in their pectoral and pelvic limb bones, and their enlarged joint surfaces. These characteristics indicate an adaptation to the generation of, and resistance to, high levels of muscular force. The thickening of long bone shafts would provide high resistance to bending forces acting on the bone and this is also reflected in the anterior-posterior bowing of Neanderthal femora (Ruff et al., 1993; Trinkaus et al., 1999). Hand anatomy also indicates powerful musculature, as does the bowing of the radial shaft and the position of certain muscle attachments in the forearm (Trinkaus and Churchill, 1988; Niewoehner, 2006). All this suggests a high level of strenuous musculoskeletal activity for Neanderthals. However, such indicators of powerful musculature are generally not unique to Neanderthals, although some details may be. Rather they are generally primitive retentions that also characterized earlier members of the genus Homo (see Cartmill and Smith, 2009) and some are still found in early modern humans in western Eurasia (Trinkaus et al., 1998).

In addition, Neanderthals exhibit relatively short, stocky limbs, particularly in the forearm and lower leg. The relatively foreshortened forearms (radius/ulna) and lower legs (tibia/fibula) correspond to the pattern seen in modern populations with long-term adaptations to very cold conditions (Holliday, 1997; Ruff et al., 2002). The shorter distal limbs lower the relative surface-to-volume ratios of Neanderthal appendages, which enhance heat retention and correspond to well-known patterns in cold adapted mammals. Furthermore, Neanderthal trunks were characterized by very broad pelvic girdles (Ruff and Walker, 1993) and barrel shaped thoraces (Franciscus and Churchill, 2002). At least one distinctive Neanderthal postcranial feature is also likely related to the broad, barrel-shaped thorax. Neanderthal pelves are characterized by superior pubic rami that are elongated and markedly thinned (see Cartmill and Smith, 2009; Klein, 2009). The ramus connects the hip joint area to the front of the pelvis. Elongating it would both broaden the pelvic girdle and extend the lower thorax more ventrally, thus enhancing the barrel shape of the thorax and increasing the volume of the thorax relative to body surface. Some of these features are also seen in Neanderthal ancestors (Cartmill and Smith, 2009), as well as other high latitude adapted archaic humans (Rosenberg and Wu, 2013) and so again are not totally unique to them. Still the extent of the heat-retaining features does suggest a strong biological adaptation to cold, which appears to uniquely characterize the Neanderthals.

In like manner, Neanderthal muscularity and robustness certainly reflects a strongly biologically based adaptation to a life way in which strength, power and the ability to master demanding tasks over demanding terrain were a necessity. The anatomical basis for such adaptations is energetically expensive, both in terms of growth and development and in maintenance (Froehle et al., 2013), so the retention of this power complex must have resulted from positive selection rather than some stochastic factor. This positive selection certainly stemmed in large part from hunting big and dangerous Pleistocene megafauna, on which Neanderthals apparently focused (Gaudzinski-Windheuser and Niven, 2009, Niven et al., 2012; Miracle, 2007; Speth, 2012), potentially without modified projectile weaponry. More mundane tasks were likely significant as well; but whatever the specific activities were, they were not unique to the Neanderthals. While early modern humans were also powerful people, the pattern of expression is different. Long-bone cross-sections approach those of recent humans as do cortical thicknesses (especially in the femur), aspects of bone shape (for example, in the radius and scapula) and in features relating to muscle attachment (Ruff et al., 1993; Trinkaus et al., 1998, 1999; Cartmill and Smith, 2009).

A lateral view of a Neanderthal skull clearly illustrates obvious differences from an early modern European skull (Figure 3). Neanderthals have lower cranial vaults characterized by low, receding frontal bones and angular occipital bones, and faces that exhibit pronounced prognathism compared to early modern specimens. However, the features that seem to stand out to many are the presence of a thick, projecting supraorbital torus, a markedly enlarged nasal opening (Figure 4) and the absence of a distinctive mental eminence (or chin). Actually these features are also largely primitive retentions, seen in earlier Eurasian members of the genus Homo and some are even seen in earlier hominins (Smith, 2010, 2013). Of course, again there are differences. Neanderthals exhibit an altered pattern of prognathism relative to earlier Homo in that lateral facial prognathism is reduced, a phenomenon known as zygomatic retreat (Trinkaus, 1987; Smith and Paquette, 1989). There is also some indication that Neanderthals exhibited more projection of the midface, especially at the level of the nasal bridge, than earlier Homo (Rak, 1986; Spencer and Demes, 1993). If this is so (but see Trinkaus, 2003), upper midfacial prognathism is a unique feature of Neanderthals, along with the pattern of zygomatic retreat.
Neanderthal faces overall were large both in length and breadth measures. To some extent, this is due to their large nasal apertures, but other factors are involved as well. For example, it is well-documented that Neanderthal anterior teeth (incisors and canines) remain much larger than in modern humans while the posterior teeth fall well within modern ranges (see Smith, 2013 for a review). Smith and Paquette (1989) and most recently Le Cabec et al., (2013), have shown that Neanderthal anterior dental roots are both thicker and longer than those of modern humans. In order to accommodate these roots, the Neanderthal face, especially the anterior alveolar processes of the maxilla and mandible, would have to be expanded accordingly. However, given the trajectory of facial growth in mammals (Enlow and Hans, 1996), the Neanderthal face would have to grow not only in length (and the anterior alveolar processes in breadth), but also in an anterior direction. This, of course, would result in maintenance of the midfacial prognathism that characterized Neanderthals, even when the lateral facial prognathism is reduced. A midfacially prognathic face would result in a receding mandibular symphysis, the masking of a projecting chin structure and likely also the unique features of the Neanderthal infraorbital region (as described by Rak, 1986). As detailed elsewhere (Cartmill and Smith, 2009), it would also require the presence of a supraorbital superstructure to maintain structural congruity between a prognathic face and the anterior neurocranium.

The large anterior teeth additionally exhibit extensive dental attrition and damage, leading to the argument that these teeth were used for extensive non-masticatory functions – the teeth as tools hypothesis (see Cartmill and Smith, 2009; Klein, 2009 for reviews). These anterior dental features have often been presented as unique features of Neanderthals. However, the large anterior teeth, as well as the basic pattern of supporting architecture and facial prognathism are all features that Neanderthals derived from their ancestors. Heidelbergs and their ancestors also exhibited these features. Rather than being extraordinary in terms of anterior tooth use, Neanderthals are just following a trend that extends much further back in human biological history.

Coon (1962) argued that the large Neanderthal nose related to cold adaptation and that this drove the typical Neanderthal beaked face (midfacial prognathism). It did so presumably by lengthening the airway so that air could be adequately warmed before reaching the lungs. However, the very large Neanderthal nose is the opposite of what is seen in cold adapted modern people. Churchill and colleagues (2012; Froehle et al., 2013) have noted that the body form and high activity levels of Neanderthals would have required expanded levels of oxygen inhalation and that this explains the enlarged nose.
in Neanderthals. Of course, an enlarged nose characterizes the genus Homo long before the Neanderthals (Franciscus and Trinkaus, 1988) and thus represents yet another primitive retention in Neanderthal morphology.

**Neanderthal biological adaptation – necessity and cost**

The Neanderthal biological adaptation to cold is striking and certainly was developed and maintained at a high biological cost to these organisms. The obvious question is: why was this necessary? During the Pleistocene, there were times when climatic conditions in Europe were relatively favourable, much as they are today. Figure 5 illustrates vegetation zones estimated for the last major interglacial period based on data in Kuchera (2009). Boreal forests are limited to the extreme north of Europe and deciduous forest characterizes much of the continent. However, during phases of glacial advance (Figure 6) the situation is quite different, with alpine tundra dominating even the middle part of the continent and boreal forests distributed very far south. While it is unlikely that Neanderthals lived extensively on the tundra, even life in southern Europe would have been extremely difficult from the standpoint of cold stress.

Based on data from central Europe (Kuchera, 2009), it can be suggested that colder conditions were more characteristic of the Pleistocene than warmer conditions (see also Klostermann, 2006). Figure 7 presents an estimate of mean annual temperatures in central Europe for the Pleistocene. In general, more than 95% of the Pleistocene witnessed mean annual temperatures colder than today and a significant span would have seen mean annual temperatures at or below freezing.

Based on these estimates, the cold stress on Neanderthals, their ancestors and their successors in Europe would have been regularly quite intense. Neanderthals clearly had cultural adaptations to buffer them from the cold. Their sites regularly show use of fire, although hearth areas are often relatively small and not as elaborate as those made by their Upper Palaeolithic successors (Klein, 2009; but see also Balter, 2009). Also, they must have covered their bodies with hides or other materials (Aiello and Wheeler, 2003; Wales, 2012) and, although there is no evidence of tailored clothing or the tools (such as bone needles, pins and awls) that would infer this ability (Mellars, 1996). Furthermore, although Neanderthals certainly utilized caves for shelter, there is little evidence for types of artificial shelters associated with the
Mousterian but somewhat more for the Châtelperronian (Klein, 2009). Thus the aforementioned climatic conditions, combined with the level of cultural evidence of cold adapted behaviours, explain the necessity for the high level of biological adaptations in body form exhibited by the Heidelbergers in Europe and their descendants, the Neanderthals. In fact, Holliday's (1997) data on body form show that Neanderthals have a more extreme adaptation than modern cold-adapted people, leading him to describe them as ‘hyper-polar’ in adaptation.

Since European Heidelbergers produced well-made totally wooden throwing spears (Thieme, 1997, 1999), it is reasonable to assume Neanderthals had similar technology; and the wooden spear found in the midst of elephant ribs at Lehringen (Germany) support that assumption (Movius, 1950). Still, the majority of Mousterian tools suggest that most tools were used in close quarters with prey animals and that considerable muscular power was necessary for their use (Mellars, 1996; Klein, 2009). These cultural factors are fully commensurate with the indicators of greater musculoskeletal exertion reflected in Neanderthal postcranial anatomy. The powerful bodies of Neanderthals were necessary as a critical aspect of their subsistence (and other) activities and are a further indication of the strong biological basis of Neanderthal adaptation.

The distinctiveness of the Neanderthal head primarily reflects retention of primitive features rather than novel adaptations that evolved only in them. The key factor, from my perspective, is the maintenance of the large anterior teeth, which necessitated expanded roots and the supportive architecture discussed in the previous section. Development of the larger tooth crowns during ontogeny and of the supporting structures were, as in the case of the postcranium, energetically very expensive, as was maintenance of these structures during life. Although the exact factors are not known, the retention of these features must have been under relatively strong selection. Behaviourally, Neanderthals and earlier hominins must have regularly used their teeth in ways modern people do not, even if those exact uses are unknown. Thinking of the retention of large anterior teeth and related morphology as secondary to selection for something else just does not make adaptive sense to me. Regardless, the presence of these structures certainly reflects an additional biologically based adaptation on the part of Neanderthals.

Of course, Neanderthal cultural abilities certainly buffered them to a considerable extent from the demands of their environment, but the importance of Neanderthal biologically based adaptation to life cannot be overestimated. That adaptation came at a high cost to the Neanderthals. Studies by Churchill and colleagues (2012; Froehle et al., 2013) estimate that an archaic human male of average mass (78 kg) would have needed a basal metabolic rate (BMR) of 1791 kcal/d (kilocalories per day), about 167 kcal/day (or 9%) more than an early modern human male of average mass (67 kg) and 338 kcal/d (18%) more than an average male of average mass (78 kg) would have needed a BMR of 1791 kcal/d (kilocalories per day), about 167 kcal/day (or 9%) more than an early modern human male of average mass (67 kg) and 338 kcal/d (18%) more than an average recent subsistence-level male (57 kg) simply to meet basal metabolic needs. For females, they estimate an average archaic human female (65 kg) would have needed a BMR roughly 86 kcal more per day than an average early modern human female (59 kg) and roughly 209 kcal more per day than an average recent human female (49 kg). These estimates do not allow for the effects of climate and when climate is considered a Neanderthal male in Europe might have required a BMR about 14% higher than an early modern African. This means that Neanderthal diets would have had to be extremely calorie and fat rich to provide for the biological needs of these people. Such a diet would have required a level of meat protein only obtainable by intense, skilful hunting (Richards et al., 2000; Kuhn and Stiner, 2006) and extraction (Speth, 2012). This pattern of subsistence would have required the powerful bodies exhibited by Neanderthals, which in turn would have added substantially to their energy requirements. Added to these demands are the ontogenetic and maintenance costs of large anterior teeth and their supporting architecture, and the energy demands placed on Neanderthals were likely higher than these estimates.

**Figure 8. Standard energy budget expenditure categories.**

**Biological adaptation and the doom of Neanderthals**

Neanderthals were engaged in a daily struggle to support the biology that made their survival in Pleistocene western Eurasia possible. Total energy budgets can be viewed as presented in Figure 8. Studies by Leonard and colleagues (Leonard and Ulijaszek, 2002; Leonard et al., 2007) indicate that the vast majority of human energy (upwards of 90%) is spent on maintenance, including the BMR. Assuming Neanderthals have a higher BMR than recent humans, that percentage may be higher. In addition, both growth and reproduction must come out of the already smaller production budget. Again assuming Neanderthal ontogeny is more energetically costly, this likely means there is very little of the energy budget remaining for reproduction. Froehle and colleagues (2013) provide more detail on the makeup of these various components and energy utilization in each.
This almost certainly means that Neanderthal reproductive rates were reduced compared to modern people, which in turn suggests that Neanderthal population sizes were small. Small Neanderthal population sizes are also indicated by aspects of their genetic structure (Febre et al., 2009; Prüfer et al., 2014) and archaeological estimates of their relative density compared to modern Palaeolithic people (Hassan, 1981; Mellars and French, 2011; Klein, 2009). The relative rarity of Neanderthals on the landscape made them particularly vulnerable to humans with greater fecundity. The extent of the impact of such humans on Neanderthals was illustrated by Zubrow (1989). Using demographic simulation, he showed that only a 2% demographic advantage to moderns would result in apparent Neanderthal extinction in only 30 generations. When you add all the other inherent disadvantages that a smaller, indigenous population has in the face of larger immigrating populations (Levin, 2002), it is not surprising that Neanderthal morphology and culture disappeared so quickly.

The modern human advantage

It has long generally been assumed that modern humans of the European Palaeolithic were culturally superior to the Neanderthals (Boule, 1921). Even early Upper Palaeolithic assemblages exhibit much more diversity of lithic tools, as well as an elaborate bone implement industry (see Klein, 2009), than the Neanderthals do. Only in the initial Upper Palaeolithic does this gap close somewhat and it is not certain that these cultural expressions can always be attributed to Neanderthals. Particularly noteworthy in the Upper Palaeolithic are the mobile art objects, often carved in bone or ivory and items of personal adornment (White, 2003; Conard, 2011). This aesthetic and seemingly symbolic fluorescence has been viewed as reflecting a fundamental cognitive difference between Neanderthals and early modern people, perhaps even indicating important differences in language abilities between these late hominin forms (Klein and Edgar, 2002; Klein, 2003). However, recent evidence indicates that Neanderthals were also capable of such behaviours, albeit in media that are not easy to recover or identify (Zilhão, 2011; Morin and Laurolan, 2012; Peresania et al., 2011). Furthermore, sequencing of Neanderthal nuclear DNA has revealed that the FOXP2 gene, a regulatory gene critical to the generation and comprehension of language, was identical to that of modern humans (Krause et al., 2007b). This is significant because FOXP2 was once claimed to set modern humans apart in terms of language ability. In fact, there is no convincing biological evidence that Neanderthals were less capable of language than modern people. Finally, since Neanderthal brain sizes (reflected in cranial capacities) statistically do not differ from those of early modern humans (Holloway et al., 2004) and there are no clear indications of significant structural differences in the external topography of the endocasts of Neanderthals and modern humans (see discussion in Smith, 2013), it is difficult to attribute the Neanderthal-early modern human cultural difference in Europe to any difference in intelligence or cognition.

It is easy to understand why the seeming difference in aesthetic behaviour has played so prominent a role in discussions of the cultural differences between Neanderthal and early Upper Palaeolithic people. However it is likely other factors that played the more pivotal role. As already indicated, Upper Palaeolithic people had a greater diversity of tools, including elaborate bone tools. They also had more effective pyrotechnology, built more substantial artificial shelters and had tailored clothing (see reviews in Trinkaus, 1989; Klein, 2009; Cartmill and Smith, 2009). In my opinion, it was this increased cultural complexity, particularly a demonstrably more sophisticated cultural buffer against the cold and cultural factors that reduced the necessity of musculoskeletal hypertrophy that ultimately provided modern humans the ability to outcompete the Neanderthals in the cold environs of Europe. Although the cold buffer factors are relatively clearly documentable, the specific factors that allowed the reduction of archaic levels for brawn are not as clear. Presumably these relate to better hunting implements and items that reduced the necessity of muscular force to accomplish subsistence-related as well as other tasks. Although logic dictates that increased complexity of tool forms in the Upper Palaeolithic would result in these improvements, it is difficult to isolate specific examples. That said, I contend that only after these technological achievements in both cold buffering and general adaptation were established was it possible for modern humans to finally enter Europe and rather quickly end some 200,000 years of Neanderthal dominance.

Current evidence demonstrates that modern human morphology emerges earliest in Africa (perhaps as early as 196 kya, but certainly by 172 kya), spreads into western Asia around 100 kya, but appears in Europe only relatively late (Pearson, 2013; Bräuer, 2008; Klein, 2009; Franciscus and Holliday, 2013; Smith 2013). Based on fossil evidence, the first solid evidence of modern humans in Europe occurs at 34.9 kya at the Peștera cu Oase, Romania (Trinkaus et al., 2003) and is common by 30 kya (Cartmill and Smith 2009). However, recent redating of the presumably modern Kent’s Cavern fragmentary maxilla from England to between 44.2 and 41.5 kya (Higham et al., 2011) and two presumably modern deciduous molars from Grotta del Cavallo (Italy) to 43-45 kya (Benazzi et al., 2011) suggests modern humans were in Europe earlier. If these dates and attributions are correct (but see White and Pettitt, 2012, for doubts on the Kent’s cavern maxilla’s association with the dates), the potential temporal overlap between Neanderthal and early modern fossils could be approximately 10 ky, since the latest dated Neanderthal fossils are 32 kya. It is also important to remember that the distinct cultural differences characterizing the European Upper Palaeolithic, and by proxy the appearance of early modern Europeans, are unique to the continent. Early modern humans in Africa and west Asia do not accompany such drastic cultural changes (see Klein 2009; Cartmill and Smith 2009). Thus the Upper Palaeolithic-modern human appearance connection is a distinctly European phenomenon.
Armed with these Upper Palaeolithic cultural adaptations, modern humans are finally able to deal with life in Neanderthal territory. As noted previously, archaeological evidence indicates that these Upper Palaeolithic peoples were much denser on the landscape than were the Neanderthals. The explanation for this is likely complex, but perhaps the most critical factor concerns energy budgeting. Since cultural factors replace much of the need for brawn and cold-adapted bodies, early modern people were likely able to channel more of that energy into reproduction and this increase fertility compared to the Neanderthals. Kuhn and Stiner (2006) and O’Connell (2006) suggest that moderns could also afford a more diversified dietary focus than Neanderthals, which would result in expanded food sources to support this larger population. The end result of this process was a fundamental demographic and genetic swamping of the Neanderthals, following what Levin (2002) terms ‘extinction by hybridization’ in which the morphological and genetic characteristics of indigenous species are simply overwhelmed by those of the invading organisms and quickly disappear.

Neanderthals were obviously ‘replaced’ by modern humans throughout their range, but that “replacement” actually involved considerable assimilation of Neanderthal contribution into early modern human populations. Morphologically, very little of Neanderthal influence is observable in early Upper Paleolithic people (Ahern et al. 2013; Smith 2013); however, comparable amounts of contribution are also indicated by the genetic evidence. As much as 2-4% (Green et al., 2010) or slightly less (Sankararaman et al., 2012; Prüfer et al., 2013) of modern Eurasian genetic makeup is derived from the Neanderthals. This process of extinction by assimilation of the Neanderthals was not due to aspects of differential intelligence, but rather to the triumph of a culturally-based adaptation over an energetically expensive, reproductively limiting, and largely biologically-based one. This phenomenon reflects the increasing importance and even dominance of cultural adaptations in human evolutionary history and underscores why the anthropological biocultural approach is critical to the understanding of the story of humanity –even in the Palaeolithic.

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Approaches to the Palaeolithic archaeological record in Eurasia


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Defining a Neanderthal site ‘Cluster’: reasons for international collaboration

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Introduction

The study of Neanderthals and their sites represents a compelling and unique narrative for our heritage, not just for the present state of scientific research, but also for the historical importance of the study of Neanderthal sites in the development of modern human origin studies. Historically, the discovery of Neanderthal remains marks the starting point of palaeoanthropology, the genesis of a completely new scientific discipline, and gave an indispensable push for the development of Palaeolithic archaeology. Neanderthal remains provided the first human witness for Darwin’s theory of evolution, changing the paradigm of our story of human origins and coinciding with the beginnings of modern society. Even today, Neanderthal research touches an exceptionally sensitive area of our thinking. It extends to the roots of how we perceive ourselves and to our conceptions of what it is to be human.

Beyond this critical historical importance, Neanderthals remain, quite literally, a living part of our human evolution; recent genetic research has shown that Neanderthal DNA accounts for 2.5% of the DNA of all people outside of Africa (Green et al., 2010). Despite the long history of investigation and the vibrant nature of current dialogues, there are several salient controversies which merit attention in the consideration of Neanderthal discourses. But Europe can be considered as the core zone of Neanderthal populations (Demarsin and Otte, 2006), with the near Middle East as the context for a second step of expansion. Dispersed over Europe, a cluster of outstanding sites, analysed by diversified multidisciplinary research, establishes the heart of the Neanderthal heritage. Rare biological features and extraordinary finds of the Neanderthal cultural capacity are highlighted at these sites. Due to the fragmentary status of Palaeolithic sites, the Neanderthal cosmos is explained today only by the combination of data and research results from these sites. The sites will serve as a benchmark for investigation, site conservation and management concerning Palaeolithic archaeology. International cooperation in key sites will make the unique Neanderthal heritage more visible as a whole and will raise awareness about it. At the same time cutting-edge conservation strategies and valorization programmes will become feasible. Joint work in the cluster will contribute to a new understanding of the processes – both past and present – that shape human culture as it is today.

The history of research

Neanderthals hold a unique role in the history of research on human evolution. The discovery of Neanderthal remains in 1856 at the eponymous site was the starting point for the development of a complete new scientific discipline called palaeoanthropology (Figure 1). At the same time these remains were the first human witnesses of the theory of evolution published by Charles Darwin in 1859. Therefore, Neanderthals are very closely linked to the dramatic change of the scientific
paradigm of our human history and the beginnings of modern society. Due to the enormous impact of their discovery and the formulation of the theory of evolution on society at the same time, the acceptance of Neanderthals as part of our human history has been a long and gruelling process in society as well as in science. The scientific approach to the Neanderthal phenomena was biased for a long time by ideological constraints and research errors (Auffermann and Weniger, 2006). The story of Neanderthal research is an unique example of how mythology exerted a dominating influence on the scientific process. The mythical figure of the wild man (Figure 2), going back as far as the Epic of Gilgamesh, was a persistent topos in occidental cultural memories that channelled the scientific image of Neanderthals.

In the last two decades a constant flow of new results from new research has led to a tremendous process of humanization of the image we have of Neanderthals. Therefore, the history of research of Neanderthals also tells the story about the development of scientific methods in the natural sciences.

Network of sites

We propose, as a first step, a network of ten sites from seven European countries that reflect the complete history of the Neanderthals and its meticulous formation. Each of the sites shows, by the history of research, its special findings and status of preservation, a unique building block of the overall picture. At the same time the mixture of these sites represents an example of best practice for cutting-edge research, site management, educational valorization as well as touristic and museographical expertise.

Neanderthal (Germany)

The history started in 1856 in a limestone gorge called Neanderthal, 15 km east of the city Düsseldorf (Schmitz and Weniger, 2006). During quarry works, bone remains were discovered in the Kleine Feldhofer Grotto. A local teacher and naturalist, Dr Johann-Carl Fuhlrott, identified the bones as remains of a fossil human man and initiated a compelling discussion on our human origins that continues until today (Figure 3). The cave and its surrounding valley were destroyed by the advancing quarry works, but the discovery and the site were well placed in memory of humanity.

The bones from the Feldhofer Grotto give excellent evidence for social care in Neanderthal society, contradicting the cliché of a brute beast. A badly healed fracture of the left forearm of a male Neanderthal resulted in a disability of his left extremity. Although the fracture happened during his adolescence, the male reached old age, which would have only been possible by being cared for by group members. The reduced movement resulted in a higher activity of the right arm that developed an extraordinary thickness of the cortical bone. This pattern was crucial in allowing a palaeogenetic analysis on a sample from the right humerus. In 1997, more than 140 years after its discovery, the eponymous find gave birth to a palaeogenetic breakthrough (Krings et al., 1997). For the first time it was possible to isolate DNA from a fossil human. This process illustrates the extreme
importance of conservation and the tremendous scientific potential of museum items more than a century after their discovery.

During limited excavations of the discovery site in 2000, the position of the destroyed Feldhofer Grotto could be relocated (Schmitz, 2006). Various bone fragments from Neanderthals and faunal remains as well as stone tools were recovered from a dump area in front of the former cave (Figure 5). Even today the area still holds a vast amount of Palaeolithic and palaeoanthropological remains from the Feldhofer Grotto. The discovery site itself is an archaeological park now and narrates the story of the discovery and its meaning to modern society. Together with the nearby Neanderthal Museum it is a first class touristic attraction that receives about 170,000 visitors per year. It is a conclusive composition of research, history, landscape and touristic quality.

Spy (Belgium)

The acceptance of Neanderthals as fossil humans was hotly debated and only with the discovery of more remains from two adult Neanderthal individuals at the grotto of Spy in 1886 was a majority of researchers convinced. This site was therefore an important building brick in the history of Neanderthal research. Additionally, the excavation at Spy was, for the first time, made up of a multidisciplinary research team composed of an archaeologist, a geologist and a palaeoanthropologist. This setting is a first class example of how research on human origins is organized. The reconstruction of our human history is a challenge that provides opportunity for the close cooperation of various scientific disciplines.

The grotto of Spy lies near a village of the same name, 16 m above the left side of the Orneau River in carbonic limestone. Thick deposits of the main entrance hall and terrace in front of the grotto show a rich accumulation of animal and human remains from various periods of time ranging from the Middle and Upper Palaeolithic to the Neolithic. Due to the fact that early excavations in the nineteenth and twentieth centuries resulted in poorly documented, only partially studied or even unpublished material, three interdisciplinary projects (TNT, MARS and Spy Action 1) were created between 2004 and 2006 to reassess all the collections from Spy grotto. This led to the discovery of new Neanderthal fragments, some of which could be associated with the two individuals found in 1886 and some which belonged to a very young Neanderthal child (Crevecoeur et al., 2010). These new found remains were dated to the late phase of Neanderthal existence prior to 40,000 BP, a period during which modern humans began to populate Europe, and the transition between the Middle and Upper Palaeolithic took place (Semal et al., 2009). Understanding this populating process and the cultural relationships between the two groups has been a major focus of palaeoanthropological research. These events again demonstrate the scientific potential of curated museum collections and what interdisciplinary projects can mean for the progress of archaeological research.

The Spy grotto is today the most famous Neanderthal site in Belgium. It is a touristic highlight open to visitors and is accompanied by an interpretation centre in the vicinity that shows the importance of the site and the Neanderthal lifestyle. The exploration of the grotto and the museum nearby are a perfect combination of archaeological sightseeing and communication of knowledge.

La Chapelle-aux-Saints (France)

For a very long time the image of Neanderthals was that of hairy apelike humans. Even half a century after the eponymous find in the valley near Düsseldorf, Neanderthals were not fully appreciated as a part of the human lineage. This misinterpretation partly traces back to the discovery of the first nearly complete Neanderthal skeleton to have been excavated at La Chapelle-aux-Saints at the beginning of the twentieth century (Delporte, 1984).

1908 was an important year for palaeoanthropology in France. Amédée and Jean Bouyssonie, two brothers and professors already known for their prehistoric research, found the first Neanderthal burial. A couple of years earlier they had noticed some silex artefacts in a small lime stone grotto called Bouflia near the village of La Chapelle-aux-Saints (Corrèze). They decided to excavate the site not knowing what their discovery would trigger. The study of the skeletal remains resulted in the first comprehensive and very detailed description of anthropological characteristics of Neanderthals thought to be typical for his species at the time. The study was published between 1911 and 1913 (Figure 4) by palaeontology professor, Marcellin Boule, and for many years served as a model of reference on this subject (Boule, 1911).
Unfortunately, a reconstruction based on the skeletal remains for a museum in Paris had some anatomical errors, mainly because few specimens had yet been available for comparisons in that period. The pathological features on the skeleton – pronounced osteoarthritis, a deformed hipbone and missing teeth – gave rise to an image of Neanderthals as hairy apelike creatures of bent composure with buckled knees and a distorted spine. For decades this was the leading opinion and the Archaeological Society had huge difficulties in reinstating the public image. Only during the second half of the twentieth century did various research studies establish a more accurate picture of Neanderthal anatomy.

A new reconstruction of the cranium (Figure 6) became essential for the remedy of the scientific errors. It was carried out at the Musée de l’Homme from 1984 to 1985 and it helped to better situate Neanderthals in human evolution. For the first time, detailed comparisons between cranial features of Homo erectus, Homo sapiens and Homo neanderthalensis could be undertaken. Analysis of the silex artefacts found in the grotto showed that Neanderthals exploited local resources, but also knew their environment so well as to get raw material from areas further away. Age determination of burned artefacts was achieved and dated the site to 56 to 47,000 years BP. A description of the lesions on the skeletal remains was published to refute pathological interpretations. And, of course, the most important fact reinstated Neanderthals as intelligent beings with social relations: the clearly dug depression where the dead Neanderthal was laid down represented an intentional burial.

These later studies contributed largely to a new image of Neanderthals and revealed their level of intelligence and cognitive abilities. A museum near the site, created by the initiative of the community of La Chapelle-aux-Saints, helps to remember the discovery of this particularly important fossil – a marker for scientific description and scientific bias. Inaugurated in 1996, it highlights the important role these fossil remains played in the development of human palaeontology. The Musée de l’Homme de Neanderthal ‘Jean Bouyssonie’ takes the visitors on a journey through time and shows the history of the fossil, the conditions of the find, but also its political and religious significance. With the comparison of the old and new reconstruction it explains the philosophy of that time and the long way to reinstitute Neanderthals as part of the human lineage. This whole history underlines the need for research and knowledge-conveying institutions to help the public understand that Neanderthals were not that different from us.

La Ferrassie (France)

Very soon after the extraordinary discovery at La Chapelle-aux-Saints another remarkable site attracted the attention of the archaeological community. The Grand Abri at La Ferrassie near Les Eyzies-de-Tayac-Sireuil (Dordogne) held a Neanderthal burial place in exceedingly good condition and a clear-cut and well preserved stratigraphy of sedimentary layers from the Middle and Upper Palaeolithic.

In 1896, Denis Peyrony obtained the right to excavate the site for 30 years after a rockshelter, having been buried by debris from a limestone quarry, was found due to roadworks. During extensive fieldwork between 1909 and 1921, Peyrony and his colleague, Louis Capitan, discovered seven Neanderthal skeletons of different ages and genders. In 1973 another excavation campaign led by Henri Delporte and Jean-Louis Heim, to clarify the stratigraphy and to take pollen and sedimentary samples for further research, unearthed an eighth individual.

La Ferrassie is in many ways one of the most important complex and complete sites in Palaeolithic research. First, the sedimentation showed a clear succession of thick archaeological layers representing Neanderthal occupation and the subsequent phase of modern humans. Studying the archaeological material Peyrony redefined the Upper Palaeolithic period of Aurignacian and created the term Périgordian, specifying a chronologically parallel layer and lithic tradition undefined until then. Although this term isn’t used anymore, his detailed observations helped establish and confirm most Upper Palaeolithic industries. Other positive results concerning the stratigraphy was the definition of the first complete Mousterian lithic inventory of the ‘La Ferrassie Type’ and the recognition of an evolution in lithic material from the Middle to Upper Palaeolithic raising more questions concerning transition industries. Sedimentary, palaeontology and pollen analysis held information about the flora and fauna of layers from the last glacial cycle discovering a transition layer between these two periods.
Secondly, La Ferrassie was one of the few sites known at that time with a high number of complete skeletal remains of Neanderthals in Europe. The fact that two adults and six children of different ages and genders were conveniently laid down in the same place during the Middle Palaeolithic Mousterian period in La Ferrassie held many advantages concerning archaeological and anthropological research. The very good conservation of the skeletons and their anatomically correct deposition clearly indicate intentional burials. Proof of burial behaviour demonstrates Neanderthals’ capability of conscience and reflection of a crucial event in the human biography. The high number of individuals and their variation in age and gender helped characterize anatomic features of this species, which is important for comparisons with other human species. Furthermore, the existence of very young children generates significant facts on ontogenesis and growth of the Neanderthal skeleton, which helps to specify the original features known and defined in adults.

The history of this rockshelter shows the importance of a meticulously excavated and patiently documented site at a period where the cognitive capacities of Neanderthals were not yet recognized by the scientific community and Palaeolithic chronologies were not yet properly defined. The preserved profile (Figure 7) allows visual access of the site today. It forms part of an archaeological trail, starting at the Musée National de Préhistoire in Les Eyzies-de-Tayac-Sireuil, which can be visited to learn about the rich history of the area and further discoveries of Palaeolithic sites in the region.

Le Moustier (France)

The site of Le Moustier plays an important role in the development of Palaeolithic research in two different ways. First, a lithic inventory unearthed in the upper rockshelter in the middle of the nineteenth century gave birth to the ‘Mousterian’, which is a central Palaeolithic techno-complex of Neanderthal culture, documented all over Europe, the Near East and North Africa. Secondly, skeleton remains of two young Neanderthals were discovered in the beginning of the twentieth century; one was excavated in very disputable conditions causing a scandal in archaeological society that changed the perception of ancient human remains in archaeology and led to the emergence of a law protecting archaeological sites.

Next to the small village of Le Moustier (Dordogne), near Les Eyzies-de-Tayac-Sireuil, the River Vézère formed its bed in limestone and gave rise to a rock spur containing a high number of rockshelters that were populated during various Palaeolithic periods. As early as 1863 the excavation of the upper rockshelter at Le Moustier by Edouard Lartet and Henry Christy allowed the definition of Mousterian culture, its archaeological facies and its placement in an environmental and chronological context due to the large volumes of archaeological fillings at this exceptional prehistoric dwelling place.

In 1908 ensuing excavations in the lower rockshelter delivered the remains of a Neanderthal male adolescent. Unfortunately, the conditions of the excavation were catastrophic – the excavator, Otto Hauser, was more interested in the monetary value of the find than in its scientific significance and covered and re-excavated the find several times before letting it be excavated by a colleague so that the positions of bones, artefacts and stratigraphic layers have to remain doubtful. Sold to the Völkerkunde Museum in Berlin, the remains were thought destroyed and lost during the Second World War. In the second half of the twentieth century the cranium and some burnt postcranial remains were rediscovered in several museums and finally, serious reconstruction attempts using computer tomography and stereolithography were undertaken between 1992 and 1998. Recently a critical review of Hauser’s excavation and interpretation claimed that no entire intact corpse ever existed of the young adolescent Neanderthal and that the cranium with mandible, and scattered isolated and broken postcranial fragments were the only bones intentionally deposited.
The second burial of a Neanderthal newborn, more meticulously excavated and better documented by Peyrony in 1914, was
also supposedly lost to heritage and rediscovered in the Musée National de Préhistoire in Les Eyzies-de-Tayac-Sireuil. The very
well preserved skeletal remains helped to understand Neanderthal burial practices and provided new data on Neanderthal
ontogeny by distinguishing specific morphological differences between Neanderthal and extant newborns (Günz et al., 2011).
A virtual skull reconstruction was recently attempted on high-resolution computed tomographic data to correct defects found
in earlier reconstructions allowing further comparisons in that direction.

The prehistoric site of Le Moustier is not very well known except by professionals. But the excavations carried out and results
obtained there during four generations play a crucial role in the history of European archaeology and palaeoanthropology
as well as in the development of knowledge about the evolution of Mousterian facies, the morphology of Neanderthals and
their symbolic activities. Furthermore, the hypothesis of Neanderthal sub-populations corresponding to distinct geographical
localities is being reconsidered. The adolescent of Le Moustier belongs to the European population of Neanderthals and seems
to be the ideal fossil to examine due to its position in the western part of Europe.

The site is open to the public (Figure 8) and displays a preserved profile of several tens of thousands years of Upper Pleistocene
human occupation. The two rockshelters are part of the UNESCO World Heritage site ‘Prehistoric Sites and Decorated Caves
of the Vézère Valley’.

Saint-Césaire (France)

An important reference site for understanding the transition from the Middle to Upper Palaeolithic in Europe lies at the Abri
La Roche-à-Pierrot near the village Saint-Césaire (Charente-Maritime). The results of several excavation campaigns yielded
the first evidence for an association of a Neanderthal skeleton with the late Middle Palaeolithic level called Châtelperronian,
today known as a transitional industry to the Upper Palaeolithic (Soressi, 2011). This realization started fierce discussions about
evolutionary demographic and cultural relationships between Neanderthal populations and early modern humans in Europe.

The collapsed rockshelter was discovered in 1976 at the base of a 5-6 m high limestone cliff and excavated for the 11 years
that followed. Besides long Middle and Upper Palaeolithic sequences with lithic artefacts and faunal remains, the site comprised
well preserved, but highly fragmented human remains of an adult Neanderthal. As they were lying in the precise stratigraphic
context of Châtelperronian industry the suggestion was ventured that Neanderthals had been the makers of these implements
– a revolutionary declaration because modern humans were considered the only producers of this industry thus far (Lévêque
et al., 1993). Accompanying finds of personal adornment like shells and perforated animal teeth are hotly debated. So the
establishment of this late Middle Palaeolithic industry as a late cultural development of Neanderthals challenged the arguments
concerning the cognitive capacities of the last Neanderthals and their contemporaneity with modern humans in Europe.

Various studies have since been conducted on the skeletal remains with results explaining several aspects of dietary and social
behaviour of the last Neanderthals. Isotopic data from collagen analysis show subsistence on large herbivores like woolly
rhinoceros or mammoth suggesting an acquisition of meat by hunting and not scavenging (Bocherens et al., 2005). Computer
tomographic reconstruction of the Saint-Césaire skull revealed a healed cranial fracture inflicted with a sharp tool, maybe
during an act of interpersonal violence. Furthermore, the question of natural deposition or purposeful burial is discussed: the
destructive depositional environment and the fact that no burial pit or new stratum was recognized indicate the possibility
of natural deposition.

Only few discoveries challenge our view of major aspects in the Palaeolithic record and the discovery of human remains in a
Châtelperronian level has solidly established the presence of Neanderthals at the beginning of the Upper Palaeolithic. Visitors of
the Paléosite de Saint-Césaire, a very modern and interactive museum, can follow the trail of traces to the original excavation
site and, alongside learning about evolution and Neanderthals, understand the importance of this site.

El Sidrón (Spain)

The region of northern Spain has a long tradition of Palaeolithic research yielding a rich cultural record but rarely human
remains. That is why the fossil evidence from the grotto El Sidrón in the Piloria community (Asturias) is one of the most
significant Neanderthal samples from the Iberian Peninsula. The high number of individuals identified, comprising different
developmental stages from infancy to adulthood, and the exceptional preservation of all skeletal parts (including hand and
foot bones and some rare bones) are essential for understanding the evolution of the human lineage (Rosas et al., 2006).
The cave lies in a karstic system and consists of several galleries (Figure 9); one of them, the Ossuary Gallery, contained an exceptional set of Neanderthal remains found in 1994, which gave rise to multidisciplinary studies at the site. Since the year 2000 new systematic excavations have taken place and more Neanderthal samples have been recovered. Altogether the excavations to date have yielded about 1800 skeletal fragments and 400 Middle Palaeolithic stone tools, although faunal remains are very scarce. The bones belong to twelve Neanderthal individuals, including six adults, three adolescents, two juveniles and one infant, and date back to 49,000 years BP. The skeletal parts lay in anatomically correct, but secondary position suggesting a collapse of the upper gallery where they had been deposited. The fact that several pieces of lithic industry could be refitted suggests single and brief cultural activities and very little movement after the final deposition. These observations support the synchrony of the whole assemblage and the possibility of a contemporaneous death and burial of all or a part of the same social group of Neanderthals.

Several DNA analyses and studies of the Neanderthal remains resulted in new observations concerning kinship and genetic diversity of the sample (Lalueza-Fox et al., 2011): for example, the individuals buried in El Sidrón stem from three different maternal lineages; two specimens, sharing the same pathological – possibly heritable – condition and same DNA, indicate a maternal relation; functional genes (for example, for the regulation of hair and skin pigmentation and for the development of language) were identified; northern and southern varieties in anatomy were characterized allowing further insight into evolutionary processes and diversification of Neanderthal populations across geographic regions. Even virtual anthropological methods were used to create a 3D model showing intraspecific variations in Neanderthal populations.

All these observations show many new aspects of Neanderthal evolution and behaviour indicating small groups, characterized by low genetic diversity, practising patrilocal mating behaviour. The El Sidrón site is unique for understanding demographic characteristics and population dynamics of Neanderthal groups. The sample of El Sidrón is both expanding our knowledge of Neanderthals in Europe and modifying perceptions of Neanderthal anthropology, biology and evolution.

The Gibraltar Caves

The complex of five caves on the Rock of Gibraltar is significant for Palaeolithic research as excavations during the 1990s yielded a contemporaneity between late Middle Palaeolithic and early Upper Palaeolithic occupation layers proving that the last Neanderthals and earliest modern humans coexisted in regions of the southern Iberian Peninsula. This supported a new theory of the ‘last refugium’ of Neanderthals in the south of Spain before their disappearance from our continents.

The Rock of Gibraltar is a 426 m high monolithic limestone promontory and is a British Overseas Territory, comprising the biggest part of the Gibraltar peninsula at the south-western tip of Europe. The area, mostly covered by a nature reserve, contains several caves with Palaeolithic deposits and some Neanderthal remains. The first cave, Forbes Quarry, was discovered in 1848 and became famous for the discovery of one of the best preserved Neanderthal crania. This event put Gibraltar at the top of early human studies, but the significance of this find was not registered for sixteen years. Even the second meaningful discovery in Gorham’s Cave in 1907 was not further investigated. A first extensive excavation by John Waechter from 1951 to 1954 was followed by a second research campaign in the 1990s called the Gibraltar Caves Project. The results displayed a repeated use of Gorham’s Cave beginning in the Middle Palaeolithic and ending after the Neolithic period (Figure 10). Surprisingly, dating analysis generated an occupation period during the Middle Palaeolithic between 45,000 and 28,000 BP, creating a discussion about how long Neanderthals survived in the south of Europe before modern humans arrived.
Ten years after the discovery of Gorham’s Cave, Devil’s Tower rockshelter was exposed yielding a significant find of further Neanderthal remains: an upper and lower jaw and braincase of a four-year old child. In 1995, a computer tomographic (CT) reconstruction helped to show the morphological differences between Neanderthals and modern humans at an early stage of their development. Ibex Cave, discovered in 1975, and Vanguard Cave were both excavated from 1994, and their artefacts and faunal remains showed sporadic human occupation with single short episodes of activity. Furthermore, do faunal and floral remains, especially residues of marine shells, seal bones and finds of cobbles for cracking nuts imply for the first time that Neanderthals exploited marine coastal resources and had a wide-ranging and diversified diet?

Considered to be one of the last known Neanderthal occupations in Europe (Finlayson et al., 2008) the Gibraltar sites provide a regional context for the discussion of the theory suggesting a ‘refugium’ for Neanderthals on the Iberian Peninsula – a rich habitat that enabled survival during dry climate periods longer than elsewhere in Europe and western Asia. Furthermore, comparisons of the archaeological evidence from Middle and Upper Palaeolithic levels help to clarify the European chronology of this Pleistocene period and to place the site in the Mediterranean and European context. The skulls provide valuable data on Neanderthal skeletal variation and the use of marine resources correct popular conceptions of the Neanderthal diet as carnivore. The site Gorham’s Cave was nominated in 2010 to the UNESCO World Heritage Tentative List.

Fumane Cave (Italy)

Fumane Cave is one of the key European sites of critical importance for the investigation of the behavioural changes that occurred at the bridge of the Middle and Upper Palaeolithic. The cave is located on the western side of the Lessini Mounts near the village of Fumane, Verona, Italy. It was discovered in the early 1960s by Giovanni Solinas, an amateur archaeologist that identified a Palaeolithic deposit highlighted during enlargement works of a road from Fumane to Molina. In 1964 a first investigation of the sequence was carried out by Franco Mezzena and Angelo Pasa, with the collaboration of the Museum of Natural History of Verona. After a period of inactivity, a second cycle of research started in 1982 coordinated by the University of Ferrara and the University of Milan.

The human occupation at Fumane Cave spans between 100,000 to 30,000 years BP and testifies a long succession of brief and long-term residential settlements by Neanderthals and Anatomically Modern Humans. The late Mousterian levels are very rich in lithic artefacts, anthropogenic modified animal bones and hearths. Recently, a taphonomic analysis of several bird bones (Figure 11) demonstrated the recurrent manipulation of the wings for the extraction of feathers (Peresani et al., 2011). This remarkable discovery was accompanied by a later finding, a fossil marine shell with traces of hematite and striation on the inner lip (Figure 11). This evidence enriched the hypothesis of the production of personal ornaments by Neanderthals and the development of complex symbolic behaviour before the arrival of Anatomically Modern Humans.

Fumane Cave is located in a strategic geographical position favouring the seasonal hunting displacement between the alluvial Padan plain and the Venetian Pre-Alps. This advantageous location encouraged the settlements of the cave, also by the early waves of Homo sapiens that entered the Italian Peninsula. At Fumane Cave, after the Mousterian deposits, the presence of two short occupations bearing the Ulluzzian techno-complex is attested. The assignment of the Ulluzian techno-complex to Neanderthals or Anatomically Modern Humans is a hotly debated topic of current research. Some authors recognize the Ulluzian as a transitional industry for morpho-technological reasons, like the Châtelperronian from south-west France and north-western Spain for sharing some technical behaviours such as the production of backed tools and bone points.

The exceptional archaeological record of the Fumane Cave is complemented by the recovery of six human teeth, four of which were found in the Mousterian sequence and the remaining two in the Ulluzian and Proto-Aurignacian levels.

The archaeological finds of the Fumane Cave are stored in the nearby Museum of Sant’Anna in Alfaedo and the Museum of Natural History of Verona that can be easily visited after an excursion at the site.
Krapina represents the most extensive set of Neanderthal bones in Europe (Monge et al., 2008). Located at the base of a sandstone cliff near the village of Krapina, 50 km north of Zagreb, the site was discovered in 1899 and excavation started in the same year. The excavator, Gorjanović-Kramberger, used an advanced excavation technique well ahead of its time by recording the position and level of each object. X-rays of human fossils were used for the first time in palaeoanthropology just seven years after Roentgen’s discovery. Gorjanovic-Kramberger even performed chemical analysis of the bones to prove their antiquity – a technique that helped to unmask the Piltdown fraud nearly 50 years later.

At Krapina, nearly every anatomical part of the Neanderthal skeleton is represented and different ages and genders are documented. Therefore the assemblage of more than 900 human remains, representing about 70 individuals, supplies an aspect of biological variation of Neanderthal populations and makes Krapina a unique site in Neanderthal prehistory in Europe. Manipulation of bones like scratching and incising of the Krapina collection enlivened a strong controversy about cannibalism versus ritual mortuary practices within Neanderthal society. This scientific discussion continues and will be an important topic of research in the future.

Although the original site has been destroyed by quarry works the collection is extraordinarily well preserved. The necessity of several generations of paleoanthropologists to study the Krapina collection led to a new form of digital documentation (Figure 13). Today the Krapina collection is the only Neanderthal collection that has been completely CT scanned and is accessible for researchers online. This practice allows the protection of a unique cultural heritage from excessive scientific analysis. Krapina therefore represents a role model for the arrangement of both aspects.

The chronology of the Krapina Neanderthals places them into an early interglacial phase of the last glacial cycle, which is rare with Neanderthal sites in Europe and gives the site a special position within the site cluster.

A new Neanderthal Museum has been established at the site, which includes the largest collection of reconstructed Neanderthal individuals worldwide.
Summary on the founding of a European Neanderthal cluster

The cluster of Neanderthal sites holds the potential for several criteria used in World Heritage nominations.

Criterion (i) ‘represent a masterpiece of human creative genius’ may be applied for sites with Neanderthal burials and with objects of personal adornment. Both behaviours give evidence to the rise of symbolic culture for the first time in Europe in late Neanderthal groups.

Criterion (iii) ‘bear a unique or at least exceptional testimony to a cultural tradition or to a civilization which is living or which has disappeared’, the most often accepted argument, is evident for all sites of the cluster.

Criterion (iv) ‘be an outstanding example of a type of building, architectural or technological ensemble or landscape which illustrates (a) significant stage(s) in human history’ could be applied for the cluster because Neanderthals represent the archetype of ice age people in human cultural memory.

Criterion (vi) ‘be directly or tangibly associated with events or living traditions, with ideas or with beliefs, with artistic and literary works of outstanding universal significance’, could be applied for sites that were milestones in the historiography of palaeoanthropology and archaeology.

The founding of a Neanderthal site cluster under the auspices of the World Heritage Convention would give an exceptional opportunity to develop cutting-edge methods for site preservation, research, curatorship and valorization programmes for Palaeolithic cultural heritage. Pleistocene hominid sites provide the opportunity for special tasks and activities that are different from the conservation strategies of, for example, monumental or architectural heritage sites. Cooperation in a Neanderthal cluster could develop first class strategies for global protection, conservation and research of Pleistocene cultural heritage. Sites of the proposed Neanderthal cluster look back on an exceptional long tradition of site management and scientific research. At the same time, all sites have long-term experience of valorization programmes and touristic enhancement, of site presentation and attraction of public interest and education.

Bibliography


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Human Origin Sites and
the World Heritage Convention in Eurasia

VOLUME II
Human Origin Sites and the World Heritage Convention in Eurasia

Nuria Sanz, Editor
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HEADS 4
VOLUME II
<table>
<thead>
<tr>
<th>Page</th>
<th>Title</th>
<th>Author</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction</td>
<td>Nuria Sanz</td>
</tr>
<tr>
<td></td>
<td>Head and Representative of the UNESCO Office in Mexico</td>
<td>General Coordinator of the HEADS Programme</td>
</tr>
<tr>
<td>5</td>
<td>Current research in caves of the Swabian Jura, the origins of art</td>
<td>Nicholas Conard</td>
</tr>
<tr>
<td></td>
<td>and music, and the Outstanding Universal Value of the key sites</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Prehistoric 'moveable heritage': meaning, fate and value</td>
<td>Francois Sémah</td>
</tr>
<tr>
<td>7</td>
<td>The Swabian Jura</td>
<td></td>
</tr>
<tr>
<td>31</td>
<td>History of Research and the Aurignacian of the Sites in the Swabian Jura</td>
<td>Michael Bolus</td>
</tr>
<tr>
<td>32</td>
<td>Vogelherd. The lithic technology of the Swabian Aurignacian</td>
<td>Judy yun Chang</td>
</tr>
<tr>
<td></td>
<td>and its importance for early modern humans in Europe</td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>Geoarchaeology and the interpretation of the past in the caves of</td>
<td>Christopher E. Miller</td>
</tr>
<tr>
<td></td>
<td>Swabia: current and future research priorities</td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>The Vogelherd Cave and the discovery of the earliest art – history,</td>
<td>Ewa Dutkiewicz</td>
</tr>
<tr>
<td></td>
<td>critics and new questions</td>
<td></td>
</tr>
<tr>
<td>74</td>
<td>Personal ornaments as signatures of identity in the Aurignacian –</td>
<td>Sibylle Wolf</td>
</tr>
<tr>
<td></td>
<td>the case of the Swabian Jura and western Germany</td>
<td></td>
</tr>
<tr>
<td>92</td>
<td>Different! European Upper Palaeolithic art: a cultural heritage of</td>
<td>Harold Floss</td>
</tr>
<tr>
<td></td>
<td>Outstanding Universal Value</td>
<td></td>
</tr>
<tr>
<td>103</td>
<td>Protecting the Stratigraphic Sequences of Caves on the Swabian Jura</td>
<td>Claus Joachim Kind</td>
</tr>
<tr>
<td>135</td>
<td>Conclusions and the way forward</td>
<td>Nuria Sanz</td>
</tr>
</tbody>
</table>
Introduction

Few of the world’s archaeological contexts have been able to produce an assemblage of as many essential and extraordinary finds as the Swabian caves. Thanks to painstaking research over time, excellence in archaeological methodology in the caves and their surrounding landscapes, and archaeological deposits being treated with microsurgical precision, we have been able to discover the symbolic behaviour of the first culture heritage of the European Homo sapiens sapiens.

In addition to upholding interdisciplinary excellence, guided and supported by professionals, as this volume reveals, individual perspectives have been furthered without losing sight of the archaeological reality of the Swabian phenomenon as a whole, its significance for Europe and its comparison with other archaeological excavations that the University of Tübingen develops in parallel across three continents. This volume offers the reader the transversality of viewpoints without precedent.

From the end of the nineteenth century, the discovery of Palaeolithic parietal art has let us glimpse what is known as a ‘preliterary imagination’. Far from being distant from our own aesthetic experience, it was capable of producing a close and automatic connection to the contemporary day. The figurative art of the Swabian caves, portable naturalist sculptures representing animals and other forms, confirms the symbolic capacity of modern humans and also our proximity to the aesthetic force with which this art speaks to us.

The figures of the Lion-Man, the mammoth, the bird and the Venus of Hohle Fels are representative of the first human creative genius, while giving us an immediate sense of familiarity. Experts and non-experts alike never cease to be amazed by the discoveries of the past 40,000 years of contemporaneity and the ability of these works to present the world in a way all can understand.

Equally remarkable are of the early examples of musical instruments carved from mammoth ivory and bone. These finds from the Aurignacian deposits of the caves of the Ach and Lone valleys demonstrate that the emergence of figurative imagery was accompanied by a rich tradition of music that echoed through the acoustically brilliant caves of the Swabian Jura. These and other cultural innovations accompanied the spread of modern humans across Europe and the extinction on the indigenous Neanderthals. The wealth of new symbolic artefacts mirrored the demographic success of modern humans and signalled rise of new forms of social and cultural behaviour.

The growth of the brain in modern humans implies specific physiological and anatomical thermoregulation, challenges of partition and locomotion, and included complex and multifaceted processes, but the change in encephalization does not explain the consequent development of new capacities. Intelligence, language, cognitive abilities and traces of symbolic conscience must be explained by other selective pressures. We do not identify the record of language primarily by the physiological study of the brain. Instead we use archaeological evidence to infer the new capacities of modern humans and, in this sense, the explorations and discoveries in the Swabian caves are a testimony to this exceptional phase of human evolution.

The methodological design of the research in progress gives examples that portable material culture will contribute to opening new paths to understanding not the when but the how of what defines and distinguishes us as modern humans.

I would like to take this opportunity to thank Professor Nicholas Conard for his unconditional support of the HEADS project. His contribution and dedication to UNESCO have consolidated a platform of expertise and loyalty to the World Heritage Convention from the point of view of theory to the most sophisticated archaeological methodologies.

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Introduction

One might expect the archaeological record to document a slow steady evolution of art, but this does not seem to be the case. Instead, we see a sudden development of figurative art 40,000 years ago in Europe. Neanderthals and other archaic hominins of the Middle and Late Pleistocene occasionally modified objects with engraved lines, notches or cut marks, but none of these artefacts are recognizable figurative depictions. At best, they are highly abstract depictions, but one could also consider them slightly modified objects that probably did not store symbolic information to the archaic hominids who made them or saw these objects.

Claims for musical traditions among Neanderthals also remain speculative. The purported Neanderthal flute from Divja Babe, Slovenia, for example, has been rejected by many authors who view this find critically. Rather than being a flute with finger holes made by a Neanderthal (Turk, 1997), this is a natural object modified by a large carnivore (Albrecht et al., 1998; d’Errico et al., 1998).

In the Levant, there is little or no evidence of figurative art before 30,000 years ago and despite relatively intense research in parts of Asia and Australia, no convincing examples of early figurative art or musical instruments have been published.

A number of sites from southern Africa have provided important evidence for intentional marking of objects. The best known and most impressive examples of such finds are the many pieces of marked ochre from Blombos Cave on the southern coast of South Africa (Henshilwood et al., 2002; Henshilwood et al., 2009) and the recent discovery of several hundred engraved ostrich eggshell pieces from Diepkloof on the Western Cape and lesser numbers of engraved ostrich eggshell pieces Klipdrift on the Southern Cape (Texier et al., 2010, Henshilwood et al., 2014). The impressive finds from Blombos date to roughly 75,000 years ago, while the more standardized and more numerous engravings from Diepkloof date to about 60,000 years ago. These symbolic artefacts are not figurative depictions and we have no means today to decode their meaning. Because these engravings are abstract and geometric rather than naturalistic, they are classified as abstract rather than figurative depictions. Many researchers, including the author, consider these finds and the many examples of shell ornaments from North Africa, South Africa and the Levant dating between c. 100,000 and 50,000 years ago as clear evidence for material culture being used to store information (Vanhaeren et al., 2006; Bouzouggar et al., 2007; d’Errico and Stringer, 2011).

The earliest examples of figurative art in Africa come from Eric Wendt’s excavations in late Middle Stone Age (MSA) deposits at the Apollo 11 Cave in south-western Namibia and date between 25,500 and 27,500 radiocarbon years ago or roughly 30,000 calendar years ago (Vogelsang, 1998). These examples of painted mobile art depict a number of animals, geometric forms and a therianthrope. As discussed below, the situation in Europe is very different in that several sites have provided unambiguous evidence of figurative representation starting about 40,000 years ago.

Given the evolution of anatomically modern humans in Africa by c. 200,000 years ago (White et al., 2003; McDougal et al., 2005) researchers might expect that the earliest evidence for figurative art will one day be found in Africa. Many factors related to research intensity, taphonomy and preservation influence the distribution of known symbolic artefacts. Additionally, the preservation of organic materials in tropical and subtropical regions is often less favourable than in higher latitudes of Eurasia. Thus, it would be foolish to assume that the current distribution of finds is a direct and complete reflection of the evolution of symbolic behaviour. Nonetheless, researchers must develop explanations for the available archaeological record and here I will follow this approach rather than speculating on what might hypothetically be discovered in the future.
The European record and the case of the Swabian Jura

The term ‘art’ is poorly defined in art history and there is no universally valid definition of what art is. I use the term here in keeping with conventions in Palaeolithic research in which abstract and figurative depictions of all kinds are referred to as ‘art.’

Starting around 40,000 years ago in the context of the European early Upper Palaeolithic, several sites have produced examples of figurative depictions. These include six schematic, red, monochrome paintings on small limestone blocks from Fumane Cave in northern Italy (Broglio, 2002, Broglio and Dalmeri, 2005) and a small carved piece of schist from Stratzing in the Austrian Wachau, which Neugebauer-Maresch (1989) published as a depiction of a dancing woman. The paintings from Fumane date to roughly 35,000 radiocarbon years ago and the figurine from Stratzing to c. 31,000 radiocarbon years ago. While a degree of inexactitude persists with radiocarbon dating and in establishing a reliable calibration curve, these radiocarbon ages correspond to ages between roughly 35,000 and 40,000 calibrated years ago (Weninger and Jöris 2008; Higham et al., 2009). The finds from Fumane come from strata attributed to the Proto-Aurignacian, which is also referred to as the Fumanian (Conard and Bolus, 2006), while the figurine from Stratzing originates from the Aurignacian deposits at the site.

Another early example of a purported figurative depiction comes from Kostenki 14 (Markina gora) in Don Valley dating to c. 40,000 BP (Sinitsyn, 2003). This ivory artefact, which has been described as depicting a human head, is so schematic that it remains difficult to interpret and is inadequate for demonstrating the presence of early figurative art at the site.

A different situation is represented by the early engravings from the Aurignacian deposits of south-western France from sites including Abri Castanet, Abri Blanchard, Abri Cellier and La Ferrassie (Leroi-Gourhan, 1995; White et al., 2012). These depictions of vulvas and highly schematic animals are often more difficult to date, but often appear to be about 30,000 radiocarbon years old, which underestimates the actual age of the depictions that may be closer to 35,000 calibrated years ago. Prior to the reliable dating of art from Fumane, Stratizing and the sites from the Swabian Jura discussed below, these depictions were often viewed as belonging to the initial phase of Palaeolithic art (Leroi-Gourhan, 1995). The basis of this interpretation by Leroi-Gourhan and others was the assumption that figurative depictions must have begun with simple and schematic representations before more realistic and more complex images appeared in the archaeological record.

Cave painting has spectacular beginnings as documented at Grotte Chauvet in the Ardèche region of southern France (Clottes, 2001). Here numerous depictions of animals date as far back as 32,000 radiocarbon years ago. The selection of animals depicted in Chauvet often include dangerous, strong and large animals, thereby showing remarkable similarities to the Aurignacian figurines from Swabia (Floss, 2007) and no stylistic similarities to the simple and schematic representations from Fumane. The depictions from Grotte Chauvet include groups of beautifully realistic and dynamic paintings dating to about 32,000 radiocarbon years ago, which corresponds to an age in excess of 35,000 calendar years ago.

The Swabian figurines from Vogelherd, Hohlenstein-Stadel, Geißenklösterle and Hohle Fels date to between 40,000 and 35,000 years ago (Conard and Bolus, 2003, 2008; Higham et al., 2012) (Figure 1). The newest dates from Geißenklösterle point to the beginnings of the Swabian Aurignacian prior to the Heinrich 4 cold event, with ages dating as far back as 42,500 calendar years ago (Higham et al., 2012). These results suggest that the Swabian Aurignacian, contrary to many scholars’ expectations, actually predates the Proto Aurignacian or Fumanian. The dates of the upper Aurignacian of archaeological horizon II (AH II) at Geißenklösterle, which contains four figurative carvings and three flutes, fall between 40,000 and 37,000 calendar years ago. AH II at Geißenklösterle has been dated by thermoluminescence to about 37,000 years ago. The underlying lower Aurignacian of AH III has yielded TL ages of c. 42,000 BP (Richter et al., 2000), which are consistent with the most recent radiocarbon ages. Based on stratigraphic grounds and observations at Hohle Fels, it appears that musical instruments and figurative art were established in the area during the earliest Aurignacian of Swabia (Conard, 2009; Conard et al., 2009b).
The earliest figurative depictions include the mammoth ivory figurines from four caves in Swabia in south-western Germany (Hahn, 1986; Schmid, 1989; Conard and Bolus, 2006). The Swabian Caves of Vogelherd, Geißenklösterle, Hohle Fels and Hohlenstein-Stadel have produced more than 50, often fragmentary and mostly very small, ivory figurines and rare figurative representations in bone and stone (Floss, 2007; Conard et al., 2009a). These small sculptures date well in excess of 30,000 radiocarbon years, which corresponds to about 35,000 to 40,000 calendar years ago (Conard and Bolus, 2003; Higham et al., 2012). Due to the noisy radiocarbon signal in this period and above-average $^{14}C$ production, the radiocarbon ages at the Swabian Caves and the similarly aged deposits elsewhere underestimate the antiquity of these artworks. The Swabian ivory figurines include depictions of horses, mammoths, lions, bison, bears, a water bird, a fish and three therianthropes that combine features of lions and humans (Hahn, 1986; Conard, 2003b; Conard et al., 2009a) (Figures 2 to 8). These artworks are small and beautifully carved. They stand in sharp stylistic contrast to the highly schematic paintings of animals and a possible therianthrope from Fumane. Geißenklösterle has also produced a painted rock from this period that preserves traces of red, yellow and black pigments (Hahn, 1986; 1988).
In addition to the many ivory figurines, all four sites that have produced figurative artworks from the Aurignacian have also yielded numerous examples of personal ornaments (Conard, 2003a; Wolf et al., 2013). Among the many examples of personal ornaments, those carved from mammoth ivory are most frequent and represent many more or less standardized forms (Wolf this volume Figures 6 and 9). The most common type is the carefully carved, small, double-perforated, oval ivory bead. This type is well-represented in both the Ach and Lone Valleys and is one of many arguments indicating the Aurignacian inhabitants of both valleys belonged to the same cultural group and likely maintained social contact.

Excavations at Hohle Fels in the Ach Valley recently recovered a finely carved, headless, female figurine with prominent sexual features from the basal Aurignacian deposits (Conard, 2009; 2010) (Figure 9). This remarkable find is probably the earliest of the many figurines from the Swabian Jura and extends the record of these so-called Venus depictions back to the beginnings of figurative representation. The female figurine, often referred to as the ‘Venus of Hohle Fels’, has a ring on top of its broad shoulders indicating that the figurine was suspended or perhaps worn as ornament or symbol. Several other figurative depictions from the Swabian Aurignacian are perforated and may also have served as ornaments or jewellery (Conard, 2003a).

These figurative depictions from European contexts are the earliest known worldwide. They all date to the early Upper Palaeolithic and were presumably made by modern humans; however, as far as we can tell, Neanderthals still occupied parts of Europe at this time (Conard and Bolus, 2003; Longo et al., 2011; Higham et al., 2012).

The context in which figurative art developed has been the subject of considerable debate in recent years (for example, Lewis-Williams, 2002; Conard and Bolus, 2003; Conard, 2011) and will not be elaborated upon here. Regardless of the specific social-cultural mechanisms that led to the development and spread of figurative art, there is nearly a consensus among archaeologists and paleoanthropologists that the makers of these early artistic traditions were both anatomically and culturally modern people. D’Errico (2003) and Zilhão (2001), however, have argued that Neanderthals were capable of making and using a wide range of symbolic artefacts. While many other advanced behavioural forms have precursors in earlier periods, there is no persuasive evidence for figurative depictions prior to the beginnings of the European Upper Palaeolithic (Conard, 2008).

Musical instruments

Perhaps because of the long research tradition and favourable taphonomic conditions the earliest examples of musical instruments have been recovered from early Aurignacian contexts in south-western Germany (Hahn and Münzel, 1995; d’Errico et al., 2003; Conard et al., 2004; Conard et al., 2009b). As is the case with figurative representations, researchers often view evidence for music and musical instruments as an indication of fully developed cultural forms based on symbolic communication. The assumption in this context is that where there is figurative art and music, there must have been fully developed language, by which Palaeolithic people assigned specific concrete and abstract meaning to words and could efficiently communicate information about the past, present and future. Thus, where there is figurative art and music, there must have been behaviourally modern people.

Although speech, song, music and dance may well have existed earlier still, the oldest musical instruments known are four bone flutes and four mammoth ivory flutes from archaeological horizon II at Geißenklösterle (Hahn and Münzel, 1995; Conard et al., 2004), from the re-excavations at Vogelherd (Conard and Malina, 2006) and from the lowest Aurignacian find horizon (AH Vb) at Hohle Fels (Conard et al., 2009b) (Figures 10 to 12). These instruments were all found in highly fragmentary condition and were often identified many years after they were excavated by researchers sorting and refitting ivory and bone artefacts. The long-term nature of the research in the Swabian caves makes it possible to pursue
excavation and lab work over decades and facilitates the careful recovery and study of these and other classes of small symbolic artefacts. As work sorting and refitting the many thousands of fragments of bone and ivory from the Swabian caves continues, it is likely that new pieces of bone and ivory flutes will be identified.

The earliest of these finds are the well-preserved flute carved from the radius of a griffon vulture and two small fragments of ivory flutes, which were found in the basal Aurignacian layer of Hohle Fels. Excavators recovered the flute carved from the radius of a griffon vulture only 70 cm away from the female figurine within the same thin stratigraphic unit, AH Vb (Conard et al., 2009b) (Figure 11). In AH II at Geißenklösterle excavators recovered a well-preserved bone flute made from the radius of a swan (Hahn and Münzel 1995). The same stratigraphic unit also produced a well-preserved example of a flute carved from mammoth ivory (Conard et al., 2004). This instrument reflects a remarkable piece of musical engineering, since the process of manufacturing a flute from massive ivory is much more complex and time consuming than carving a flute from a hollow bird bone. One advantage that an ivory flute provides is that its size and its tonal qualities are not predetermined by the available dimensions of the raw material itself, as is the case with flutes made from bird bones. Instead, the craftsperson could make an ivory flute to the dimensions and tonal specifications desired.

Reconstructions of these instruments produce a diverse and rich tone quality pleasing music (Seeberger 2002, 2004). These flutes can be played without a reed and they are clearly flutes rather than pipes or trumpet-voiced instrument as suggested by d’Errico and colleagues (2003). The bone flute from Hohle Fels has a V-shaped mouth piece that makes it possible to play any melody one wishes on this instrument. The flutes can also be played using a reed, which makes them easier to play but changes their acoustic qualities. All the flutes from the Swabian Jura were recovered in strata including a wide range of lithic artefacts, organic artefacts and burnt and unburnt faunal remains. Thus, it seems that the instruments were used and discarded within a context of everyday life. The flutes from the Ach and Lone Valleys of south-western Germany suggest that music played a diverse and varied role in the lives of early modern humans in Europe.

Other sites, most notably Istaritz in the French Pyrenees, have produced additional flutes suggesting that wind instruments were in wide use during the early Upper Palaeolithic (Buisson, 1990; d’Errico et al., 2003). Of course, there are innumerable other, less conspicuous forms of percussion and wind instruments that could have existed during the early Upper Palaeolithic or earlier still, yet they remain to be identified. Earlier purported examples of Middle Palaeolithic flutes have generally been met with scepticism in archaeological circles, as is the case with persistent claims for a Middle Palaeolithic flute made from a cave bear bone from Divje Babe in Slovenia (Turk, 1997; Albrecht et al., 1998; d’Errico et al., 1998). Therefore, based on the available evidence, the earliest musical instruments have been documented in the early Upper Palaeolithic of Europe. They date to the period in which populations of anatomically modern humans expanded across Europe at the expense of the indigenous Neanderthals. Like figurative art and other innovations in symbolic communication, musical traditions directly or indirectly contributed to the success of our species and helped, along with other innovations and adaptations, to place early modern humans at a demographic advantage in their competition with Neanderthals (Conard et al., 2006; Conard, 2011).
While one can explain the expansion of modern humans and the extinction of Neanderthals without arguing for a causal role of symbolic artefacts, the rapid spread of figurative depictions, musical instruments and mythical imagery suggests that these classes of artefacts and the symbolic behaviour they document did indeed contribute to the demographic success of anatomically modern humans. Certainly these developments also took place in social and economic contexts in which nutrition likely improved, and birth and survival rates increased slightly above the rates of archaic populations in adjacent regions. The subsistence base of the Aurignacian people of the Swabian Jura regularly included fish and small game that Neanderthals rarely used (Conard et al., 2013) and nutritional and demographic variables ultimately drove the expansion in the range of early modern human. Nonetheless, without some form of positive selection for symbolic artefacts and expanded symbolic communication, it is hard to imagine a scenario which would have led to the universal presence of music, art, ornament and religion among living populations of modern humans. The Swabian Aurignacian may represent a uniquely favourable situation characterized by the excellent preservation of organic artefacts combined with a long and successful research tradition. If indeed these classes of symbolic artefacts underwent positive selection and their makers generally experienced elevated biological fitness, one would expect symbolic artefacts to spread rapidly beyond the small groups in which they initially developed (Shennan, 2001). Through a combination of demographic success of their makers and cultural transition between populations, new forms of symbolic behaviour would have expanded rapidly within and between populations. Similar processes could explain the spread of an earlier generation of symbolic artefacts during the first half of the Late Pleistocene when abstract engravings, personal ornaments made of shells and the use of ground ochre are all well documented.
These observations, however, do not explain what specific adaptive advantage figurative art, music, new forms of ornament and new systems of belief would have brought with them. In a general sense we can view these classes of symbolic artefacts as reflecting a kind of cultural glue that helped hold large social units together and foster a shared identity. In the case study of the Swabian Jura, I suggest the following scenario: after a period of low population density of Neanderthals, which I have elsewhere labelled the ‘Population Vacuum Model’ (Conard et al., 2003), modern humans arrived in the Swabian Jura carrying with them a wide range of innovative organic and lithic technologies that we associate with the beginnings of the early Aurignacian. The most likely route into the Swabian Jura was via the Danube Corridor (Conard and Bolus, 2003). These immigrants into the Upper Danube drainage encountered new and challenging environmental conditions only several tens of kilometres north of the alpine glacier. While making forays into neighbouring regions and further expanding their range, they also developed a variety of new behaviour. At the time of their arrival, as demonstrated by the female figurine from the basal Aurignacian at Hohle Fels, their belief system included the use of human female imagery to foster fecundity and ensure the survival of mothers and infants. Clearly a small population of newly arrived modern humans could not have afforded to lose many infants or, even still more importantly, woman of reproductive age. In a more inclusive sense, this pattern of beliefs related to the female figurine could also have been meant to induce fecundity, fertility and abundance in general, beyond the narrowly defined context of safe and reliable human reproduction and early midwifery (Conard, 2010).

In addition to the beliefs suggested by the female figurine from Hohle Fels, the presence of three examples of depictions showing features of both lions and humans from Aurignacian deposits at Hohlenstein-Stadel, Geißenklösterle and Hohle Fels documents other aspects of beliefs and socio-cultural norms of the inhabitants of the Ach and Lone Valleys. The large therianthropic ivory figurine from Hohlenstein-Stadel, the much smaller one from Hohle Fels, and the mixed human and animal relief from Geißenklösterle depict important variations on the theme of transformations between humans and animals. Regardless of whether or not one accepts all the specific arguments associated with the frequent claims for shamanism (Lewis-Williams, 2002), these depictions unambiguously demonstrate that transformations between the real world and a netherworld of mythical images of ‘lion men’ formed another important aspect of the system of beliefs during the Swabian Aurignacian. These images are the first crafted artefacts that document what could be considered religious beliefs. Certainly the repeated discovery of lion men is not just chance, but reflects a codified link between regular day-to-day life and ideas and beliefs that linked Aurignacian people of the Swabian Jura to a spirit world beyond their daily experiences in the concrete world around them.

Turning to the evidence for music from the earliest phase of the Swabian Aurignacian, one sees plausible evidence that music played a role in social interaction and group dynamics. The small excavation of the basal Aurignacian of Hohle Fels has yielded remains of two different flutes made from mammoth ivory and a third much more complete flute made from the radius of a griffon vulture. As mentioned above, excavators recovered two bone flutes and one ivory flute from Geißenklösterle only 3 km away from Hohle Fels, which demonstrates that the finds from Hohle Fels were more the rule than the exception. This claim is supported by the discovery of fragments of a bone and an ivory flute from Vogelherd in the Lone Valley c. 30 km to the northeast. At a minimum, these finds document eight different flutes including no fewer than four kinds of flutes (Conard et al., 2009b). Given the highly favourable acoustical conditions in these caves, it is perhaps not entirely surprising that the flutes would all have been found in the occupational debris of these three caves, where they were no doubt played, perhaps within larger social groups, again plausibly helping to cement the social relations of these first populations of modern humans in the Swabian Jura. In the smaller social units of the earlier Neanderthal populations of the region, social relationships were maintained without figurative representations or musical instruments made from durable materials, as have frequently been found in Aurignacian deposits.

These musical episodes in the Swabian caves, whether sacred or profane, would have been important settings for developing group solidarity and bonding between members of the group, while at the same time helping to establish what was probably a wide repertoire of shared musical knowledge that may well have included voiced music and percussion. Given the extremely small size of the excavations that have been conducted using modern excavation techniques, the available discoveries reflect only the smallest portion of the original musical material culture and figurative art from the region.

Conclusions and implications for the Outstanding Universal Value

In conclusion, this paper argues that four new classes of symbolic artefacts, 1) ornaments with arbitrary three dimensional form, 2) figurative representations, 3) mythical imagery, 4) musical instruments, individually and together document a vastly heightened level of symbolic communication in the Aurignacian in comparison to the preceding Middle Palaeolithic of the Swabian Jura (Conard, 2008). All four classes of artefacts are well documented both in the Ach and Lone Valleys in similar or in some cases identical form. These similarities in the symbolic material demonstrate that people who occupied these valleys must have belonged to the same cultural tradition, almost certainly maintained social relations and communicated using the
same or very similar language. Given that only a few dozens of kilometres separate the sites of the Ach and Lone Valleys, one could also argue that individuals of the Aurignacian occasionally moved between the valleys and cultivated social relationships and perhaps familial bonds between these neighbouring regions. Such symbolic artefacts are entirely lacking within the known material culture of the Neanderthals. This leads to the conclusion that Neanderthals maintained their economic and social relations with far less reliance on the manipulation of symbolic artefacts. Many arguments indicate that in the Swabian Jura Neanderthals lived in relatively small groups with low population densities (Conard et al., 2006; Conard, 2011). They probably knew most of the people within their sphere of social interaction directly and personally, thereby reducing the need for communication via the display and use of symbolic artefacts.

I have suggested the Kulturpumpe Hypotheses as refutable models for the origin of these symbolic artefacts (Conard and Bolus, 2003 and references therein). The strong Kulturpumpe Hypothesis implies that the early modern humans of the Swabian Aurignacian developed these classes of artefacts in the region and thereby contributed to a kind of quantum leap in symbolic communication. The weak Kulturpumpe Hypothesis argues that the Upper Danube represents a region with numerous innovations in symbolic artefacts including ornaments carved in arbitrary three dimensional forms, figurative images, mythical images and musical instruments, but that multiple analogous centres of symbolic innovations must have existed in different regions. In both models, these innovations likely became sustainable and spread in a context of elevated population densities and larger social and economic units relative to the preceding Middle Palaeolithic. The cause of these innovations could hypothetically have been triggered by at least three variables that worked in isolation or together (Conard and Bolus, 2003): 1) innovations in response to the rapidly changing environmental conditions and extreme fluctuations of MIS 3; 2) competition between archaic and modern humans that led to a ratcheting up of symbolic communication within the context of demographic and biogeographic competition between the two populations; or 3) innovations that took place in a social cultural context that were not caused by environmental stress or competition with other hominin populations.

Despite being postulated in the late 1990s, neither the strong nor the weak Kulturpumpe Hypotheses have been refuted. To refute the strong Kulturpumpe Hypothesis, researchers simply need to demonstrate the unambiguous presence or these categories of symbolic artefacts in another region or regions prior to their appearance in the Swabian Jura. I find it remarkable that this has not yet occurred, despite the model being fifteen years old. The weak Kulturpumpe hypothesis is much more difficult to refute because many specific forms of symbolic artefacts including personal ornaments and figurative depictions are only know from the excavations in the caves of the Swabian Jura.

Regardless of the ultimate causes of these cultural innovations, the rapid spread of the new classes of symbolic artefacts first documented in the Swabian Jura strongly suggests that they contributed to the demographic success of their makers and underwent a process of positive selection. Through demographic expansion and cross-cultural exchange many of the innovative elements of the symbolic repertoire of the early Aurignacian rapidly spread across western Eurasia and beyond. Given the apparent inability or unwillingness of Neanderthals to live in this world characterized by the increased symbolically mediated interaction, Neanderthal populations declined and were assimilated or went extinct.

Given the large numbers of unique finds and the early appearance of many classes of symbolic artefacts at the caves of the Ach and Lone Valleys these sites fulfil the requirements for Outstanding Universal Value. Certainly the oldest known evidence for new forms of social identity including three dimensionally crafted personal ornaments, figurative representations, new forms of beliefs and religious practices, and the first proof of the existence of music and musical instruments meet the high standards UNESCO holds for Outstanding Universal Value. Thus one must conclude that the caves of the Ach and Lone Valleys are uniquely qualified for the status of World Heritage cultural sites.

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Bibliography


Prehistoric ‘moveable heritage’: meaning, fate and value

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Prehistoric moveable heritage

1.1 A question of words

‘Moveable heritage’ is a rather odd expression that sounds clerical in a way. When dealing with research and conservation of heritage properties and collections, we enter a field that is - or ought to be - definitely part of the daily life of all related stakeholders. Mutual understanding should therefore be an important communication prerequisite, however perception of words may vary between different communities or individuals.

Heritage, patrimony, heirloom, inheritance or legacy?

Words related to heritage are most often used in a synonymic way. Though, nuances exist between them, at least from the perception we have of their etymology. Usually, the above mentioned terms may be understood as somewhere or something (i) that belongs to a community, a family, an individual; (ii) that we are entrusted to keep and transmit; (iii) that we must maintain and develop or (iv) that we are free to give, to trade (including by simple translation of its value, for example, when selling a property in order to enable our descent to acquire a better social position), or even to destroy. The focus one may bear on a specific heritage element depends on numerous factors.

Moveable and immoveable

Speaking an international common language, in other words, using concepts appraised and understood by a large multicultural community, is a current challenge. It often needs the adoption, at least in a first step, of a simplified vision of the very objects we deal with. Only after the community has learned by experience to deal with related issues and reached a convenient level of mutual understanding, can it progress towards a more relevant classification, taking nuances, overlaps and integrative needs into account. As a matter of fact, the original World Heritage Convention itself has long discriminated, in the nomination criteria, so-called ‘cultural’ heritage from ‘natural’ heritage (UNESCO, 1972). It is only after a long period of implementation that the single, unified set of ten criteria defining Outstanding Universal Value was established, hence acknowledging the interrelationship between nature and culture (UNESCO, 2005).

To a certain extent, a comparable remark might be made for current dichotomies such as tangible versus intangible heritage, the latter being not always but most often tightly related to sites and artefacts. In a similar way, one may question, beyond its obvious practical use in terms of conservation, the need to discriminate immoveable heritage from moveable heritage.

1.2 Prehistoric sites and moveable heritage

Monuments or landscapes, embedded in their geographical location and their environment, are essentially immoveable properties (Figure 1). Their ownership, conservation, development and exploitation obviously pose a lot of questions, but all stakeholders easily perceive their ‘heritage’ nature. Any withdrawal - or destruction - of a part of them (for instance, extracting a relief from a temple; French, 1999) is considered as an invasive action that clearly infringes on the site’s conditions of integrity.

When it comes to prehistoric sites, some of them can be assimilated to monuments or landscapes, and this is especially the case for megalithic monuments or rock art properties. Most of prehistoric sites recording evolutionary steps of human lineage, major steps in the earth’s environmental history during the Quaternary period or ancient human occupations and cultures can only disclose their value by means of invasive operations such as excavations. Discovered objects and recovered samples, together with their inseparable contextual data (stratigraphical position, relations with other fossils or artefacts, taphonomical context etc.), are therefore critical in order to assess the authenticity of the site (Sémah, 2011). Extracted items, once physically...
isolated from their original context, are subsequently part of ‘moveable’ heritage, though from scientific and conservation points of view they are - and must remain - closely related to the property.

2. Heritage collections and scientific research

2.1 The dialogue between the site and the collections

The result of fieldwork, surveys or excavations is critical in appraising the value of a site. It also often happens that the accidental discovery of a fossil or an artefact plays a major part in the assessment of a site; its discovery leads to extensive research, as it has been the case for numerous hominin-bearing sites in Europe and in Asia (O. Schoetensack, 1908 and Figure 2).

The study of objects encompasses a large part of prehistoric research, from the palaeontological (including palaeoanthropology) and palaeoecological points of view as well as to reconstruct the technical, subsistence and symbolic behaviours of the ancient human groups. Concentrating most of the data collected during field work, the study of moveable heritage allows a rewarding comparative study, yields new clues regarding the taphonomy (and hence the value of collected samples, for instance, for dating purposes) and opens a fruitful complementary approach to the archaeostratigraphic record. In that sense, a site’s moveable heritage is inseparable from the site itself. It recurrently happens as well that researchers find masterpieces for example, a human fossil) in collections many years after an excavation (Grimaud, 1982 a and b; Figure 3).

2.2 Practices that have significantly changed

Until the middle of the twentieth century, the approach of scientists was more oriented towards a classical ‘inventory-like’ collection activity of the remains of ancient humans. Some excavations were actual ‘mining’ activities aimed at collecting objects, but others were oriented towards a comprehensive approach of ancient human groups in their environment (see for instance Selenka and Blanckenhorn, 1911; Breuil and Obermaier, 1914 and Figure 4). Whatever the case, the use was widely spread to consider prehistoric remains as significantly telling. For instance, items coming from an important excavated site could be distributed all over the world, to other research laboratories of museums, in order to foster a comparative approach and hence progress in the scientific knowledge. Such a procedure understated the analogy with the practice followed in the case of biological and – sometimes – palaeontological research, along with the designation of holotypes, paratypes and so on. Together with some conservation constraints, one of the consequences of this approach has been to assign the objects to separate collections and sometimes separate institutions, following categories: human fossils, lithic artefacts, animal fossils, etc. were stored apart, with an evident difficulty of correlation for the researcher and also a significant risk of data loss.

Figure 1. Older than 4,000 years, the numerous engravings of Vallée des Merveilles (Mont Bego, Tende, Alpes Maritimes, France) are made on flat rock surfaces abraded by glacial erosion. In 1988, the “Chef de Tribu” stele, damaged by visitors, was safeguarded in the Musée des Merveilles (Tende) after its removal by helicopter and replaced by a high quality replica. © H. and M.-A. de Lumley, Centre Européen de Recherches Préhistoriques de Tautavel and Institut de Paléontologie Humaine.

Figure 2. The Mauer mandible, holotype of Homo heidelbergensis (see Wagner et al., 2010). © K. Schacherl.
The scientific approach considering the site – or a group of sites – as a complex but unique system came much later. Hallam Movius, who pioneered modern excavation methods, counted among the first researchers to set up comprehensive ‘modern’ collections that almost maintained the conditions of integrity of the discoveries (see Movius, 1975 and Figure 5a).

Nowadays, most research programmes in prehistory follow this trend and establish storehouses or even laboratories and museums in the vicinity of the sites whenever possible. Such operations mean that the conditions of ‘scientific integrity’ of the property are respected, even though the excavation process may have affected its physical integrity. However, significant exceptions do exist, some of which will be considered in Part 3.3. One has to acknowledge that in many countries central research institutions are still tempted to attract important pieces of a collection. This can result in the selection in reference series whose utility can be discussed, and sometimes the scattering of the objects may prove to be harmful. Some international collaboration programmes still result in the sharing of some collections - initially for analysis purposes - between institutions. Reunification often happens to be difficult, even after many years.
3. The museum: site counterpart, repository or sanctuary

3.1 The specific role of site museums

We highlighted above the importance of the comparative scientific approach that is fostered by the grouping of series of objects in the collections. In a fully comparable way, museums guide the public to find a concentration of discoveries that are pretty rare in the field or often less spectacular (they are observed before any cleaning or rehabilitation) in the showcases. Moreover, being able to use powerful picturing instruments (for example, magnification) beyond the simple observation of an item, the exhibition allows the clear display of the most meaningful characteristics of the objects (such as cut marks on intentionally butchered bones).

Site museums (Figure 5b) are especially important from this point of view: remaining in immediate proximity of the site, the moveable heritage is not really considered as withdrawn from its original position. The museum becomes a complementary interpretive facility presenting an actual ‘storyboard’ that shortens, for the purpose of the time of a visit, the long excavation process of the site. It offers a quite rich perception, based not only on the spectacular aspect of the objects but also on the progress of scientific research. Some site museums also include actual reconstructions of the occupation floors or of prehistoric caves.

In this way, the museum encourages the cross visits to the site and to its exhibition and is fully part of the site’s conditions of integrity and answers the 5Cs objectives identified by the World Heritage Committee (see, for instance, Rao, 2012) and subsequently followed by HEADS:

quite obviously in terms of Conservation, Communication and Credibility as the contents foster awareness of the relations and processes between the in situ discovery and the displayed object; but also, by way of consequence;

regarding the Communities, who find a structure near the site devoted to the conservation of their heritage;

in terms of Capacity building, as the integrated [site + museum] system includes a clear scientific dimension and often offers training opportunities related to conservation, management and cultural development.

3.2 Modern temples ...

Presenting original objects seems mandatory in order to achieve the goal of having a site museum that fully contributes to the demonstration of the site’s conditions of authenticity. The possibility of seeing originals nearby an excavated site is particularly important as it contributes to the ‘spirit of the site’ feeling, hence fostering local communities’ and visitors’ awareness, in addition to attracting visitors to the area. As far as possible, the use of replicas ought to be limited to the witnesses of in situ structures subsequently destroyed by excavation (for example, burials, Sémah et al., 2004; Détroit, 2002 and Figure 6), to comparison objects (for example, those found in other parts of the world) or whenever possible to objects that can be manipulated by the visitor for didactic purposes (for example, lithic artefacts or fossils for visually impaired visitors).

The lack of originals, whatever the material and intellectual quality of the display, may make the visitor uncomfortable, giving the feeling of watching an exhibition rather than being in a museum: the museum may fail to achieve the goal of complementing the site.

However, when local circumstances do not allow a convenient conservation, the visitor can easily understand that only replicas of a limited number of most meaningful pieces are displayed in the site museum, as long as the reasons are briefly given and the actual place of storage is clearly indicated.

The very possibility of accessing original objects in the ‘modern temples’ that are large museums, contrary to the limitation of their access to a very small specialist community, is a crucial element in ascertaining the value of the heritage. It might imply a purposely made journey to the repository or to a temporary exhibition event, even a specific application to access the objects, but this possibility must exist, with the rare exception of objects whose state of conservation prevents any movement. To give a comparison, although it is quite difficult to ask for permission to conduct specific analysis on the Crown Jewels of the United Kingdom, anyone in the world is entitled to admire the originals, even for a short while. Having such a possibility is just as important when it comes to a well-known ancestor member of our human lineage.
3.3 ... and the associated risks

However, such a geographical distribution of part of a collection is not exempt of risks, as is the case for research institutions (cf. Part 2.2.). Among these risks, the most common is the policy of influential museums (for example, national museums, either in emerging countries or developed ones) to attract the masterpieces from a collection gathered on a site. It results into the scattering of the discoveries that is far from favourable to the continuity of the research process, reminding that the latter is mandatory to assess the site's conditions of authenticity. For instance, the famous human fossils (Homo erectus, formerly called Pithecanthropus) discovered on Java Island, Indonesia, since the late nineteenth century are presently stored in at least six different places in three countries (see, for instance, Sémah, A.-M. and K. Setiagama, 2007).

Those practices may well extend to sometimes numerous series of objects, subject to an adamant museographic, display oriented protection that resembles that found in a sanctuary. From a legal and administrative point of view, they result in a procedure that is mid-way between that used for cultural artwork and that used for natural specimens. Some countries discriminate two statutes, using one inventory for ‘patrimonial’ collections and another one for ‘regular’ or ‘study’ collections. The consequence is a twofold inventory whose praiseworthy objective, useful in museographic matters, may hamper the conditions of integrity of the collection.

Certainly, huge amounts of bone or flint shards will not be worthy of permanent exhibition. However, no responsible scientist should reasonably claim to be able to fully estimate the potential value of any excavated object. Rigour in the field implies giving the same importance to any recovered object, hence balancing the invasive character of the excavation process by the ‘patrimonial’ quality given to any extracted material. Excavation and post-excavation record and conservation practices are presently much more sophisticated compared to those in practice a hundred years ago, and certainly much less than those that will be implemented in the future. Recent examples of DNA and residues sampling, or of microwear protection on mineral and organic objects are quite significant from such a progress viewpoint. Moreover, it often happens that quite important objects are diagnosed much after the excavation (for example, a fragment of human fossil, see Part 2.1. and Figure 3).

4. The multifaceted life of moveable heritage

We have considered above several aspects of the ‘new life’ of moveable heritage that begins after discovery. This life can be influenced by a number of factors, including historical ones.

4.1 When conservation and repositories create a new environment for heritage

Human creativity in conservation and dissemination matters has quite diverse, sometimes unforeseen outcomes and may build actual systems by itself. Such ‘secondary’ systems might appear all the more complex as they cumulate different historical ‘layers’.
A good example, regarding living collections, is that of zoology, especially for protected, rare or endangered species, for which we find a variety of structures: old menageries and taxidermy animal collections from cabinets of curiosities gave birth to zoological parks or gardens and to zoological galleries. The creation of natural reserves was quickly accompanied by their touristic exploitation on the one hand and by the setting of conservation centres on the other. Modern zoological parks clearly oriented their activity not only towards animal public display but towards living animals conservation and reproduction, with dead specimens often enriching the galleries. All these structures contribute to the conservation of the species, to the awareness and knowledge of the public, but one has to acknowledge that they constitute independent systems whose implications go well beyond the living animal in its environment by itself. Kiki, the giant Seychelles islands tortoise Dipsochelys elephantina (IUCN, 1993), survived more than 85 years in Paris while living in the Jardin des Plantes before it died at age 146.

As a historical character, it is presently displayed together with other famous animals in the Grande Galerie de l’Evolution.

Prehistoric remains might meet comparable destinies and build comparable systems. Distribution of fossils and artefacts from the same site to one or more institutions sometimes reflects important steps in the history of science. The Musée d’Archéologie Nationale in Saint Germain en Laye, near Paris, has displayed since the early 1900s among other items, the famous Gravettian ivory female figurine of Brasempouy (Dame à la Capuche), discovered by Edouard Piette in the French Pyrénées (Piette, 1897 and Figure 7a). Piette donated his collection to the museum, promulgating quite strict conditions concerning the display and classification. Though recently rehabilitated, the Salle Piette has remained as such for more than a century. It offers now, within a modern museum, an actual historical example of old museographic practices that bear witness of the early stages of prehistoric sciences (Schwab, 2008 and Figure 7b).

The above mentioned example of the Java Homo erectus fossils (cf. Part 3.3.) includes that of the taxon’s holotype, Dubois’ Pithecanthropus erectus (Dubois, 1894 and Figure 8). The Dubois collection is curated by NBC Naturalis in Leiden, the Netherlands, where the museum exhibits the original fossils. In this case, the system was not only influenced by the colonial history of the Netherlands Indies before the independence of the Indonesian Republic, but it also records a major step in the history of science (see, for instance, de Vos, 2004), including the amazing development of palaeobiogeographical studies in the Malay archipelago that followed the scientific revolution of the mid 1800s (Darwin, 1959; Wallace, 1869) and also the dawn of palaeoanthropology. Whatever the individual or political opinion one may have of the situation and whatever the future destiny of the fossil, the Trinil skullcap will remain closely associated to the Leiden museum, as the Rosetta Stone is to the British Museum: both countries will actively and lastingly share the responsibility of the conservation, the access and the dissemination of the heritage they presently host.

Any attempt to re-distribute such collections, to build a ‘modern’ comprehensive collection for the purpose of respecting the sites’ conditions of integrity or any attempt to reconsider the display should clearly harm the integrity of the new system created much after the excavations. On the contrary, we must take full advantage of such secondary structures and processes in order to foster conservation and interpretation of the heritage, and society’s awareness as well.

### 4.2 Moveable heritage presented in situ

Mobile heritage can play a significant part in the safeguarding of the excavated sites and zones themselves. Some prehistoric sites offer particular conditions (climate, opportunities of sheltering and safeguarding) that allow the researcher to make part of them into an open air museum, whose display helps to appraise the actual ancient situation. This is the case in Olorgesailie, Kenya, picturing the situation of Acheulean groups along a former lake shore (Isaac, 1977) or in Iserna la Pineta, Italy, a camp of rhino and elephant hunters during the early Middle Pleistocene sealed by volcanic ashes (Peretto, 2013 Figure 9) or in Melka Kunture, Ethiopia, where the long time span of prehistoric horizons are visible together with a beautifully integrated site museum (Chavaillon and Piperno, 2004; Mussi, 2012 and Figure 10). The result is quite impressive for the visitor, who can benefit from much more attractive onsite guided visits. It also helps researchers to get a more comprehensive view of stratigraphical horizons, allowing them to better plan the subsequent excavations.

However, such accomplishments imply recurrent maintenance needs and sometimes scientists are inclined or obliged to mix up originals and replicas, an approach that in certain cases might be disputable, as it introduces a bias in the field conditions appreciation. Though not concerning moveable heritage, the issue of conservation and of its consequences regarding the
display or not of the *Australopithecus* footprint trails found in Laetoli, Tanzania (Leakey M. and Harris, 1987; Musiba et al., 2012) is related to such a question.

Other approaches exist as well. Among them is the presentation, at immediate proximity of the site, of ancient floors and/or object casts. The consequence is to create a smaller buffer zone or access gallery just before the site, fostering the visitor’s awareness regarding the site’s value. These ‘entrances’, beyond their informative character, oblige the visitor to make a halt between the trip to the site and the visit itself, hence contributing to the basic safeguarding of the sites (Sémah et al., 2004 and Figure 11). Another way is to acknowledge a specific component of the value given to a specific object, such as the value attributed by local communities. The discovery of an important fossil or artefact may become symbolically high among the occupants of the area, sometimes confining to a multi-version, more or less legendary story that is transmitted between generations (Figure 12). Different kinds of ‘memorials’ can be considered for such a purpose, from the single signpost to an actual monument, including the display of a replica of the object together with an interpretive commemorative poster.
5. Valuing prehistoric moveable heritage?

5.1 Antiques, laws, conventions and monetary value

The antiques market is quite active throughout the world. It is indeed more developed in the field of art and craft collections of classical archaeology objects (decorative ones, such as statuary, ceramics, metal implements and so on) but actual commercial networks exist regarding palaeontology and prehistory. It mostly concerns fossils, lithic and animal hard material implements or artefacts reflecting symbolic behaviours.

Such a market is not necessarily a ‘black’ one: various national regulations acknowledge to some extent the right of personal ownership for discoverers (for instance, in the case of surface finds), not to mention objects that have been present in private collections for years. Numerous prehistoric remains are therefore legally available for sale, obviously including cases that infringe on the widely ratified or accepted UNESCO Convention on illicit practices regarding cultural property (UNESCO, 1970).

This situation is somewhat difficult to manage for heritage authorities, and the boundary between the trade of a couple of objects owned for long by a family and the actual traffic of objects remains vague. It encourages the establishment of market prices for objects, grounding only of their physical state: a contextualized or possibly contextualized object is physically similar to one which lacks any documentation. Furthermore, some national regulations (for example, in several European countries) regarding the economic model of the public sector require the museums to appraise their collections in terms of capital, a practice that is not much publicly disseminated but clearly exists.

On its own, the very possibility of selling objects encourages the persistence of illicit trade. Every year, an important number of remains are seized by customs throughout the world and are most often transmitted for storage in national museums.

5.2 Heritage material exploitation and the question of ‘transfer of ownership’

In many countries, illicit trade comes along with illicit or illegal excavations, which are quite harmful for prehistoric sites and which may take several forms. The most classical situation is that of the occasional smuggling of a found or purchased object by a visitor who wants to bring back home a souvenir: the consequences maybe catastrophic, as the dissemination of such practices and the correlative multiplication of acts (though looking marginal for each of them) can infect the whole of the conservation system.

The most dramatic practice is the organized, systematic looting of a site, analogous to what frequently happens on classical archaeological sites. Such operations can be linked to powerful financial networks, which may extend well beyond the antiques market. A good example is that of treasure and pot hunting in the Philippines that harmed numerous caves (including prehistoric sites) in search for the gold stock accumulated by the Japanese army during the Second World War (see Byrne, 2014 and Figure 13).

Fossil and artefact searches for commercial purposes by members of the local communities may occur as by-products of their daily agricultural or quarrying activity. Here also, the collection can be occasional (for the tourist market) or systematic (for organized commercial networks practicing illicit trade). It may even happen that quarries, behind their official purpose, mostly aim at recovering fossils and artefacts: when a spectacular specimen is spotted in the stratigraphical layers, one may easily exploit the natural resource - for example, sand - not far from the
fossil, creating an artificial smaller embankment slope that will of course help the fossil to collapse accidentally by itself in the quarry, as if the discovery were made by chance.

It is quite difficult, especially among a numerous community, to trace the boundary between an obvious, financially oriented looting of the property and an approach that is related to heritage ownership perception. As a matter of fact, some of the above-mentioned practices (especially the isolated acts) can have more complex motivations than purely commercial ones and often originate in the nature of the relationships a local community develops with the authorities:

**With the scientists**

who trained people for surface surveys; this has been for long the case in the *Homo erectus* bearing Sangiran World Heritage site. The early stage research carried out on the property included actual large-scale hunts organized after heavy rains in order to collect fossils unconcealed by erosion (von Koenigswald, 1956). People were rewarded ‘per fragment’ by Ralph von Koenigswald, who in this way succeeded in collecting a significant number of specimens that allowed him to build his well-known biostratigraphical framework of the area (von Koenigswald, 1949). During the hunt, villagers and members of von Koenigswald’s team would break more complete fossils into several parts in order to acquire a higher reward. This practice persisted until quite recent times and numerous famous ‘Pithecanthropus’ fossils were given to the scientists against retribution. This was especially the case for the Sangiran 27 and 31 archaic specimens, found at the same location, respectively transmitted to Professors T. Jacob and S. Sartono in the late 1970s (see, for instance, Sartono and Grimaud-Hervé, 1983; T. Jacob, in Lumley and Lumley, 2014).

**With the government**

when the community feels the heritage they own is appropriated by the authorities in a monopolistic way. Rightly or wrongly, the communities resent an unjust separation between the land they own and occupy, and the included moveable heritage that joins collections in a museum they do not appropriate. In order to control what they consider as a useless ‘leak’ of their heritage, they claim for individual or - more rarely - collective financial compensation.

### 5.3 Fake objects, new objects and site pollution

Imitation is also a financially rewarding business, which mostly affects the small-scale trade carried out with tourists. This implies, for instance, the rough modification of an animal remain, the making of a composite object mixing old and new materials, the manufacturing of new artefacts and so on.

However, there are currently reported cases of trickery by scientists in well-known prehistoric sites that involve a highly sophisticated way of imitating patina, mineralization and human fossils by concealing or erasing modern anatomical characters in order to make the piece look like an actual fossil. Such a process is nothing but a modern way of repeating the famous scams carried out by Pittdown (see Weiner, 1980) or Moulin Quignon (see, for instance, Cohen, 1999) and remind us of some famous - though happily rare - fraudulent practices like the planting of objects in an unexcavated part of a site.

Cases of ‘site pollution’ are much more frequent and linked to the lack or carelessness of dissemination of good practices. For instance, this happens at artefact-rich locations where groups of visitors or even field schools open practical workshops in order to understand the nature of the raw material or to learn about the manufacture of artefacts. The activities are not always carried out in a well isolated place, and the resulting flakes and waste are not always carefully packed, buried with a clear sign or brought back. This results in the high risk of unintentional deception of future research. Moreover, it also happens that such experiments are carried out using actual prehistoric artefacts, which were not correctly identified by the novice artefact maker.

### 6. Sharing perception, value and access to the heritage

#### 6.1 Sharing values and learning to speak a common language

The above mentioned examples reveal the quite complex, nuanced and sometimes unexpected fate of fossils and artefacts once released from the stratigraphical layers they originate from. This complicates any attempt to stipulate clear and universal rules regarding their conservation and access. These examples also relate to the large diversity of stakeholders and users of
the heritage, who belong to multiple sociocultural categories. Such an observation opens a large field of thinking regarding what we usually call ‘good practices’.

A primary step is the necessity to speak a common language. We have seen (cf. Part 1.1.) that this is not a very simple task. Once again, we must come back from this point of view to the basic question of the prehistoric site’s conditions of integrity. The moveable heritage is part of this and in the case of sites that have already disappeared, along with the collected documentation, constitutes the only witness.

The primary dialogue must therefore take place around the heritage, on the site or when dealing with a collection. People who meet in such places, most often members of local communities, scientists or curators, basically share a common quality: they have something to tell about the heritage, a message to deliver to other stakeholders or users, present or future. These messages might well be different: the one transmitted between generations within a farmer family has little to do with the content of a peer reviewed scientific publication or a museum’s documented inventory or published catalogue. Yet all these parties can easily learn to communicate provided they share a common experience and are sincerely willing to hear from each other.

Common words come along with common experience in such cases and the excavations campaigns often provide the best opportunities for such exchanges, especially when sharing the most valuable moments of important discoveries (Figure 14).

6.2 A bottom up policy prior to a top down policy

The above-mentioned dialogue is essential in terms of conservation and goes well beyond the simple institution of a bottom up policy:

Directly dealing with the heritage, in an often integrative way that concerns both the sites and the collections, it is quite useful in terms of daily conservation and safeguarding.

Being carried out during scientific activities, it clearly provides added value for the purpose of assessing the conditions of authenticity and is closely related to the concern of sites’ conditions of integrity.

The complementarity between the messages delivered respectively by local and scientific communities is important: the former has long been a main medium of heritage transmission between generations that becomes enriched by the scientific significance of the heritage; the latter guarantees the conditions of authenticity and benefits in many cases local knowledge in order to plan, implement and document scientific work. Initiatives as those presented in Part 4.2. (see Figure 12) illustrate such complementarity.

Such a dialogue, basically oriented towards the identification of heritage value, shows close analogies from one place to the other in the world, hence contributing to the development of international practices.

It creates a community of interest between several stakeholder groups that becomes easier to integrate on a larger scale, in other words, including governmental authorities and international organizations that can, in return, more easily stipulate and implement official regulations regarding the heritage.

6.3 Towards a practical implementation of dialogue

Practices are numerous regarding prehistoric heritage, some of them having been mentioned in the previous pages. Several among them clearly illustrate the directions to be followed, encouraged or tested in order to improve the conservation and safeguarding of the collections and associated contextual documentation.

In the properties and associated museums or storehouses

Beyond the contact developed during activities related to moveable heritage, several initiatives are to be developed.

Concerning visitors, provided the question of artefacts and fossils trade is correctly handled in accordance with local communities (see also the value of replicas issue below) the public must learn to behave precisely like they are intended to in a natural reserve, for example, to stay within the indicated tracks, to avoid picking up or harming any object or creature
from the environment. The analogy is not only a behavioural one; it must be disseminated in order to foster the perception of integration of both the natural and cultural character of the prehistoric heritage. The very role of the site museum and/or access buffer zones (cf. Parts 3.1. and 4.2.) must be highlighted and disseminated.

Nevertheless, local communities cannot be asked to adopt exactly the same attitude. On the one hand, their daily activities (such as farming) impact the environment and on the other hand, they are actual stakeholders and owners of the property and associated objects. Capacity building in terms of daily behaviour regarding heritage safeguarding must be developed beyond the excavation and survey campaigns. Their role in safeguarding might remain occasional, yet it must not be minimized.

Citizen sciences (or more precisely participative sciences) initiatives should play an important part from that viewpoint. They have significantly developed during recent years regarding biodiversity conservation (see Couvet et al., 2008). It is quite amazing to notice that the correlative investment regarding prehistory is most often limited to educational activities and didactic activities developed in dissemination structures or to volunteer - paying or not - participation in fieldwork campaigns. Such initiatives must be developed in the framework of the very local society related to prehistoric sites. The objective is to allow, under well-controlled conditions, the current monitoring of the sites and, whenever relevant, the collection of fossils and artefacts by community groups (for example, farmers, supervised groups of school children and students).

Regarding the commercial value of moveable heritage

Dealing with fossils and artefacts, it is almost impossible to adopt a ‘no value’ position comparable to that implemented nowadays by governments regarding commercial prohibition of protected commodities that constitute ‘renewable’ resources and whose exploitation harms endangered biodiversity elements: for instance, massive public destruction of ivory tusks have been publicly carried out during recent years in America, Asia and in Europe.
However, it appears fully possible to give a commercial value to replicas. Here, the ‘no value’ position obviously applies to the utilized material and the basic value relies on the skill put in the object and on the quality of the related documentation. The practice is widely in use in art museums, but still too seldom in the field of prehistory. Nowadays, the precision of a replica no longer relies on that of the casting technique, which makes use of numeric instruments. It depends more on the skill and time given to reproduce the patina and highlight significant details. Close collaboration between scientists, museums and communities can be developed on a capacity building and cooperative basis. Controlled dissemination of reasonably priced high quality replicas that come along with their scientific significance helps to prevent the illicit trade of heritage objects, improves the visitors’ awareness and directly helps the local economic development (Figure 15).

Regional and international collaboration

The first observation concerns the concept of universal responsibility, crucial in the activities and thematic programmes undertaken by the UNESCO World Heritage Centre and Advisory Bodies. But such a responsibility, which needs to comply with a multitude of national regulations and development policies, cannot be achieved without the active participation of research institutions, universities and museums.

Their relationships constitute powerful regional and international networks whose effect is still far from being maximal in terms of the harmonization of capacity building efforts (at the scientific and academic training levels), documentation databases (including excavation records), sample duplicates conservation and access or analytical procedures and related results access. For example, the present objective of serial, transboundary nominations of sites following a thematic issue that is under consideration by the World Heritage Centre must be fostered by an actual effort of cross-access to the collections and data coming from the relevant sites.

An effort regarding the traceability of collections is also quite important, even though modern museums nowadays apply a strict policy before accepting the purchase of new objects or receive them as a donation:

Regarding ancient collections,

it can much help in locating heritage that has been distributed among various institutions (cf. Parts 2.2. and 4.1.), including some major pieces that are deemed ‘lost’ or whose importance was not properly identified at the time.

Regarding collections that are lacking context,

such as those seized by customs (cf. Part 5.1.) whose scientific value is quite limited because of the permanent loss of data, but not necessarily their museographic value. It is not that difficult to confer them a somewhat artificial but quite useful ‘new’ value and life: they remain original items that are representative of an area, a region or a cultural horizon. Renewable exchange loans can be considered between museums that are located far away, each one being eager to present original material for the purpose of comparison, as was the case during the early stages of prehistoric science (cf. Part 2.2.). The practice of strengthening relations among museum networks can have a quite positive impact on other collaborative projects (cf. Part 6.4.), including the coproduction of temporary exhibitions presenting outstanding discoveries.

7. Conclusion: ‘Pusaka’ in Sanskrit

The Sanskrit language uses the word Pusaka in order to qualify the most valuable part of a family heritage, the one impregnated with our ancestors’ souls, who influences the heir and should remain for future generations even if all other parts of the heritage happens to disappear.

Considering a limited number of examples, we easily realized that, when dealing with prehistoric ‘moveable’ heritage, complexity is more a synonym of richness, from the single fossil fragment collected by a farmer in his field up to the historically meaningful presence of a major item in a museum, located far from the place of its discovery.

Assuming at all levels absolute responsibility to this heritage implies developing and weaving numerous relationships between all owners, actors and users; it essentially indicates to be able to look comparably at prehistoric objects and, overall, to be able to recognize, deep inside each fossil or artefact, a part of our collective Pusaka.
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Bibliography


The Swabian Jura
History of Research and the Aurignacian of the Sites in the Swabian Jura

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Introduction

With its rich cave sites, the Swabian Jura of south-western Germany represents a key region for the study of the late Middle Palaeolithic and the Upper Palaeolithic. This is why it has been a major centre of Palaeolithic research since the nineteenth century that is closely connected with excavations of Oscar Fraas, Robert Rudolf Schmidt, Gustav Riek, Robert Wetzel, Joachim Hahn and others. Particularly renowned among the Swabian cave sites are Geißenklösterle, Hohle Fels, Vogelherd and Hohenstein-Stadel for having yielded the oldest universally accepted figurative art and musical instruments from the Aurignacian period (Hahn, 1986; Hahn and Münzel, 1995; Conard, 2009a, b; Conard et al., 2009).

Its extensive stratigraphic sequences, which comprise the late Middle Palaeolithic and the whole Upper Palaeolithic cultural sequence and exceptional finds make the Swabian Jura a region of international importance and Outstanding Universal Value for Palaeolithic research. Since within the cultural sequence of the Swabian Jura, the Aurignacian deposits have yielded by far the most impressive archaeological objects and data, the focus of this paper will be on the early Upper Palaeolithic. Other periods such as the Middle Palaeolithic, the Gravettian and the Magdalenian, although of utmost regional importance too, will only be dealt with marginally.

With ages of down to 43 Ka cal BP the Swabian Aurignacian belongs to the oldest proof of that techno-complex and thus, the Swabian Jura plays a key role in the discussion about the earliest anatomically modern humans in Europe. Many lines of evidence point to the period between roughly 45 and 30 Ka BP as the period in which modern humans arrived in Europe and displaced the indigenous Neanderthal populations. At the same time, many innovations associated with the Upper Palaeolithic including new stone and organic technologies, use of personal ornaments, figurative art and musical instruments are, for the first time, documented in the European archaeological record.

Two models developed in Tübingen in connection with the sites of the Swabian Jura are the Danube Corridor and Kulturpumpe models (Conard, 2002; Conard and Floss, 2000; Conard and Bolus, 2003). According to the former, anatomically modern humans rapidly entered the interior of Europe following the Danube Valley. The latter model presents a working hypothesis to explain the early advent of fully modern behaviour and the cultural innovations of the Aurignacian and Gravettian in the Swabian Jura. The Danube Corridor model is supported by modelled age estimates from recent Accelerator Mass Spectrometry (AMS) measurements with the ultrafiltration technique and the independent confirmation of the early 14C dates using TL measurements on burnt flint (Richter et al., 2000; Higham et al., 2012). Dates from several sites in the Swabian Jura document Gravettian to earlier than 30 Ka cal BP (Higham et al., 2012). These rich assemblages predate similar assemblages in central Europe and correspond to a period when the Aurignacian was still widespread in Western Europe (Delporte, 1998; Djindjian et al., 1999; Conard and Bolus, 2003; Moreau, 2009).

The Swabian Jura

Geographically, Swabia corresponds to the eastern half of the modern state of Baden-Württemberg. It covers the area from Lake Constance north to the border with the state of Hessen and includes the westernmost part of the state of Bavaria. The most prominent topographic feature is the low Jurassic-aged limestone mountains and plateaus of the Swabian Jura, referred to in German as the Schwäbische Alb. The Swabian Jura ranges in elevation from about 450 to 1000 meters and is characterized today by a relatively cool and wet climate. 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. Most of the key Palaeolithic sites are caves. Research in Swabia has typically focused on caves, which in most cases provide excellent preservation of faunal remains while, although they are present, little is known about open air sites (Conard et al., 2006).

The most important Swabian sites are represented by the caves in the Ach Valley 15 km west of Ulm between Schelklingen and Blaubeuren and the Lone Valley 25 km north of Ulm (for a map see Conard, this volume, Figure 1). Many of these sites,
for example, Hohle Fels, Geißenklösterle and Sirgenstein in the Ach Valley and Vogelherd, Hohlenstein-Stadel and Bockstein-Törl in the Lone Valley have yielded considerable stratigraphic sequences with both Middle and Upper Palaeolithic deposits. Other caves with shorter cultural sequences are known for their Middle Palaeolithic (Große Grotte and Kogelstein in or next to the Ach Valley; Bocksteinschmiede and Haldenstein in the Lone Valley) or Upper Palaeolithic (Brillenhöhle in the Ach Valley) assemblages respectively.

The history of research

The history of research on the Swabian Palaeolithic goes back 150 years. Following a number of earlier less systematic discoveries in south-western Germany (Schmitz, 2005), the history of systematic scientific research on the Swabian Palaeolithic began in the mid 1860s with Oscar Fraas’ excavations at Bärenhöhle in the Hohlenstein complex in the Lone Valley and at the open air site of Schussenquelle near the Federsee in Oberschwaben. Fraas, the director of the Königliches Naturalenkabinett in Stuttgart, had initially conducted paleontological studies of Pleistocene deposits when in 1865, he read about the groundbreaking Palaeolithic discoveries in the Dordogne and the Pyrenees. Influenced by the work in France, he conducted excavations of the rich Magdalenian site of Schussenquelle in 1866 and in the same year, documented the first lithic artefacts from Hohlenstein-Bärenhöhle which he had overlooked in his previous 1861 or 1862 excavations when searching for cave bear bones (Fraas, 1867; Schuler, 1994). Fraas belonged to the initial generation of researchers who helped to define the goals and methods of the field. While he was certainly aware of the discussions over the fate of Neanderthals and the development of modern humans, this was not one of his main areas of research (Conard et al., 2006).

The Aurignacian of Swabia was first documented during the excavations of Ludwig Bürger (Figure 1) at Bocksteinhöhle (Bockstein Cave) in the Lone Valley in 1883 and 84. Here, Bürger recovered and published a number of classic Aurignacian artefacts including lithic and organic tools, as well as personal ornaments (Hahn, 1977; Conard and Bolus, 2006).

Subsequent generations of scholars including Robert Rudolf Schmidt, Gustav Riek, Robert Wetzel and Joachim Hahn have continued fieldwork in Swabia since then. All these scholars have directly addressed the questions related to the disappearance of Neanderthals and the appearance of modern humans in south-western Germany.

The 1930s saw a number of key excavations of Aurignacian deposits including, most notably, the work of Gustav Riek (Figure 1) at Vogelherd Cave (Dutkiewicz, this volume) and Robert Wetzel (Figure 1) at Hohlenstein-Stadel and Bockstein in the Lone Valley, the latter site with only few Aurignacian artefacts but many Middle Palaeolithic ones. Eduard Peters (Figure 1), also excavator of the Middle Palaeolithic rockshelter Heidenschmiede near Heidenheim, excavated at the less well-known sites of Göpfelsteinhöhle (Göpfelstein Cave) and Scharfstein in the Lauchert Valley. All of these digs, and especially the results from Vogelherd, played a prominent role in establishing the Swabian caves and the Upper Danube region as a whole as an area of central importance for the study of the
The Swabian Jura

Aurignacian (Conard and Bolus, 2006). The sites mentioned also yielded Middle Palaeolithic deposits, thus shedding further light on the transition from the Middle to the Upper Palaeolithic.

In the 1950s and 1960s, Robert Wetzel continued his excavations in the Lone Valley at the Hohlenstein and Bockstein complexes until his death in 1962. In the Ach Valley, Gustav Riek excavated Große Grotte and Brillenhöhle. With the exception of Hohlenstein-Stadel, the focus of these excavations however was rather on the Middle Palaeolithic, the Gravettian and the Magdalenian than on the Aurignacian.

In the last decades of the twentieth-century, Joachim Hahn (Figure 1) addressed the question of the origins of the Aurignacian in many publications. He drew from the comparative research that formed the basis of his dissertation on the Aurignacian (Hahn, 1977) and on his excavations, most importantly at Geißenklösterle in the Ach Valley of the Swabian Jura (Hahn, 1988). Following earlier work by Eberhard Wagner in 1973, Hahn began long-term systematic excavations at that site in 1974. The results from Geißenklösterle provided the first fine-grained data from the Swabian Aurignacian and helped set standards for modern excavations. To gain a second stratigraphic sequence documented with modern methods, Hahn began fieldwork at the nearby site of Hohle Fels, where Oscar Fraas and Gustav Riek had dug generations earlier. Hahn’s work at these sites played a key role in establishing the importance of the Swabian caves within the cultural developments of the European Upper Palaeolithic (Hahn, 1986, 1988; Conard and Bolus, 2006; Conard et al., 2006).

Starting with the end of the twentieth century, research on the last Neanderthals and first modern humans intensified. Subsequently, many masters and doctoral theses have been completed, as well as the author’s habilitation (Bolus, 2004a) on this topic. The Tübingen team restarted excavations at Geißenklösterle (for example, Conard and Malina, 2002), increased work at Hohle Fels and re-excavated the backdirt from Riek’s excavation at Vogelherd in 1931 (such as, Conard and Malina, 2006) (for the current research see also Conard, this volume). Most recently, new excavations at Hohlenstein-Stadel in the Lone Valley were started by Claus-Joachim Kind (Kind and Beutelspacher, 2010; Beutelspacher and Kind, 2012). Among other important results, these excavations produced new fragments of the famous Lion man, which rendered a new reconstruction of that figurine possible (Ebing-Rist et al., 2013).

Following years of intensive and systematic site prospection in the Lone Valley (Glätzel, 2012), a new era of research started in 2013 with test digs in two formerly unknown Lone Valley caves: Lindenhöhle and Fetzershaldenhöhle. The first preliminary results have just been published (Conard and Zeidi, 2014).

The newest period of research has been accompanied by many publications on interdisciplinary studies: new dating results (Richter et al., 2000; Conard and Bolus, 2003, 2008; Conard, 2009a; Higham et al., 2012), lithic and organic technology (Barth, 2007; Hardy et al., 2008; Hardy, 2009; Moreau, 2009; Taller et al., 2012; Taller, 2014; Wolf, 2014), faunal remains (Krönneck et al., 2004; Münzel and Conard, 2004a, b; Niven, 2006; Hofreiter et al., 2007; Münzel et al., 2011; Krönneck, 2012; Kitagawa, 2014; Conard et al., in press), land use and settlement intensity (Conard et al., 2006, 2012) and geoarchaeology (Schiegl et al., 2003; Goldberg et al., 2003; Miller, 2014; see also Miller, this volume). Moreover, essential information is provided by many annual reports in Archäologische Ausgrabungen in Baden-Württemberg and publications in other journals, conference proceedings and exhibition catalogues (Bolus and Conard, 2001; Müller-Beck et al., 2001; Bolus, 2003, 2010, 2011; Conard et al., 2003; Köbl and Conard, 2003; Teysandier and Liolios, 2003; Conard and Bolus, 2006; Teysandier et al., 2006; Floss and Rouquerol, 2007; Conard and Seidl, 2008; Archäologisches Landesmuseum Baden-Württemberg and Abteilung Ältere Urgeschichte und Quartärökologie der Eberhard Karls Universität Tübingen, 2009; Ulmer Museum, 2013).

The sites

Lone Valley

The Lone Valley is fed by groundwater that emerges in Urspring and flows east. This occurs mainly in times of heavy precipitation; otherwise, the valley is dry. Middle and Upper Palaeolithic, Mesolithic, as well as sites from later periods are known from much of the length of the Lone Valley (for a map see Conard, this volume, Figure 1). Particularly important in the current context are the cave sites, which produced rich Middle and Upper Palaeolithic assemblage and provide key evidence for the period of the transition between Neanderthals and modern humans.
Haldenstein

The Haldenstein cave, excavated by Gustav Riek in 1938, yielded a very small assemblage consisting, besides faunal remains, of only two leaf points (Blattspitzen) and a large blade. This assemblage can be attributed to the Blattspitzen Group characterized by bifacial leaf points, which, although not sufficiently dated, seems to represent the latest expression of the Middle Palaeolithic (Bolus, 2004b). Blattspitzen assemblages are rare in the Swabian Jura and in general only consist of few lithic artefacts. Contrary to colleagues in other parts of Europe, for instance, eastern central Europe, the German research tradition does not view the Blattspitzen Group as an early Upper Palaeolithic techno-complex but instead classifies it as belonging to the latest Middle Palaeolithic.

Bockstein

The Bockstein complex consists of a number of caves and sites. These sites include the Bocksteinhöhle, the Törle, the Westloch, the Bocksteinschmiede, the Bocksteinloch, the Brandplatte, the Bocksteingrotte and the Bockstein-Abhang. First excavations go back to the nineteenth century, while Robert Wetzel conducted major excavations in the first half of the 1930s and continued his fieldwork between 1953 and 1956 (Figure 2). Of particular interest are the Middle Palaeolithic assemblages from the Bockstein complex, first of all those from Bocksteinschmiede (Wetzel and Bosinski, 1969), which are attributed to the Keilmessergruppe (Micoquian/Pradnikian). These assemblages, the richest and most important Middle Palaeolithic assemblages from the whole Swabian Jura, include backed bifacial knives (Keilmesser), handaxes and a broad variety of side scrapers.

The first Aurignacian artefacts, among them a large split-base point, come from Bürger’s excavation in Bocksteinhöhle in 1883/1884. Another Aurignacian assemblage (layer VII), overlying Middle Palaeolithic deposits and itself overlain by Gravettian layers, was excavated by Robert Wetzel and Marie-Luise Wirsing between 1953 and 1956 at Bockstein-Törle, the original Palaeolithic entrance of Bocksteinhöhle.

Layers VII (Aurignacian) and VI (Aurignacian or Gravettian) yielded ages in the 30-32 Ka BP range (Conard and Bolus, 2003). The attribution of layer VII to the Aurignacian is based mainly on the presence of multiple bone points and carinated and busked burins (Hahn, 1977). While bone points are known from the Middle Palaeolithic of Vogelherd and the Große Grotte, they are rare prior to the Aurignacian. Similarly, the diverse forms of carinated and nosed scrapers and carinated and busked burins are unknown in the Swabian Middle Palaeolithic.

Hohlenstein

Hohlenstein is a complex of sites which consists of several caves and rockshelters, of which Hohlenstein-Stadel, Hohlenstein-Bärenhöhle and the rockshelter Kleine Scheuer are the most important. As is the case with the Bockstein complex, the first excavations go back to the nineteenth century. Again, it was Robert Wetzel who alongside Otto Völzing conducted major excavations in the 1930s, which they continued between 1954 and 1961. Following a short excavation campaign in the interior of Hohlenstein-Stadel by Eberhard Wagner in 1983, Nicholas Conard, Birgit Fischer and Michael Bolus excavated test-pits between the cave entrances and the Lone floodplain in 1997 and 1998 (Bolus et al., 1999). Between 2008 and 2013, Claus Joachim-Kind conducted new excavations both in the interior of Hohlenstein-Stadel and in its fore place (Kind and Beutelspacher, 2010; Beutelspacher and Kind, 2012; Kind, this volume).

Both Stadel and Bärenhöhle yielded Middle Palaeolithic deposits followed by Aurignacian, Magdalenian and Holocene find layers. Hohlenstein-Stadel, a 50 m long, horizontal cave, is the most important site of the Hohlenstein complex. The Middle Palaeolithic assemblages, like the ones from Hohlenstein-Bärenhöhle, mostly consist of low-standardized tools including side-scrapers and some points (Beck, 1999) and are usually classified as Swabian Mousterian. Particularly noteworthy, however, is the presence of the anthropomorphic figurine of the Löwenmensch (Lion man) found in 1939 by Robert Wetzel together with an assemblage of Aurignacian lithic and organic artefacts in spit 6 of the 20th metre of his excavation. Previous conventional radiocarbon dates from this spit lay in the range of c. 32 Ka BP (Schmid, 1989; Conard and Bolus, 2003). New dates from
this 20 cm spit confirmed the earlier dates, while modified bones from the underlying 20 cm spits 7-11 yielded dates from c. 34-42 Ka BP (Conard and Bolus, 2003). Most recently, radiocarbon measurements of animal bones from the new excavations yielded ages down to 40 Ka cal BP for the lowest Aurignacian subunit of Hohlenstein-Stadel where the fragments of the Lion man had been found (Beutelspacher et al., 2011).

Vogelherd

Vogelherd is probably the best known site in the Lone Valley. Primarily, this fact stems from the cave’s spectacular Aurignacian finds. The cave is accessible from three interconnected entrances with openings toward the north, south and southwest (Figure 3).

During his 1931 excavation, Gustav Riek documented four Middle Palaeolithic layers (IX-VI) with faunal remains and only few lithic artefacts, but with two organic tools (Conard et al., 2006, 2012). The Middle Palaeolithic is followed by the rich Aurignacian layers V and IV, which, besides faunal remains and abundant lithics, contain numerous organic tools and small figurines of mammoth ivory (Riek, 1934) (Figure 4). The sequence also included two Magdalenian layers (III and II) as well as Holocene deposits (layer I). Between 2005 and 2012, a team from Tübingen University directed by Nicholas Conard excavated the backdirt taken out by Riek in 1931 (Conard, this volume; Dutkiewicz, this volume).

AMS radiocarbon dates of samples from layer V fall between 31 and 36 Ka BP (Bolus and Conard, 2003). These results tend to predate earlier conventional radiocarbon dates from Vogelherd. The relatively young conventional dates may well result from bulk sampling of many small faunal remains of mixed ages. A degree of mixing between strata is not surprising given that the entire deposits of the cave were excavated over a period of less than three months. AMS dates of isolated bones from layer IV have also yielded dates of Magdalenian age, indicating that Riek’s techniques did not succeed at rigorously separating the archaeological units. Several dates, including one AMS date of c. 26 Ka BP from layer IV, suggest that a Gravettian component is also present at Vogelherd.

The Aurignacian assemblages from Vogelherd are extraordinarily rich indicating that the cave was occupied repeatedly during that period. Besides abundant lithic tools (Chang, this volume), a broad variety of organic tools has been unearthed during both Riek’s excavation and the excavations in the backdirt. The lithic tools include typical carinated and nosed endscrapers, burins, splintered pieces and a considerable number of Spitzklingen (pointed blades). Of the many bone points with split bases from the site, the vast majority comes from the lower Aurignacian layer V (Riek, 1934; Hahn, 1977) (Figures 4 and 5). While Riek did not find personal ornaments unambiguously coming from the Aurignacian deposits, the excavations in the backdirt produced several hundred of typical Aurignacian forms, among them double perforated ivory beads. Most impressive are the...
ivory figurines from the Vogelherd Aurignacien, about a dozen of them coming from Riek’s excavation, several others from the excavations in the backdirt (Figures 4 and 10a). Finally, fragments of bone and ivory flutes have to be mentioned (Conard, this volume; Dutkiewicz, this volume).

The Ach Valley

The Ach Valley is part of a former, Early Pleistocene, Danube Valley with a complex geological history. The cave sites most relevant for this paper are situated on both sides of the valley between the villages of Blaubeuren and Schelklingen (for a map see Conard, this volume, Figure 1).

Große Grotte

Große Grotte, the easternmost Palaeolithic cave site in the Ach Valley, yielded no Upper Palaeolithic finds but several Middle Palaeolithic layers (Wagner, 1983). Gustav Riek excavated the cave between 1959 and 1961, and in 1964. While most of
The layers are not very rich, a bone point from the uppermost layer should be mentioned since it represents one of the rare examples of organic tools from the German Middle Palaeolithic (Conard et al., 2006).

Another purely Middle Palaeolithic site should be mentioned here: Kogelstein, the last remnants of a former cave situated between the Ach Valley and the neighbouring Schmiech Valley (Böttcher et al., 2000).

Sirgenstein

The Sirgenstein Cave, situated in a limestone cliff on the north-western side of the Ach Valley about halfway between Schelklingen and Blaubeuren, was completely excavated in 1906 by Robert Rudolf Schmidt (Schmidt, 1910). The stratigraphic sequence (Figure 6) starts with Mousterian which according to the excavator came from two layers (VIII and VII). According to a reanalysis of the artefacts (Çep, 1996), both layers sensu Schmidt might in fact represent just a single Mousterian horizon. On top of the Mousterian, Schmidt discovered an archaeologically sterile layer with arctic microfauna, which separated the Middle Palaeolithic from the Aurignacian but was not present in the whole excavation area. Schmidt subdivided the Aurignacian sequence into three layers (VI-IV), while he labelled the assemblages from the overlying layers III and II as ‘Proto-Solutréen’. Today we know that there is no Solutrean in central Europe and that the assemblages in reality belong to the Gravettian. The Magdalenian layer I represents the top of the Pleistocene sequence (Schmidt, 1910, 1912; for a discussion of Schmidt’s results in the view of modern research see Bolus and Conard, 2012).

AMS dates taken on samples from two bone points, two bone burnishers and a bone awl from the Aurignacian and Gravettian layers fall in the range of c. 30-27 Ka BP (Conard and Bolus, 2003). They suggest a degree of mixing between the archaeological units, but are consistent with the cultural attribution of the assemblages from layers VI to II to the Aurignacian and Gravettian. While split-based bone points are lacking, bone tools and typical Aurignacian stone tools such as carinated and nosed end scrapers are present in layers VI to IV.

Geißenklösterle

Geißenklösterle as it today represents the collapsed ruin of a former cave situated in the Bruckfelsen, c. 60 m above the Ach in the village of Blaubeuren-Weiler (Hahn, 1988). The Aurignacian layers are particularly important and preserve the oldest finds from this period known in our region (Richter et al., 2000; Higham et al., 2012).

The cave was discovered as a Palaeolithic site in 1958 by Reiner Blumentritt. In the same year, Gustav Riek excavated a small test-pit in the entrance area. Following a first excavation campaign in 1973 directed by Eberhard Wagner, Joachim Hahn from Tübingen University carried out systematic fieldwork between 1974 and 1991. Nicholas Conard and his Tübingen colleagues continued the excavations between 2000 and 2002.

These excavations uncovered a long stratigraphy comprising layers from the Middle Palaeolithic, the Aurignacian, the Magdalenian and finally, the Mesolithic and other Holocene material. Excavated with modern standards of excavation and documentation the site thus provides, together with the sequence from neighbouring Hohle Fels, the best studied sequence in the Swabian Jura. While the Middle Palaeolithic yielded only few tools, generally bearing cryoretouches and only in general attributable to the Swabian Mousterian (Conard et al., 2012), the Gravettian and Aurignacian layers were especially abundant in finds. Between the Middle and the Upper Palaeolithic, an archaeologically nearly sterile layer was observed clearly separating the respective occupations.
The Aurignacian can be subdivided into a lower (Archaeological Horizon [AH] III) and an upper (AH II) Aurignacian. Dating series using the TL signal of burnt flint yielded an age of about 40 Ka BP for the lower Aurignacian and an age of about 38 Ka BP for the upper Aurignacian (Richter et al., 2000). Moreover, we have several dozens radiocarbon dates, both conventional and AMS dates. Recently, dates obtained with the ultrafiltration method yielded calibrated and modelled age estimates of down to 43 Ka cal BP for AH III (Higham et al., 2012), making the lower Aurignacian of Geißenklösterle one of the oldest, if not the oldest Aurignacian assemblage known so far. According to the new ultrafiltration dates, the upper Aurignacian of AH II is placed between 35 and 39 Ka cal BP.

Both horizons yielded evident features, the most outstanding feature of the lower Aurignacian being a fireplace, which Hahn did not excavate entirely and which was further investigated during the new excavations in 2001 (Hahn, 1988, 1989; Conard and Malina, 2002). For the upper Aurignacian, a large concentration of burnt bones should be mentioned (Hahn, 1988).

As is the case for all Aurignacian assemblages in the Swabian Jura, the stone knapping technique is very similar in both horizons. Essentially, the Aurignacians used a relatively simple, but marked, unidirectional blade production technique. The toolkit is similar in both horizons, but the percentages of special tool types differ significantly. Carinated and nosed end scrapers appear much more often in the lower Aurignacian while splintered pieces are rare there. Burins nearly reach the same numbers in both horizons. The upper Aurignacian is dominated by simple end scrapers and splintered pieces by far outnumber those of the lower Aurignacian. Among the burins there are several busked burins. Other tool types include Spitzklingen and retouched blades. It is only in the upper Aurignacian that very small numbers of Dufour bladelets appear (Figures 7 and 8).

Organic artefacts are represented in the lower Aurignacian above all by projectile points and carefully worked ivory rods, furthermore, there is one antler percussor. What is striking is the high amount of debris from ivory working which indicates that a high number of organic artefacts had been manufactured. Only in the upper Aurignacian projectile points with split bases appear (Hahn, 1988; Bolus and Conard, 2006), while a slender ivory point with massive base comes from the lower
Aurignacian (Bolus and Conard, 2006). All in all the range of organic artefacts is more diverse in the Geißenklösterle AH II assemblage. Among others there is one *bâton percé* made of ivory from AH II (Figures 7 and 8).

The lower Aurignacian yielded seven pendants, which demonstrate an astonishing variety: there are elongated pieces as well as drop-shaped pieces made of ivory, as well as perforated fox canines (Figure 7 and 9). In addition, two worked fragments of soapstone from the same complex may be interpreted as the remains of pendants as well. All pieces mentioned were found near the fireplace or in the fireplace itself (Hahn, 1989). The objects of personal ornamentation in the upper Aurignacian are dominated by double perforated ivory beads, their number reaching more than one dozen. No parallels exist for a large retoucher-like pendant made of reindeer antler. In the context of ornamental objects, decorated antler rods with regular incisions at the rim also have to be mentioned (Figure 8).

Art objects up to present only appear in the upper Aurignacian AH II. Four ivory figurines, including a relief with an upright standing anthropomorphic figurine with carefully carved notches along the edges and regularly carved depressions on the backside, are well known (Hahn, 1986) (Figure 8). Belonging to the same context are two flutes made of swan bones, which, like the art objects mentioned, range among the oldest ones of their kinds worldwide (Hahn and Münzel, 1995) (Figure 8). One example of an exceptional object is a flute made of ivory that Maria Malina refitted from numerous ivory fragments from Hahn’s excavations (Conard et al., 2004a; Conard, this volume) (Figure 10f).

Hohle Fels

Hohle Fels is a cliff of White Jura limestone located just northeast of the town of Schelklingen. Behind the entrance, open to the northwest, a tunnel-like passage of about 30 m in length with a niche about halfway expanding to both sides leads into a large cave hall, which at the base measures 500 m². The cave has a volume of 6000 m³ and is therefore one of the largest caves of the Swabian Jura. The genesis of Hohle Fels is probably associated with the fact that the Danube River ran through the Ach Valley until the height of the Riss glacial stage. The cave was drained when the Danube cut deeper into the valley. Unlike the other archaeological caves of the Ach Valley, Hohle Fels lies near the valley floor rather than in the more elevated cliffs, just 7 m above Ach level. Situated at the eastern side of the cliff containing the cave, a rockshelter named Helga Abri yielded rich assemblages from the final Palaeolithic and the Mesolithic.

The excavations at Hohle Fels have a long history dating back to Oscar Fraas’s and Theodor Hartmann’s work in the 1870s in the large hall of the cave. The cave was thought to completely lack further Palaeolithic sediments after these excavations. However, between 1958 and 1961 Gustav Riek and Gertrud Matschak, a pharmacist from Schelklingen, excavated at different localities within the cave and demonstrated that there were undisturbed Palaeolithic sediments containing artefacts at least in the tunnel-like passage. Joachim Hahn started first excavations in the niche of the passage between 1977 and 1979 and then excavated, more or less annually, from 1988 until his death in 1996. The current phase of excavation started in 1997 under the direction of Nicholas Conard (during the first years in collaboration with Hans-Peter Uerpmann) and continues today (Conard, this volume).

The stratigraphy uncovered in Hohle Fels is very similar to the one excavated in Geißenklösterle. The sequence starts with four Middle Palaeolithic layers (AH IX-VI) followed by an nearly archaeologically sterile layer. An exceptionally rich Aurignacian sequence is subdivided into five units (AH Vb, Va, IV, IIb, IIa), some of them including anthropogenic features (see Conard and Bolus, 2008). AH Ile and IId mark the transition from the Aurignacian to the overlying Gravettian which is subdivided into AH IIcf, IIc and IIb. Finally, sediments probably deposited during the Last Glacial Maximum (LGM) are followed by Magdalenian deposits (AH Ia and IIa). The upper part of the Magdalenian had been cut off due to the use of the cave during World War II. Some disturbances in the remaining Magdalenian deposits yielded Holocene material.
AMS dates for the Middle Palaeolithic assemblages range between roughly 36 and 40 Ka, while the earliest Aurignacian from AH Vb yielded ages down to 40 BP. Dates for the other Aurignacian subunits (Va-IIa) range roughly between 35 and 30 Ka BP. AH IId and lle yielded ages between 30.5 and 28 Ka BP, ages between 30 Ka and 28 Ka BP were measured for the Gravettian (Conard and Bolus, 2008; Conard, 2009a).

The Middle Palaeolithic layers are somewhat richer than those from Geißenklösterle, but nevertheless yielded only small assemblages of the Swabian Mousterian (Conard et al., 2012). Although the Gravettian deposits from Hohle Fels yielded a wealth of finds including abundant organic tools, personal ornaments and few art objects, they will also not be further considered in this paper.

The Aurignacian layers are characterized by an abundance of typical stone tools such as carinated and nosed endscrapers as well as a broad variety of busked and carinated burins and organic tools. The organic tools include only few split-base points, but the fact that one of them was discovered in the lowermost Aurignacian with dates down to 40 Ka BP demonstrates, that obviously split-base points are present from the start of the Swabian Aurignacian (Conard and Malina, 2009). The lowermost Aurignacian also produced a pencil-like ivory point similar to the one from the lowermost Geißenklösterle Aurignacian (Bolus and Conard, 2006). All Aurignacian subunits have yielded a wealth of personal ornaments, mostly carved from mammoth ivory, among them double perforated ivory beads so typical for the Swabian Aurignacian and specific ornament types, which are limited to the Hohle Fels Aurignacian (Figure 10b-d).

Most noteworthy are the art objects and musical instruments from the Hohle Fels Aurignacian. Ivory figurines have been found throughout the Aurignacian sequence, the most spectacular one being without doubt the ‘Venus’ from the lowermost Aurignacian layer Vb, which, with an age of around 40 Ka BP represents the oldest female representation worldwide (Conard, 2009a; Conard, this volume) (Figure 10e). Less than one metre away from this figure, a bone flute was discovered in the same layer. Together with fragments of two ivory flutes from AH Vb and Va respectively, these flutes, like the ‘Venus’, are the oldest of their kind and the oldest musical instruments worldwide (Conard et al., 2009; Conard, this volume).

Brillenhöhle

The Brillenhöhle (Glasses Cave) is an oval-shaped, cupola-like cave situated around 80 m above the Ach, its name describing the two eyeglass-like openings in the ceiling. Gustav Riek excavated the cave between 1955 and 1963.

Other than in the caves mentioned before, no Middle Palaeolithic artefacts have been found in this cave. The Aurignacian is only represented by two organic projectile points from layer XIV. Radiocarbon dates obtained from these points range between 32.5 and 30.5 Ka BP (Bolus and Conard, 2006). According to Riek (1973), layer VIII, for which he published a minimum age of 29 Ka, contained a fireplace on its top, but unfortunately the layer did not yield artefacts.

Layers VII, VI and Vu (‘V unten / IV lower’) are attributed to the Gravettian, while layers IVu (‘IV unten / IV lower’, IVo (‘IV oben / IV upper’) and possibly III yielded rich Magdalenian material (for a re-evaluation of the Gravettian lithics see Moreau, 2009). Riek (1973) published a date providing a minimum age of 25 Ka from burnt bone from the Gravettian fireplace of layer VII. More recently, two bone samples from layer VII have been dated to around 27 Ka and 26 Ka respectively (Conard and Moreau, 2004).

Discussion – the main characteristics of the Swabian Aurignacian

The Middle Palaeolithic assemblages from the Swabian Jura were not presented in detail in this paper. It should be stated, however, that the low find density in most Swabian Middle Palaeolithic sites indicates that Neanderthals visited most caves only sporadically and for short stays. The large number of cave bear bones shows that bears used the caves much more intensively than humans during the Middle Palaeolithic (Conard et al., 2012).

The find density in the Swabian Aurignacian is much higher than in the preceding Middle Palaeolithic. This seems to indicate that the Aurignacians used the caves much more intensively than the Neanderthals. This is underlined by the fact that cave bear bones, though still numerous, are much less abundant than in the Middle Palaeolithic when human presence in the caves had only been sporadic (Conard et al., 2012).

Archaeologically sterile or nearly sterile layers at several Swabian key sites such as Geißenklösterle, Hohle Fels, Sirgenstein and most probably Vogelherd are indications of a clear break between these two periods of human evolution. Starting with the lowermost Aurignacian assemblages – Geißenklösterle AH III, Hohle Fels AH Vb and Hohlenstein-Stadel AH A/V – some 40 Ka ago the material culture in Swabia changes dramatically. Abundant data from the Swabian sites show a
wide spectrum of new artefact types, both lithic and organic, and a variety of personal ornaments as well as figurative art and musical instruments which are totally lacking in the local Middle Palaeolithic assemblages. Evidence from the basal Aurignacian of AH Vb at Hohle Fels demonstrates that the Swabian Aurignacian was fully developed from the beginning and contained the whole package of early Upper Palaeolithic innovations including symbolic artefacts.

The lithic technology of the Swabian Aurignacian is based on a unidirectional blade and bladelet production; furthermore, there is also some evidence of systematic flake production (Bolus, 2012). Blades and, to a much lower degree, bladelets were produced from platform cores while in most cases carinates served for the production of bladelets. This leads to the conclusion that the production of blades and bladelets followed frequently, but not exclusively, separate reduction sequences.

Retouched forms include a wide variety of tools such as carinated and nosed endscrapers (which might also be seen as bladelet cores), simple endscrapers, burins of various types including busked and carinated burins, Spitzklingen (pointed blades), splintered pieces, truncated pieces and blades with lateral Aurignacian retouch. All of these forms are completely lacking in the preceding Middle Palaeolithic of the region.

Organic tools are present with a remarkable variety of types. First and foremost, projectile points have to be mentioned here. Pencil-based ivory points are known from the lowermost Aurignacian deposits of Geißenklösterle and Hohle Fels. Split-based bone points, a marker of the early Aurignacian, are known from several sites including Bocksteinhöhle, Vogelherd and Geißenklösterle. At Hohle Fels, split-based points with an age of down to 40 Ka BP are already present in the lowermost Aurignacian layer AH Vb. Given the age of about 32 Ka BP for one specimen from Brillenhöhle, split-based points appear nearly throughout the whole ‘lifespan’ of the Swabian Aurignacian. Other types of organic tools include burnishers, awls, ivory rods and bâtons percés made of ivory.

Personal ornaments include a wide array of perforated and grooved teeth from carnivores and herbivores. Moreover, the Aurignacian sites have produced a variety of fully carved beads and pendants from mammoth ivory. Most characteristic are finely carved double perforated beads, which have been found both in Ach and Lone Valley sites. They are unknown from Aurignacian contexts elsewhere (Figure 10b-d). All stages of production of the beads are documented at Hohle Fels, Geißenklösterle and Vogelherd. Double perforated ivory beads appear throughout the whole lifespan of the Swabian Aurignacian, the oldest specimens with an age of down to 40 Ka coming from AH Vb of Hohle Fels and from AH III of Geißenklösterle, the youngest ones with ages of 30.5-29 Ka coming from AH Ille of Hohle Fels and AH IV of Sirgenstein. Other forms include, among many others, basket shaped ivory pendants, small ivory discs and violin-shaped ivory beads (Conard, 2003a; Wolf et al., 2013; Wolf, this volume).

An integral trait of the Swabian Aurignacian is the presence of figurative art represented primarily by small figurines carved from mammoth ivory (Figure 10a, e). Until today, four caves – Hohle Fels, Geißenklösterle, Vogelherd and Hohlenstein-Stadel – have yielded about fifty art objects, often fragmentary, which represent the most impressive examples for symbolic artefacts within the Swabian Aurignacian and which date between 40 and 30 Ka BP (Floss, 2007). In most cases, animals are depicted: mammoths, felines, horses, bison and other, less frequently depicted species including a bear, a waterbird and a fish (Conard, 2003b, 2009b). Regularly the figurines bear symbolic signs, the meaning of which is unknown to present-day people. A special group is represented by therianthropic figurines, which combine human with animal features. Two of them, one from Hohlenstein-Stadel with a length of about 30 cm and one from Hohle Fels with a length of less than 3 cm are referred to as Löwenmenschen (Lion men), since they show a combination of characteristics of lions and humans (Conard, 2003b; Ebinger-Rist et al., 2013). A third object, a small ivory plate from Geißenklösterle, bears the half-relief of a figure with uplifted arms which might also represent a Lion man (Hahn, 1986).

A singular piece of art is a ‘Venus’ figurine carved from mammoth ivory which was discovered in the basal Aurignacian of AH Vb in Hohle Fels (Conard, 2009a) (Figure 10e). A radiocarbon age of down to 40 Ka years makes this ‘Venus’ the oldest of all
figurines recovered from the Swabian caves and perhaps the earliest example of figurative art worldwide. With this discovery, the idea that the three-dimensional female depictions of the Willendorf type developed no earlier than in the Gravettian some 10 Ka later can be rejected.

Only 70 cm away from the Venus, the same find layer produced a flute made from a vulture bone (Conard et al., 2009). The fact that with this instrument already eight Aurignacian flutes are known from three Swabian caves – Geißenklösterle, Hohle Fels and Vogelherd – shows that a musical tradition existed in the Swabian Jura as early as 40 Ka ago. Four of the flutes are made from bird bones, the other four are made from mammoth ivory (Hahn and Münzel, 1995; Conard, 2007; Conard et al., 2009) (Figure 10f). While it requires advanced technical skills to make a flute out of a bird bone, which is hollow by nature, it is a demonstration of technical mastership to carve a flute out of a massive piece of ivory. One of the most surprising observations is that with these Aurignacian flutes it is possible to play complex melodies just like with modern flutes today (Conard, this volume).

The Aurignacian deposits in Hohle Fels yielded a number of anthropogenic features, which are fire-related but represent dumping areas rather than real fireplaces (Conard and Bolus, 2008). At least one fireplace was excavated in the lower Aurignacian (AH III) in Geißenklösterle. For the Aurignacian deposits of both Sirgenstein and Vogelherd several fireplaces were documented by the excavators (Schmidt, 1912; Riek, 1934).

Subsistence in the Swabian Aurignacian was based primarily on horse and reindeer just like in the Swabian Middle Palaeolithic; moreover, there is a certain percentage of mammoth which was very sparsely exploited by Neanderthals (Münzel and Conard, 2004a; Conard et al., 2012).

The human fossil record from the Swabian Jura is very sparse. Only one single Neanderthal femur was excavated from the Mousterian levels of Hohlenstein-Stadel (Kunter and Wahl, 1992). Since the Vogelherd fossils, for a long time thought to be of Aurignacian age, proved to be Neolithic (Conard et al., 2004b), the Aurignacians of the Swabian Jura themselves are only known from three isolated teeth from Sirgenstein and possibly one tooth from Hohlenstein-Stadel (Conard and Bolus, 2003). All belong to anatomically modern humans and, despite the scarcity of human remains, we consider anatomically modern humans responsible for the whole Swabian Aurignacian.

Conclusions – the Outstanding Universal Value of the Swabian Jura sites

The Swabian Jura of south-western Europe is a key region for the study of the late Middle Palaeolithic and the evolution of the Upper Palaeolithic starting with the Aurignacian. Important stratigraphic sequences and more than two hundred radiocarbon and TL dates from key sites such as Geißenklösterle, Hohle Fels, Sirgenstein, Vogelherd and Hohlenstein-Stadel provide a reliable stratigraphic framework for the late Middle Palaeolithic and the evolution of the entire Upper Palaeolithic that is unique not only in Germany but in the whole of central Europe.

Of outstanding importance are the spectacular finds from the Aurignacian layers of the Swabian cave sites. The Aurignacian in the region started more than 40 Ka ago and right from the start this techno-complex is characterized by the full package of early Upper Palaeolithic innovations such as new artefact types, both lithic and organic, and a variety of personal ornaments as well as figurative art and musical instruments. The Swabian caves produced the oldest examples of figurative art and the oldest musical instruments worldwide. There is no other region in the whole world where the appearance of these singular early Upper Palaeolithic features can be traced at that early time.

Besides the extraordinary finds, interdisciplinary research on the important Swabian sites with long stratigraphic sequences, clustered in two valleys, allows for the detailed reconstruction of land-use patterns both in the late Middle Palaeolithic and in the Upper Palaeolithic.

The Outstanding Universal Value of the Swabian Jura sites is increased by the modern presentation of original finds for the public in museums such as the Landesmuseum Württemberg in Stuttgart, the Urgeschichtliches Museum Blaubeuren as a branch museum of the Landesmuseum, the Ulmer Museum, the Museum der Universität Tübingen in Hohentübingen Castle and, last but not least, the Archäopark Vogelherd that opened in May 2013 (Barth, 2012; Dutkiewicz, this volume).
The Swabian Jura

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Bibliography


Vogelherd. The lithic technology of the Swabian Aurignacian and its importance for early modern humans in Europe

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Introduction

The Aurignacian is a lithic techno-complex documented over large parts of Europe (Hahn, 1977; Delporte, 1998). The Aurignacian is no longer considered as a homogeneous and monotone culture, although each regional assemblage certainly shares common technological and behavioural features, which we associate with early modern humans in Europe. Before the interpretation of this tradition in the European perspective, we first need to clearly identify the Aurignacian phases in each region.

Why is the Swabian Jura important to the understanding of the Aurignacian with regards to the early modern humans in Europe? The Aurignacian sequence of south-western Germany, especially the Swabian Jura, can be one of the reliable regional model base on the numerous studies and sites of the Aurignacian. The presence of ivory figurines, personal ornaments and organic tools in the Swabian Jura (Conard and Bolus, 2003; Zilhão, 2007; Bolus, 2011) also suggests that this region was one of the earliest culturally important areas for anatomically modern humans (for further information see Wolf, 2014 and Dutkiewicz, 2014 in this volume). Although we currently have some information about the Swabian Aurignacian, there are few lithic technology studies about the Aurignacian assemblages in south-western Germany. As the production of lithics seems to show a clear evolution across the Aurignacian periods (Teyssandier, 2008), the technological analysis of the Aurignacian lithic assemblages allows us to pose some questions related to evolutional technological trends and further the behaviour of the early modern humans in Europe.

This paper is predominately based on the work of the Aurignacian lithic production at the site of Vogelherd. The result of this study will lead to a better understanding of the Swabian Aurignacian and help in resolving questions associated with the appearance and extension of modern humans in Europe.

Swabian Aurignacian

General context of the Swabian Aurignacian

The Aurignacian of the Swabian Jura was first documented by Ludwig Bürger at Bocksteinhöle in the Lone Valley, in 1883-84 (Bürger, 1892). The standard of research of this region was evaluated by Robert Rudolf Schmidt (Schmidt, 1912) through the excavation at Sirgenstein in the Ach Valley in 1906. Joachim Hahn’s research (Hahn, 1970, 1986, 1989) concerning the Swabian Palaeolithic sites has played a major role in understanding the importance of this region for the cultural developments of the European Upper Palaeolithic. The fine stratigraphic sequences of the region were defined especially through his systematic excavation with modern methods at the sites of Geißenklösterle and Hohle Fels in the Ach Valley (Hahn 1986, 1988, 1989). Research on the Swabian Aurignacian continues today. This work consists of new excavations and artefact analyses (lithics, fauna and so on) of Geißenklösterle, Hohle Fels and Vogelherd in order to provide an overview of the region and its chronology (Bolus, 2003; Conard and Bolus, 2003, 2006, 2008; Floss, 2001).

The important cave sites, containing Aurignacian levels, are situated in both the Ach and Lone Valleys (see Conard 2014, this volume, fig. 1); Bockstein, Holenstein Stadle and Vogelherd are in the Lone Valley, and Brillenhöhle, Sirgenstein, Geissenklösterle and Hohlefels are located in the Ach Valley. More than one century of archaeological research in the Swabian Jura has produced abundant information about the prehistoric occupation of the mentioned cave sites. Among others, Geißenklösterle, Hohle Fels and Vogelherd can be key sites to understand the Swabian Aurignacian due to the long research history, a long sequence of human occupations, rich artefacts and new data from new excavations.

Recent radiocarbon dates place these occupations into a chronological framework (Conard and Bolus, 2003, 2008; Conard et al., 2003). The Swabian Aurignacian assemblages in general dated between 40 and 30,000 BP with dates between 33,000
The Swabian Jura

and 30,000 uncal BP particularly numerous. Recently, the new radiocarbon dates from Geißenklösterle document the presence of the Aurignacian in the Swabian Jura prior to the Heinrich 4 cold phase, around 42,500 cal BP (Higham et al., 2012). The results are apparently earlier than other early Aurignacian sites and fall into the same range with the Proto Aurignacian period in Western Europe, especially in southern France. How should we interpret these new dates from Geißenklösterle in a European context? In order to answer this question, we need to know not only the absolute dates but also the mode of lithic production of the Swabian Aurignacian.

The presentation of the site: Vogelherd

General presentation

The cave of Vogelherd is located approximately 25 km northeast of Ulm in the Lone Valley (Figure 1, Conard, 2014, this volume, fig 1).

The first excavation of Vogelherd, under the direction of Gustav Riek, took place in 1931 (Riek, 1934). Riek and his team from the University of Tübingen dug the entire cave out for ten weeks. However, he did not systematically keep track of where the artefacts came from. The old excavation also missed artefacts of the smallest calibre such as bladelets. In spite of these limitations, due to the fast excavation and techniques employed by Riek, Vogelherd is still one of the most important Upper Palaeolithic sites for understanding the sequence (aspects, phases) of the Aurignacian in the Swabian Jura. New excavations at Vogelherd were conducted between 2005 and 2012 under the direction of Nicholas J. Conard in order to complete information from the back dirt of the excavation in 1930s (Conard and Malina, 2006; Conard et al., 2007, 2008, 2009, 2010, 2013; Conard and Zeidi, 2012). Nine archaeological assemblages (cave floor, one Acheulean, one Mousterian, three Aurignacian, two Magdalenian and one Neolithic) were, based on the typological comparative analysis of lithics, unearthed in this old excavation (Riek, 1934). Today, the sequence of Vogelherd has been re-evaluated through new dates. This re-evaluation allows us to revise the chronology of the archaeological levels from the Middle Palaeolithic to the Neolithic (four Middle Palaeolithic, two Aurignacian, two Magdalenian and one Neolithic) (Conard et al., 2003).

Concerning the Aurignacian periods, a study of Hahn (Hahn, 1995) revealed the first radiocarbon dates from Vogelherd. These dates range from 32,000 to 23,000 BP for the Aurignacian deposit of
The archaeological levels IV and V. More recent 14C AMS dates confirm the presence of two significant Aurignacian levels at the site, dating between 29,000 and 36,000 BP (Conard et al., 2003). This recent work on dating defines two main assemblages (levels IV and V) within the Aurignacian sequence instead of three (Lower, Middle and Upper Aurignacian) as thought before (Conard et al., 2003) (Figure 2).

Why Vogelherd?

In order to clarify the Swabian Aurignacian, a reliable Aurignacian sequence base on the lithic production would be required. Vogelherd seems to yield an appropriate framework for elaborating such a sequence because of its historical role in the study of the Aurignacian in the Swabian Jura and its abundant materials.

The Aurignacian of the site of Vogelherd was defined by several scholars after it was found in 1930s. In his monograph (1934), G. Riek subdivided the Aurignacian into three phases: 1) Upper Aurignacian (level IV, Obere Aurignacien), 2) Middle Aurignacian (level V, Mittlere Aurignacien), 3) Lower Aurignacian (level VI, Untere Aurignacien). He associated level V with the Aurignacian I of D. Peyrony, based on the forms of sagaie points and the frequency of the retouched tools.

Vogelherd IV and V were considered as Stage B by J. Hahn (1970). This stage was characterized by simple end-scrapers fabricated on retouched blades. Bladelets were often detached from the front of these end-scrapers. He also assumed that level V of Vogelherd was much more evolved than most of the Aurignacian I in France.

D. de Sonnerville-Bordes (1966, 1971) interpreted the Swabian Aurignacian as an assemblage which had a very strong originality compared to the classic Aurignacian in the more western Europe such as France, Belgium and Spain. Furthermore, she regarded Vogelherd as having a typical Aurignacian sequence, which allows us to study the evolution of the culture in central Europe.

This Vogelherd Aurignacian certainly was considered a classical early Aurignacian/Aurignacian I in past research through a typological analysis of their lithics. A question that follows is whether or not the Aurignacian at Vogelherd is the early Aurignacian. We can only answer this with an accomplished technological study of whole lithic assemblages, instead of only selected characteristic tool types.

Lithic techno-complex at Vogelherd

Raw materials

Local Jurassic chert was the dominant raw material in the Swabian Jura during the Aurignacian. It was mainly subdivided into the local grey Jurassic chert and the brown Jurassic chert, which in German are called Jurahornstein and Bohnerzhorstein, based on its general appearance and colour (Bressy and Floss, 2006; Burkert and Floss, 2005). It is found about 3-12 km from the Ach Valley (Burkert and Floss, 2005; Floss and Kieselbach, 2006). Other raw materials acquired between 5 to 120 kms away.
are present but less common. The tabular chert from the Franconian Jura, found about 160 km east of the Ach Valley, and the Bohnerzjaspis from the upper Rhine Valley, found 180 km west of the Ach Valley, are remarkable long distance transported materials (Burkert and Floss, 2005; Floss and Kieselbach, 2006).

Concerning the raw materials in Vogelherd, the local Jurassic chert was mostly utilized (69% [level IV], 72% [level V]) and the second most used material is the Tabular chert (18% [IV], 12% [V]). The Bohnerzjaspis, the Tertiary, the radiolarite, the quartzite, the quartz and the Keuper chert, on the other hand, were treated in almost equal frequencies.

Overall, Aurignacian lithic industries in the Swabian Jura show a similar pattern in which one local raw material dominated and tools made from more distance materials were infrequent. Sources of raw materials used by Swabian Aurignacian people generally follow the Danube River in an east-west trajectory (Burkert, 1999; Burkert and Floss, 2005) (Figure 3).

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Figure 5. A scheme of lithic production two different reduction sequences to produce blades and bladelets (modified after Bon 2002).

Figure 6. Vogelherd Cores (1-5, 7 modified after Hahn 1977, 6 after Riek 1934).

Chaine opératoire

Regarding the local Jurassic chert, the total number of debitage products, including cortical flakes, tablets, éclats laminaires and crested blades are distinguished. A part of the debitage was possibly practised in situ. However, few and mostly exhausted cores, low frequency of cortical and big flakes show that the decortications/roughing out of the raw materials were preceded outside the site. The fabrication of the non-local materials was probably achieved outside the site and the finished products were imported to Vogelherd. This is true for both Aurignacian assemblages.

At Vogelherd, two different reduction sequences to produce blades and bladelets are observed: 1) two independent reduction sequences; and 2) integrated lithic production (Figure 4).

Concerning the first lithic reduction sequence, the production of blades and bladelets was independent. With regards to dimensions, the blades can be divided into three groups: 1) relatively thick large blades, minimum 10 cm in length; 2) slightly curved or rectilinear middle-sized blades, smaller than 10 cm in length and on average 2.5-3 cm in width; and 3) rectilinear parallel pointed and narrow small blades, 6 to 8 cm in length and on average 1.5 cm in width. The preparation of the blade debitage seems to be simple and minimal. The debitage was controlled through installing a crest and the detachment of éclats laminaires. From the front core the large blades were removed at first and then the small blades were removed from the sides of the same core. The removal of blades was practised by direct percussion with a soft hammer following the unipolar mode and the striking platform was frequently prepared (faceted butt). The debitage axes of these blades are mostly parallel and the morphology of the blades is mainly curved or straight.
Concerning the second ‘integrated lithic reduction sequence’, there is an operational continuity of blades and bladelets debitage. Interacted bladelets can be defined as large bladelets in the Vogelherd Aurignacian assemblages. They are generally 4-6 cm in length and the morphology of the bladelets is usually pointed, rectilinear and thin. These bladelets were removed from the centre of a triangle debitage surface of pyramidal cores. In order to obtain this certain type of bladelets, the volume of the cores was intentionally controlled with the extraction of lateral removals. The removal of blades and bladelets was practised by direct percussion with a soft hammer following the unipolar mode and the striking platform was often not transformed.

Prismatic/pyramidal bladelet core reduction is the other important small bladelet debitage of the integrated lithic reduction sequence. These cores have often multiple debitage surfaces and the debitage was made following the unipolar mode. Two different types of bladelets were manufactured from this core reduction. Bigger than 4 cm bladelets were detached from the front of big prismatic cores and smaller than 3 cm convergent bladelets were removed from the small prismatic/pyramidal cores.

A very remarkable small flake debitage was also confirmed. The relatively fine small flake cores were originally defined as discoidal cores by J. Hahn (1977), often reflect highly reduced blade or bladelet cores. The dimensions of these cores range 2.5 by 3 to maximum 5 by 5 cm. They were practised by direct percussion with a hard hammer and look very disordered. The edges of striking platforms of the cores were usually shattered and several impact points are observed from the surfaces of striking platform. It is still unclear why the Aurignacian people tried to produce such small flakes. Or did they want to directly use them as tools? The question is still open for the purpose and function of the cores (Figure 5).

The production of flake tools does not seem to be important in the Aurignacian at Vogelherd. The numeric occurrence of flake tools is very low in comparison with tools on blades and cortical flakes were mostly used for blanks with marginal or partial retouches. Therefore, no standard patterns or intentional aims seem to exist for the flake tools (Figure 6).

Vogelherd lithic techno-complex in the Swabian Aurignacian context

The Vogelherd lithic techno-complex should be first understood in the Swabian Aurignacian context before understanding it in an interregional perspective. A comparative study of the lithic assemblages between Vogelherd in the Lone Valley, and Hohlefels and Geißenklösterle in the Ach Valley can be a first step to clarify what the Swabian Aurignacian is, in terms of the lithic technology.

The Aurignacian lithic assemblages of Hohlefels and Geißenklösterle (Bolus, 2003, 2010, 2011; Conard and Bolus, 2003; Teyssandier et al., 2006) seem to fall within the same technological and typological aspects. The reduction sequence of blades and bladelets were separated. The blades were removed from unipolar cores, whereas the bladelets were generally detached from carinated cores. Moreover, systematic flake production is also evident. From a typological point of view, it shows a classical early Aurignacian tool assemblage, including end scrapers, various type of burins, pointed blades (Spitzklingen), lateral retouches blades, splintered pieces and truncations, etc. Concerning the raw material, in the case of Hohle Fels, the local Jurassic cherts (Jura- and Bohnerzhornstein) were mainly used during the Aurignacian period.

A certain degree of cultural variation seems to exist within the Swabian Aurignacian. The question of the relationship between the Aurignacian assemblages in the Ach and the Lone Valley, there are clear distinct in blade and bladelet core reduction. The
production of blades and bladelets is separated in the Ach Valley, whereas two different techno-complexes, the separated and continuous operation of blades and bladelets, co-existed at Vogelherd. On the other hand, they also share certain technical phases. The local grey Jurassic and Bohnerz chert were the most exploited materials and the modality of small bladelet debitage from the carinated cores seems to be equal.

These differences and similarities between the Ach and the Lone Valley may reflect the functional variation or small local variation in cultural tradition. Research on lithic technology is crucial for modelling the adaptations of the Palaeolithic people. Nevertheless, we need to approach this question from a multidirectional point of view concerning not only lithic technology but also dating, subsistence and landscapes, among others.

Conclusion and discussion

The Aurignacian, the beginning of the Upper Palaeolithic in Europe, was not homogenous throughout the whole time period of its existence. In order to comprehend the Aurignacian in the European context, we first need a reliable regional sequence for comparing it with the other Aurignacian is less well or well documented. In this perspective, the Swabian Jura can be the region for establishing such a sequence with its long research history, many sites and abundant artefacts.

Since the Swabian Jura is one of the key regions in understanding the cultural innovation during the Aurignacian related to the expansion of the early modern humans (Bolus and Conard, 2008), a clear understanding and definition of the Swabian Aurignacian is certainly necessary. However, I am not convinced that the term ‘Proto- or Early Aurignacian’ represents the optimal means of defining the Aurignacian assemblages in the Swabian Jura as this region surely shows its specific Aurignacian tradition. I would, therefore, rather use the term ‘Swabian Aurignacian’.

The Aurignacian in the Swabian Jura has been characterized by new lithic and organic technology, art figurines, personal ornaments and musical instruments (Bolus, 2011; Bolus and Conard, 2008). Among these fascinating indicators for cultural modernity, lithic technology seems to be very monotonous. However, lithic technology is a standard criterion for comparing the Aurignacian assemblages in an interregional context, as stone tools were manufactured all over Europe by the Aurignacian people.

In this paper, I have presented the Aurignacian lithic techno-complex of the site of Vogelherd. Concerning lithic production, the Vogelherd Aurignacian appears very interesting given the fact that two different reduction sequences to produce blades and bladelets coexisted: 1) independent lithic production between the blades and bladelets, 2) continuity operation from the blades to the bladelets. These two distinct techno-complexes seem to be homogenous.

In current research, the chronological position and the geographical distribution of these two different technical traditions tried to be determined (Bordes, 2002, 2003; Teyssandier, 2006, 2007a, 2007b; Le Brun-Ricalens et al., 2009; Djindjian, 2010). The separated reduction sequence between the blades and the bladelets corresponds to the classical early Aurignacian (Bon, 2002, 2006; Bon et al., 2010; Bordes and Tixier, 2005; Bordes, 2005; Teyssandier et al., 2010) and this phase is mostly represented in Southwestern France. Meanwhile, blade debitage frequently continues into the bladelet debitage and a very characteristic objet of this phase is long, thin and rectilinear bladelet which often transformed into Dufour bladelet of the subtype of Dufour (Bon et al., 2010) and/or Krems points (Teyssandier et al., 2010) during the Proto Aurignacian (Bon, 2002, 2006; Bon and Bodu 2002; Bon et al., 2010; Bordes 2002, 2003, Normand and Turq, 2006; Teyssandier et al., 2010). This techno-complex was initially identified as a Mediterranean phenomenon (geographically limited) and now extends to large part of Europe (Bordes and Teyssandier, 2012). Regarding the chronology, the proto Aurignacian is considered as an earlier phase than the early Aurignacian and is defined as the very first Upper Palaeolithic tradition. These two Aurignacian techno-complexes are certainly divided through having different cultural traditions. If so, what can we conclude from this phenomenon and from, the coexistence of two different phases in Vogelherd?

The Danube Corridor model (Conard and Bolus, 2003) postulates that modern humans rapidly entered the interior of Europe via the Danube Valley. The relatively early dates for the early Aurignacian assemblages in the Swabian Jura, especially new dates from Geißenklösterle (Higham et al., 2012), which are still under debate by some researchers (Banks et al., 2013; Higham et al., 2013), compared to the other regions in western Europe and the sudden appearance of many cultural and behavioural innovation by modern humans with a radical break from the regional late Middle Palaeolithic has supported this hypothesis. However, there is so far no clear material evidence supporting this Danube Corridor model. If we can ascertain that the Proto- and early Aurignacian lithic technology were used by the Aurignacian people in this region at the same time, this would give another help to explain the expansion of the early modern humans in Europe from east to west. In this perspective,
the Vogelherd Aurignacian can be the key assemblages to understand the Swabian Aurignacian as regards the cultural and behaviour modernity of the early modern humans in a European context.

Future research will more systematically address the cultural and technological characteristics of the Swabian Aurignacian and the technological lithic variability of the region. When we are able to identify the precise regional signature, the Swabian Aurignacian can finally be explained in a European context.

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Geoarchaeology and the interpretation of the past in the caves of Swabia: current and future research priorities

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Introduction

The Swabian sites

Cave sites containing Pleistocene-aged deposits in south-western Germany have been the focus of intensive scientific research since the pioneering excavations of Oskar Fraas in the 1860s at Schüßenquelle and Bärenhöhle. Since then, much of the research in the region has focused on a number of key sites within two tributary valleys of the Danube: the Ach and Lone. The century-long research tradition at the Swabian cave sites has made these localities important places for investigating key events in human prehistory. For example, many of these sites contain deposits spanning the Middle to Upper Palaeolithic (MP/UP) transition, when endemic Neanderthals were replaced by Anatomically Modern Humans, both of whom ultimately trace their origins to populations from Africa. The latter group – modern humans – brought with them some of the earliest figurative art and musical instruments found in the archaeological record. Therefore, the Swabian caves are significant sites that inform our understanding of the extinction of Neanderthals in Europe, and the emergence and spread of cultural modernity.

The MP/UP transition in Swabia

Some of the earliest scientific investigations of the Palaeolithic in Swabia noted the significance of the region for the understanding of what we now call the Middle to Upper Palaeolithic transition. R. R. Schmidt, in his seminal monograph Die Diluviale Vorzeit Deutschlands (1912) noted that the sequence at Sirgenstein contained both Upper Palaeolithic and Middle Palaeolithic (what he called Lower Palaeolithic) components. Based on a stratigraphic separation of these two components Schmidt suggested that the makers of both were distinct and associated the Middle Palaeolithic with Neanderthals. Gustav Riek, who excavated at Vogelherd, Brillenhöhle and Große Grotte in Swabia, also argued that the Upper Palaeolithic was a break from previous cultures and likely represented a new group of humans who moved into the region (Riek, 1934).

Based on excavations at Hohle Fels and Geißenklösterle and a study of previously excavated sites, such as Vogelherd, Sirgenstein, Hohlenstein-Stadel and Bockstein, Conard and Bolus (2003) developed the Kulturpumpemodel or Population Vacuum Model. Conard and Bolus noted that, unlike in south-western France, Eastern Europe and other regions, there was no ‘transitional’ industry between the Middle and Upper Palaeolithic in Swabia. In fact, the recent excavations at Geißenklösterle and Hohle Fels showed that the Middle Palaeolithic was separated from the Upper Palaeolithic by a culturally sterile layer. This observation was significant because it suggested that Neanderthals were possibly absent from the region when modern humans first arrived. Furthermore, radiometric dating of the earliest Aurignacian material from Swabia suggested that modern humans arrived here earlier than other regions (Conard and Bolus, 2003; Higham et al., 2012). The early arrival date for modern humans in Swabia led Conard and Bolus to also propose the Danube Corridor hypothesis, which suggested that modern humans entering Europe did so along the Danube River Valley.

The Population Vacuum Model consists of three non-mutually exclusive hypotheses that attempt to explain the nature of the Middle to Upper Palaeolithic transition of Swabia and the early appearance of art and music associated with the Aurignacian of this region. The three hypotheses are:

1) The cultural florescence leading to the dramatic increase in symbolic expression and technological advancement is the direct result of the competition between archaic and modern humans following the initial colonization of the upper reaches of the Danube by modern humans around 40 Ka BP.

2) These cultural innovations result from innovative problem solving in connection with climatic stress in the harsh environment of the northern foothills of the Alps. Greenland ice cores and other data document a series
of major climatic shifts during OIS 3. These dramatic climatic shifts happened within decades and certainly straining the social-economic patterns of the hominins living in Swabia.

3) Cultural innovations of the Aurignacian and Gravettian occurred in connection with social-cultural and demographic changes independent of competition with Neanderthals or the influence of climatic stress. In other periods, important cultural innovations are by no means invariably linked to inter-taxon competition or direct responses to environmental change. (Conard and Bolus, 2003).

The first hypothesis seems unlikely, considering the result of excavations at Hohle Fels and Geißenklösterle. Conard, in more recent publications (for example, Conard et al., 2006), has placed greater emphasis on hypothesis 2, suggesting that the earliest Aurignacian in Swabia occurred during the extreme cold conditions of the Heinrich 4 event. This argument suggests that stress brought on by extreme cold caused the region to become depopulated by Neanderthals. This led to a ‘population vacuum’ in Swabia that allowed modern humans to move into the region at an early date.

Cave deposits

Cave sites play an important and sometimes oversized role in Palaeolithic archaeology. A large majority of sites that contain significant, long-term records of human occupation in the Pleistocene are found in caves and rockshelters. First, this pattern stems from the fact that humans, for much of their history, used caves for habitation (Goldberg and Sherwood, 2006). Second and most importantly, caves act as sediment traps and generally possess ideal internal environments that contribute to the preservation of archaeological materials that can be readily dated and studied with a suite of well-established techniques. Therefore, while caves may only provide a small window onto the landscapes in which past humans lived, their ability to preserve high-resolution, artefact-rich sequences have made them attractive for Palaeolithic archaeologists to excavate.

Despite the taphonomic and stratigraphic advantages that excavations in caves may present, the deposits are often much more complex than those located in open air settings. The complex nature of cave deposits is a result of numerous sediment sources derived from within (autochthonous) and outside (allochthonous) the cave or karstic system, and different depositional and post-depositional processes which can be caused by both human and non-human agents. Acting in concert, these processes form complex deposits that can be difficult to interpret using traditional, geoscientific field and laboratory methods.

The cave system itself provides a source of autochthonous materials that accumulate within the deposits found in caves. By volume, the most common type of autochthonous deposit is comprised of large blocks of bedrock that fall from the ceiling or walls. Smaller rubble, also derived from the walls and ceiling of the cave, is commonly referred to using the French term éboulis. In caves formed by dissolution of calcareous bedrock (for example, limestone), the insoluble fraction of the bedrock, which often contains sand- or silt-sized grains of quartz and other minerals, can accumulate (Goldberg and Sherwood ref.). Autochthonous chemical sedimentary deposits, in the form of flowstone, dripstones and tufas – collectively called speleothems – are also common in caves formed within calcareous bedrock.

Other sedimentary components derive from outside the cave or shelter. These allochthonous deposits can have a wide range of sources and can be deposited via any process that is active outside of the cave. For example, wind-blown materials, such as dune sands and loess, can accumulate in caves (for example, Goldberg 2000). Similarly, colluvial material derived from mass movements down slopes outside of the cave entrance can contribute to the overall accumulation of sediment within the site. Other researchers have documented the deposition of waterlain sand, silt and clay within archaeologically significant cave sites (Angelucci et al., 2013). These depositional mechanisms, as well as the autochthonous and allochthonous deposits described above are termed geogenic.

Other depositional mechanisms and agents are biogenic and anthropogenic. Biogenic deposits result from the activities of animals, and in caves can include bird or bat guano and also bones accumulated from carnivore denning. Biogenic and geogenic deposits, and the processes responsible for their accumulation have been termed ‘n-form,’ following the site formation scheme proposed by Shiffer (1972). The presence of anthropogenic materials and deposits distinguishes archaeological cave or rockshelter sites from natural or paleontological sites. Anthropogenic deposits within caves can take a variety of forms, but in Palaeolithic settings the most common type of anthropogenic deposits are related to fire making and management (for example, Goldberg et al., 2009; Goldberg and Bar-Yosef, 2002).

At most archaeological sites, and especially those located in caves and rockshelters, the excavated sequences consist of a mixture of geogenic, biogenic and anthropogenic components that were deposited through a variety of processes attributable to natural and cultural agents. Following deposition, most sedimentary accumulations in caves and rockshelters are influenced
by post-depositional processes that can significantly alter their original character. For example, bioturbation and cryoturbation (due to animals and freeze-thaw actions, respectively) can physically mix primary depositional layers and archaeological materials. Cave deposits can also undergo chemical alteration. For instance, the accumulation of guano or other biological materials containing phosphatic and other acids can lead to the alteration and dissolution of calcareous deposits (Karkanas et al., 2000). Under certain conditions, the phosphatization of archaeological deposits can result in dissolution of bone, a process that significantly influences the distribution of faunal materials in cave sites (Weiner et al., 1993).

While most cave deposits exhibit some or most of the processes and sediment sources discussed above, their influence on the deposits can be variable over time and space. Therefore, it is important to remember that every cave site is unique and should be investigated as such (Woodward and Goldberg, 2001).

**Geoarchaeological methods for the investigation of archaeological cave deposits**

Because of the complexity of archaeological deposits, standard geoscientific methods developed and employed in open air settings have had limited success in the geoarchaeological study of cave and rockshelter sediments. The problem with standard methods that include grain-size analysis and chemical measurements such as pH and carbonate content is that they often rely on loose, bulk samples of sediment. These loose samples effectively ‘average’ together the numerous and varied components of archaeological deposits (Goldberg and Sherwood, 2006), making it difficult, if not impossible to identify the role of geogenic, biogenic and anthropogenic agents in their formation. The most successful method for investigating the formation history of archaeological sites, and cave and rockshelter sites in particular, is micromorphology. Micromorphology is the study of intact, oriented blocks of sediment that have been indurated with resin, sliced and turned into thin sections. The sections, usually 30μm thick, can be studied by the naked eye and under magnification with a petrographic microscope (Courty et al., 1989).

Archaeological micromorphology developed out of soil micromorphology, which in turn is conceptually similar to sedimentary petrology as practiced in the geosciences. Soil micromorphology was first developed by Kubiena in the 1930s. Corwall (1958) was the first to apply soil micromorphology to archaeological research; however, it was only in the late 1970s and early 1980s that micromorphology was applied to the study of Palaeolithic cave sites (Goldberg, 1979a, b). Since these pioneering studies, the application of micromorphology has spread to other types of archaeological sites and time periods.

Beginning with the first systematic micromorphological studies of archaeological sites, practitioners have attempted to link the qualitative description of thin sections with the results of more traditional quantitative or semi-quantitative techniques conducted on the thin sections themselves. Some of these methods, such as scanning electron microscopy, have been successfully applied for decades (see Courty et al., 1989). In the past several years, there has been a renewed interest in the development and application of novel microanalytical techniques in geoarchaeology. Rather than relying on contextual links between loose sediment samples and thin sections, researchers are now making direct measurements on sediments in thin sections and resin-impregnated blocks. In particular, Fourier-transform infrared spectroscopy, which previously had only been conducted on loose bulk samples, can now be done directly on thin sections (for example, Berna et al., 2012). Similarly, elemental and isotopic measurements can be conducted at the microscopic scale directly on indurated blocks and thin sections (Mentzer and Quade, 2013). Organic petrographic analysis of thin sections and polished blocks has recently deepened our understanding of the nature of microscopic organic components of archaeological deposits (Miller et al., 2013). The application of these and other microanalytical methods, integrated together using micromorphology, constitutes a new paradigm in geoarchaeological research, called the ‘microcontextual approach.’ (Goldberg and Berna, 2010).

**Geißenklösterle**

Research history and site setting

R. Blumentritt discovered the archaeological site of Geißenklösterle while working with G. Riek at his excavations in the nearby site of Brillenhöhle between 1955 and 1963 (Riek, 1973). Riek conducted a small-scale excavation at the front of the cave, which was later expanded by E. Wagner in 1973 (Hahn, 1988). J. Hahn began excavations at the site the following year and continued through 14 field seasons, ending in 1991. Hahn published most of the results of these excavations in a monograph entitled ‘Das Geißenklösterle I.’ (Hahn, 1988) Hahn also incorporated geoarchaeological investigations of the cave’s deposits with his archaeological observations, working with the well-known French geologist, H. Laville (Laville and Hahn, 1981), and later I. Campen, who wrote his dissertation on the deposits of Geißenklösterle and also Hohle Fels (Campen, 1990). Both
Laville's and Campen's studies relied heavily on field descriptions of stratigraphic units and the results of standard geoscientific techniques, such as granulometry, calcium carbonate measurements and organic content. Following the contemporary paradigm, Laville was largely interested in constructing a climate-stratigraphic scheme for the site's sequence. His larger aim was to correlate the site's layers with those of Middle and Upper Palaeolithic caves sites in south-western France that Laville previously linked to major Pleistocene climatic phases (Laville et al., 1980). Although Campen was less concerned with correlating the Geißenklösterle sequence with sites of similar age in France, he applied many bulk sample-based techniques developed by Laville and others to construct a climatic interpretation of the site's deposits.

In 2000 and 2001, N. Conard and a team from the University of Tübingen recommenced excavations at Geißenklösterle with the explicit aim of documenting and investigating the transition between the Middle and Upper Palaeolithic deposits. Prior to these excavations, Hahn's excavations had mostly focused on Gravettian and Aurignacian layers, and as a result of this focus in Geißenklösterle and elsewhere, the nature of the Middle to Upper Palaeolithic transition in Swabia was not well understood. The team from Tübingen included P. Goldberg, a geoarchaeologist who incorporated micromorphological analysis into the overall research strategy of the excavation. Portions of this study were published as a Master's thesis (Dippon, 2003) and in other papers (Conard et al., 2003, 2006; Goldberg and Berna 2010). The complete study of the micromorphological samples has been published as part of the author's doctoral dissertation (Miller, 2010) and in an upcoming monograph (Goldberg et al., in press).

Geißenklösterle, like the other caves in the Ach Valley, formed within the Obere Felsenkalke sub-unit of the White Jura which consists of massive limestones of the Schwammfazies that have been subjected to local, and sometimes heavy, diagenetic alteration (Geyer and Gwinner, 1979; Hahn, 1988). The site is perched on the steep-sided wall of the Ach Valley, c. 60 m above the modern valley floor. The Ach Valley itself was formed by the Danube, which, prior to the Riss glaciation (> 300,000 BP), incised the limestone plateaus of the southern Swabian Jura (Villinger, 1986). Following the abandonment of the Ach Valley by the Danube, a new drainage system was established and the valley filled with alluvial and colluvial deposits. The Ach River that now drains this area is significantly smaller and lower energy with respect to the Danube. Its actions are thus largely depositional, rather than erosive. Wagner (1979) estimates that the elevation of the Ach Valley floor has risen more than 40 m as a result of sedimentation occurring after the Danube abandoned its former course.

Geißenklösterle is situated within a cul-de-sac-shaped limestone massif that faces south-west. The present cavity is part of a larger, partially collapsed karstic system that today includes a natural limestone arch. The cave was most likely larger during the Pleistocene, including during the time of its use by Neanderthals and humans; however, subsequent roof collapse has reduced the size of the cave, so that today it is only eight metres wide at its entrance and ten metres deep from dripline to wall.

**Deposits**

During excavations to bedrock, Hahn (1988) and Conard and Malina (2002) identified a total of 23 geological horizons (GH), corresponding to 21 archaeological horizons (Figure 1). The deposits at Geißenklösterle contain evidence for Middle Palaeolithic, Aurignacian, Gravettian and Magdalenian occupations, largely in the form of lithic and bone assemblages, although Hahn (1988) also reported the presence of hearths.
The deposits at Geißenklösterle are largely dominated by *éboulis*; however, interspersed between the rubble is sediment comprised of sand-, silt- and clay-sized materials (the fine fraction). Field observations were useful for description and analysis of the *éboulis* and micromorphology was useful for the analysis of the fine fraction.

The lowermost layer sampled at Geißenklösterle is GH 22, which was described in the field as a yellowish brown silt that contained some fine calcitic sand (Figure 2). Excavators noted the presence of large blocks of limestone that averaged between 20 and 50 cm in length. In this section, the fine material is composed of angular clasts of silty clay that appears depleted in iron. Included within the silty-clay matrix are angular clasts that are rich in phosphates, likely derived from coprolites. There are very few indications of anthropogenic input to the lowermost deposits. The micromorphological characteristics of GH 22 suggest that it was deposited in standing water, most likely in the form of ponds filling depressions in the bedrock or on top of large concave blocks of *éboulis*. These results suggest that the initial phase of deposition within the cave began when Geißenklösterle was still karstically active. Subsequent fragmentation of water-lain clays at Geißenklösterle suggests that the depositional environment either became drier or fluctuated between wet and dry phases. However, it is possible that the fragmentation and reworking of clay in GH 22 was a result of trampling.

In the field, GH 21 was described as a consolidated, dark-yellowish loamy silt with well-rounded, vertically oriented blocks of *éboulis* measuring between 5 and 12 cm in length. The excavators noted that for the lower portion of GH 22, the *éboulis* exhibited a horizontal orientation. In thin section, the contact between GH 22 and GH 21 is clear and sharp. GH 21 marks the first occurrence within the site of well-sorted silt-sized grains of quartz and mica, contained here within a clay-rich matrix. The silt-sized grains are allochthonous, since they are not found as inclusions in the local bedrock and they likely represent input from loess. Other allochthonous components in GH 21 include rounded aggregates of reddish clay exhibiting internal microscopic fabric features termed granostriated and speckled birefringence fabrics (Stoops, 2003). These features indicate that the reddish clay aggregates likely derived from soils, which had developed along the slope or on the plateau situated behind Geißenklösterle. The silt-sized grains of quartz and mica which appear in this horizon are found mostly within these reworked clay aggregates. Although these grains ultimately have an Aeolian source, they likely represent loess which was deposited on the plateau and subsequently reworked downslope into the site.

GH 20 marks a distinct change in the deposits at Geißenklösterle. In the field GH 20 was described as a dark yellowish brown loamy silt that contained rounded *éboulis* between 5 and 10 cm in length. In thin section, the fine component of the deposit is largely composed of silt-sized grains of quartz, calcite and mica, in contrast to the clay-dominated matrix found in stratigraphically lower GHs. The dominance of silt-sized, allochthonous material suggests that GH 20 marks the initiation of primary loess deposition within the cave. In all layers sampled in this study and situated stratigraphically above GH 20, loess is the primary component in the fine fraction of the deposits.

Although, beginning with GH 20, the source and mode of fine sedimentation within Geißenklösterle is generally homogenous throughout the sequence, there are significant diachronic variations in post-depositional alteration of the deposits that are informative about site formation processes. In GH 20 the calcareous component of the loess appears partially phosphatized and the overall sediment exhibits microstructures that are typically caused by bioturbation attributed to mesofauna. Samples from this layer also exhibit lenticular microstructures, cappings on coarse inclusions and rounded aggregates. These types of features were likely produced by post-depositional freeze-thaw processes (van Vliet-Lanoe, 1985). Increased biological activity
and phosphatization of the calcareous matrix are likely related to environmental conditions that are relatively wetter, and also possibly warmer, than periods marked by freeze-thaw conditions (Goldberg et al., 2003; Goldberg et al., in press). The overprinting of microstructures associated with freeze-thaw processes on those associated with wetter, warmer conditions suggest that the deposits at Geißenklösterle were deposited when climatic conditions were fluctuating.

The results of fluctuation between periods of active deposition and stasis are clearly visible at the transition between the Middle and Upper Palaeolithic deposits. GH 17 at Geißenklösterle likely corresponds to the terminal Middle Palaeolithic; however, it lacks cultural materials. GH 17 is directly overlain by GH 15, which contains the earliest evidence for Aurignacian occupation, dating to around 40 kya (Higham et al., 2012). Under the microscope, the contact between GH 15 and GH 17 is sharp, unconformable and likely erosional. The base of GH 17 is partially calcareous but the top of the unit exhibits extensive phosphatization of the loess. Voids, or open spaces within the sediment, exhibit clay coatings, which indicates that water percolated through the sediment column and redistributed fine material. The contact between GH 17 and 15 is marked by the inclusion of coarse anthropogenic materials - including fragments of charcoal - that likely represents either a lag deposit or possibly material directly deposited on the exposed surface of GH 17. In general, the upper portion of GH 17 can be classified as a soil in which the parent material (loess and éboulis) underwent physical and chemical modification. The fine portion of GH 15 is composed of unweathered calcareous loess and marks the onset of a new cycle of loess deposition. Like GH 17, the upper portion of GH 15 appears partially phosphatized; however, no erosional surface was noted at the top of GH 15 or at any other geological contact sampled at Geißenklösterle, apart from that described between GH 17 and 15.

Because of the scope of excavations conducted in 2001 and 2002, micromorphological samples were not collected from most of the Gravettian and post-Gravettian deposits at Geißenklösterle. A single sample was collected from GH 4, corresponding with Magdalenian occupations. The fine matrix in this unit is composed of loess that has been highly cemented by secondary calcite. This unit also exhibits ice-lensing structures, which probably reflect cold post-Late Glacial Maximum conditions.

In general, the sedimentary sequence at Geißenklösterle records a shift from depositional processes likely linked to warmer conditions to those indicative of fluctuations between stadial and interstadial conditions. The base of the sequence is marked by the accumulation of clays within ponding water and also reworked clay aggregates, suggesting some level of local soil instability. Already within the Middle Palaeolithic, the effects of the onset of glacial conditions in Europe are visible in the form of increased loess deposition. The loess was deposited cyclically within the cave and periodically underwent phases of phosphatization, erosion and clay translocation. The alternation between deposition and stasis may reflect larger-scale climatic changes; however, the generally low resolution of the sedimentary record at Geißenklösterle, the overall lack of high-quality loess sequences in this part of southern Germany and the problems of dating the entire sequence, make correlation with global climate records difficult if not impossible.

**Hohle Fels**

**Research history and site setting**

Karl Friedrich Rieixinger, a potter from Gerhausen-Blaubeuren, discovered bear teeth and reindeer bones while collecting clay at Hohle Fels in the 1830s (Blumentritt and Mall, 1979). Beginning around 1844, the large sediment cone of phosphate (derived from guano and loess that had washed in through an opening in the back) was mined and completely removed (Ibid). In 1870-71, the first scientific investigation of the cave deposits began, with an excavation conducted by Oskar Fraas and in partnership with a local minister, T. Hartmann, that uncovered faunal remains and stone tools (Hahn, 1978). Excavations at Hohle Fels were continued by R.R. Schmidt in 1906, who published the materials from the site in his monograph Die diluviale Vorzeit Deutschlands (1912). G. Riek and G. Matschak renewed investigations of the cave from 1958-1960, although they never published their results. During the course of excavations at Geißenklösterle, J. Hahn excavated at the site between 1977 and 1978, with the goal of obtaining a comparable and contemporary profile. He returned to the site in 1988 and initiated an excavation campaign that continues to this day under the direction of N. Conard.

Hohle Fels has not been as intensively studied using geoarchaeology as Geißenklösterle. I. Campen, in his dissertation (1990), conducted a study of a sedimentary column from the site, focusing mostly on the post-Aurignacian deposits. Goldberg et al., (2003) published a more complete micromorphological study of the site’s sequence, again focusing on the Gravettian to Magdalenian deposits. In the same year, Schiegl et al., (2003) published a paper on the Gravettian-aged layer GH 3cf, which is largely composed of fragments of burnt bone. The most recent and complete geoarchaeological study of the site is the author’s dissertation (Miller, 2010).
The site of Hohle Fels is located near the town of Schelklingen within the Ach Valley. Unlike Geißenklösterle, Hohle Fels is situated much closer to the valley floor (7 m above it). Hohle Fels is located within a Felsen, or tor, of Jurassic limestone and is one of the largest caves in the region. The entrance consists of a 20 m long phreatic tube that connects to a large cave hall, approximately 500 m² in area and up to 12 m high. Excavations within Hohle Fels have mostly focused on the area connecting the phreatic tube to the cave hall.

Deposits

The stratigraphic sequence at Hohle Fels has been divided into twelve distinct geological layers, several of which have been subdivided (Figure 3). Miller (2010) grouped these GHs into 5 lithostratigraphic groups, based on broad similarities and diachronic trends throughout the sequence.

Group E consists of GHs 12-8 and corresponds with the Middle Palaeolithic occupation of the site. Layers in this group contain mostly homogenous yellowish and reddish-orange clays and silt with éboulis. GH 12 exhibits laminated and bedded clay, which likely was washed into the entrance area from the sediment cone located within the cave hall. Some of the laminated clays rest on layers of partially phosphatized calcareous clay that includes silt-sized grains of quartz and mica. This relationship suggests that there is a non-primary component of loess within the sediment. Phosphatization of the matrix generally becomes more extensive from the bottom to the top of layers in Group E. There are numerous grains of phosphate within Group E that are sub-angular and likely derive from hyena coprolites and the phosphatized rims of limestone éboulis.

Group D encompasses GHs 7 through 3d and includes the transition to the Aurignacian and also the Aurignacian-Gravettian transition. Whereas Group E is distinguished by its generally homogenous appearance, Group D is marked by numerous, discontinuous lenses and anthropogenic features, giving it a more heterogeneous character. These layers include GH 6a and 6b, which are rich in clay, are largely phosphatized and exhibit clay coatings and infillings; a large anthropogenic feature, GH 6a bef. 1; and a layer of large rock fall, GH 5. The fine matrix, like in Group E, contains calcareous clay, silt-sized grains of quartz and mica and sand-sized grains of phosphate. These grains are different from the sub-angular phosphatic grains found in Group E and likely source from phosphatized loess that moved downslope from the colluvial cone of sediment located in the back of the cave.

As is the case at Geißenklösterle, the Middle and Upper Palaeolithic are separated from one another by a culturally sterile unit. At Hohle Fels, the base of GH 8 contains no anthropogenic material sand the first evidence for the Aurignacian occurs at the top of GH 8. The contact between GH 8 and GH 7 is conformable yet distinct and exhibits some characteristics similar to those found at the contact between GH 17 and GH 15 at Geißenklösterle. GH 8 is extensively phosphatized whereas GH 7 exhibits...
better preservation of the calcareous matrix. GH 7 also exhibits ice-lensing structures located stratigraphically above the contact with GH 8.

GH 3db, a sublayer located within Group D, is markedly different from most deposits at Hohle Fels. GH 3db consists of laminated guano, silt and clays and contains numerous spores. This layer appears to be significantly biogenic in origin, but also formed through the influence of low-energy or standing water.

Group C, encompassing GHs 3cf through 3b, spans the remainder of the Gravettian-aged deposits and marks a return to a more homogenous appearance. Group C appears mostly as massive, reddish brown clayey silts, with uniform colour and texture that make it sometimes difficult to distinguish between stratigraphic layers. The deposits within Group C appear more calcareous than those at the top of Group D. In addition, they also exhibit several types of microfabrics and microtextures that were likely formed through the influence of freeze-thaw processes and colluviation. The base of Group C is composed of rounded aggregates of partially phosphatized loess that exhibit some localized cappings. Towards the top of the group, similar aggregates exhibit coatings of fresh to partially phosphatized loess that appear in some instances granostriated. Finally, there is a distinct break in the character of the deposits within Group C. This break at the contact between GH 3b and GH 3c is marked by relatively extensive phosphatization of the calcareous matrix at the top of GH3c (Goldberg et al., 2003).

The contact between Group C and Group B is erosional and, based on radiometric dating, corresponds to the Last Glacial Maximum (c. 20,000 BP). The deposits of Group B are associated with Magdalenian occupations and are markedly different from earlier deposits. A notable layer in this group is GH 1s, which lacks any phosphatic components (apart from a few fragments of bone) and is composed almost exclusively of calcite, along with minor inclusions of silt-sized quartz and mica. This layer also contains numerous rounded clasts of hydrocalcic minerals (moonmilk) that exhibit calcareous coatings, as well as ice-lensing structures.

Group A consists of some Magdalenian-aged deposits and mostly Holocene layers. This group was not sampled as intensively as the others, but where samples were available, the deposits exhibit evidence for at least partial reworking. This signature may be quite recent, resulting from construction work with the cave when it was mined and also when it was used as an armoury during the Second World War.

**Anthropogenic features of Hohle Fels**

Anthropogenic combustion features are relatively numerous at Hohle Fels, but distinctly limited to the Upper Palaeolithic deposits, although individual pieces of burnt bone and charcoal are occasionally found in the Middle Palaeolithic layers as well (Figure 4). The most noteworthy anthropogenic feature at Hohle Fels is the Gravettian-aged 3cf, which extended across the entire excavation area and varied between 5 and 15 cm in thickness. It was rich in lithic artefacts, faunal remains and also organic artefacts. The sedimentary matrix of this layer was composed largely of sand-sized grains of burnt bone exhibiting a wide range of colours and also a minor mineral component which Schiegl et al. (2003) described as ‘brownish aggregated grains of clayey-silty mineral constituents.’ Ash and charcoal, apart from a few small pieces found during excavation, are mostly
absent from this layer. A notable constituent of this and other anthropogenic combustion features at Hohle Fels are millimetre and smaller fragments of char derived from the burning of fat (Goldberg et al., 2009).

There is some zoning and layering of the burnt bone sand in GH 3cf; however, sub-rounded grains of burnt bone that exhibit different colours and therefore degree of burning are adjacent to one another. In some portions of the layer, the sand-sized grains of burnt bone exhibit coatings similar to the ones found on phosphatic aggregates in the rest of group C. Based on the micromorphological characteristics of this layer, Schiegl et al., (2003) and Miller (2010) suggested that GH 3cf formed through the repeated dumping of hearth waste near the back of the cave. The dominance of burnt bone within the deposit and the general lack of plant-derived ash or charcoal, suggested that the Gravettian inhabitants likely used bone, rather than wood as fuel. This may have been because wood was a limited resource in cold climatic conditions.

Interestingly, all of the anthropogenic features sampled at Hohle Fels exhibit similar micromorphological characteristics to those found in GH 3cf, suggesting that these features do not represent in situ burning, but rather are the dumped remains of hearths. Some of the other features are composed mostly of charcoal, whereas others, like GH 3cf, are composed mostly of bone.

**Site formation processes at Hohle Fels**

Unlike Geißenklösterle, which has a relatively simple site formation history, the formation processes acting at Hohle Fels are complex, due to various sedimentary sources and post-depositional alterations.

In addition to autochthonous *éboulis*, the main sources for sediment at Hohle Fels are fresh calcareous loess, which is blown in from the entrance and the large colluvial cone at the back of the cave. This sediment cone formed when soil material and loess – which had been deposited on the plateau and slope backing the site – were washed in through an opening in the back of the cave. At the same time bats, that were living in the back of the cave, accumulated guano, which reacted with the calcareous loess, causing it to form phosphate.

During the Middle Palaeolithic (Group E) the phosphatized material moved down slope and accumulated at the entrance to the cave hall, where excavations are currently ongoing. Occasionally, low energy water, possibly entering the cave through the chimney, also washed clay down slope. Anthropogenic components, such as burnt bone and charcoal, indicate that the cave was used by Neanderthals; however, the high proportion of subangular fragments of phosphatic coprolites suggests that the cave was also frequently visited by hyenas and other carnivores.

During the Aurignacian (Group D) the deposits derive from the sediment cone in the back of the cave. However, the oldest layers in this group appear more ‘fresh’ and less phosphatized, and they exhibit microstructures formed by freeze-thaw action. There are also layers (GH 3db) that indicate the presence of standing or low-energy water and primary deposition of guano. In this group anthropogenic features are numerous and there is less evidence for the presence of carnivores in the form of phosphatic coprolites.

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*Figure 5. Comparison of the Middle to Upper Palaeolithic transition at Hohle Fels and Geißenklösterle. Both sites exhibit similar characteristics, suggesting a shift from warmer to colder conditions.*
Group C, roughly corresponding to the Gravettian occupation at the site, is largely composed of rounded aggregates of partially phosphatized loess, derived from the sediment cone. These aggregates likely moved down slope either through solifluxion or gelifluxion (ice-related slope movement). Some of the aggregates exhibit coatings of fresh calcareous material mixed with silt-sized grains of quartz and mica, suggesting that as the aggregates moved down slope they accumulated fresh loess that was blown in through the entrance of the cave.

The Gravettian deposits are deeply incised by an erosional channel that is infilled with deposits dating to the Magdalenian. These deposits mark a distinct change in the source and process of sedimentation within Hohle Fels: phosphatized aggregates are absent in these layers, suggesting that the sediment cone in the back of the site was no longer active. Preliminary geophysical survey at Hohle Fels suggests that colluvial sediments from outside the cave entrance became the major source of sediment. Microstructures indicating freeze-thaw processes and cryoturbation are numerous in these deposits.

In general the deposits at Hohle Fels document a shift from generally warmer conditions, to one dominated by colder ones. However, as is the case at Geißenklösterle, there is evidence for fluctuation between warmer and colder periods.

Discussion

The MP/UP transition in Swabia – a geoarchaeological perspective

The Middle Palaeolithic layers at Geißenklösterle are separated from those of the Upper Palaeolithic by a culturally sterile unit (Figure 5). Geoarchaeological investigation of this portion of the stratigraphic sequence shows that the top of the culturally sterile layer exhibits an erosional contact and was subjected to significant weathering and post-depositional alteration. The initial Upper Palaeolithic occupation of the cave is associated with deposition of fresh calcareous loess. This portion of the sequence suggests that the transition between the Middle Palaeolithic and Upper Palaeolithic occurred when climatic conditions were shifting from warm to cold (Figure 6). We see a similar pattern at Hohle Fels, where deposition was less cyclical and more continuous than at Geißenklösterle. Here the transition between GH 8 to GH 7 suggests a shift from warmer to colder conditions, although the earliest Aurignacian occupation of the site is found at the top of GH 8, which is associated with extensive weathering of the deposits. The pattern at both sites suggests that non-occupation of the caves corresponds to a generally warmer phase and the re-occupation of the region by modern humans occurred as climatic conditions were becoming colder. These results suggest that Neanderthals were absent when conditions were generally warmer and not colder. Therefore, we can reject the hypothesis that extreme cold drove Neanderthals out of the region.

If climate did not play a significant role in the depopulation of Swabia at the end of the Middle Palaeolithic, what did? One possible explanation may come from the geoarchaeological study of anthropogenic features at Hohle Fels. There are no anthropogenic combustion features at Hohle Fels dating to the Middle Palaeolithic. The Upper Palaeolithic deposits contain numerous and thick accumulations of burnt bone and charcoal that appear to be dumped. Furthermore, we find an order of
magnitude difference in artefact density between the Upper Palaeolithic and the Middle Palaeolithic (Conard, 2011). Taken together, the rich artefactual assemblages and dumped accumulations of hearth waste suggest that the Upper Palaeolithic occupation of Hohle Fels was significantly more intense than that of the Middle Palaeolithic. The structuring of domestic waste, as evidenced by the dumped deposits, suggests that the Upper Palaeolithic occupants of Hohle Fels were practicing a form of site maintenance. Ethnographic studies (for example, Murray, 1980) show that structured waste disposal, or middening, occurs in mobile groups that are more sedentary. We would expect that groups living at one site for a longer period of time would accumulate more waste and would need to dispose of this waste in a designated place. The low density of artefactual material and the lack of structured waste within the Middle Palaeolithic occupation at Hohle Fels suggest that Neanderthal occupation of the site was generally short-term and ephemeral and may reflect generally low population numbers (Lahr and Foley, 2003). It is possible that stochastic variation in the already low populations of transitory Neanderthal groups may explain the absence when modern humans arrived; however, this hypothesis remains to be fully tested.

Future geoarchaeological goals – linking the caves with the landscape

To date, most geoarchaeological research in the Palaeolithic of Swabia has focused on the caves. This is because they contain a well-preserved and easily accessible record of Pleistocene deposits and archaeological assemblages. Current and future geoarchaeological work will link the detailed investigation of the caves with past landscapes of the Ach and Lone Valleys. An ongoing project under the direction of the author and funded by the Baden-Württemberg Ministry for Science, Research and Art aims to investigate landscape development and its influence of cave sedimentation processes and human repopulation of the region following the LGM. The project was initiated by the discovery at Hohle Fels of a major phase of erosion following the Gravettian and preceding the Magdalenian. A similar erosional event was also noted at Hohlenstein-Stadel in the Lone Valley (Jahnke, 2013). The period of erosion in these caves corresponds with the LGM, when the alpine glaciers had advanced within 30 km of the region, causing a general depopulation of the area. The project aims to test the hypothesis that changes in the configuration of the drainage systems of both the Ach and Lone Valleys were linked to deglaciation processes and influenced the sedimentation and erosional processes of the caves. Currently, the author and a PhD student have been conducting geophysical survey and plan on carrying out coring and trench excavation to understand the fluvial dynamics of the Ach and Lone Valleys. The results of this study will help us understand how the important cave sites of the region were linked to their landscapes.

Conclusion

The caves of Swabia preserve an exceptional record of environmental change and human evolution. The numerous stone tools, animal bones, jewellery, instruments and figurines provide archaeologists a view onto how modern humans and Neanderthals lived. However, it is not just the artefacts that inform us about the past, but also the sites and deposits in which these remains are found. The case study presented above shows how, through a careful study of a site’s deposits, we can investigate past environments in which our ancestors lived, and also investigate past activities and practices that are invisible to other scientific methods. In this sense, archaeological cave deposits are artefacts in their own right (Miller, 2011). Therefore, a site’s deposits and its surrounding landscape contribute significantly to a site’s Outstanding Universal Value (OUV).
Bibliography


The Swabian Jura

The Vogelherd Cave and the discovery of the earliest art – history, critics and new questions

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Introduction

The region of the eastern Swabian Jura is particularly known for the earliest evidence of figurative art in the Aurignacian around 43 to 35,000 years ago (Conard and Bolus, 2003, 21; Conard and Bolus, 2008; Higham et al., 2012; Kind, 2014, this volume; Wolf, 2014, this volume). This paper will focus especially on four caves: the Geissenklösterle and the Hohle Fels Cave in the Ach Valley, and the Hohlenstein-Stadel and the Vogelherd Cave in the Lone Valley (see Conard, 2014, Figure 1, this volume). All four sites have yielded figurative art, usually in the form of animal figurines, but also representations of humans and hybrids are known. First excavated by Gustav Riek in 1931 in the Vogelherd Cave and published in 1934 (Riek, 1934), the Swabian Aurignacian figurines are mentioned in every summary of European Palaeolithic art. That these pieces represent the world’s oldest figurative art so far was not always accepted in the scientific community. The aesthetic quality and elaborate work of the figurines were often seen as arguments against their provenance from the Aurignacian (for example, Zotz, 1951; Freund, 1957) or it is argued that there must have been older precursors (for instance, Bosinski, 1987; Bosinski, 2013). Even if the latter cannot be excluded, the dating to the Aurignacian is proved (for example, Conard and Bolus, 2008). Since their discovery, the figures from the Swabian Jura have always been the subject of art historical reflections. Despite their fine processing and their charisma, they remain enigmatic. Especially enigmatic to us are the numerous engraved marks – points, parallel lines, crosses and cross-lines – which are found on almost all the figurines and also on numerous organic tools of the same time period. We face many interesting questions concerning these marks: which signs are present on which figurines? Which marks or combinations of marks are typical of the particular sites? Were they placed simultaneously or with a time interval? Is it possible to establish a kind of ‘signature’ on the marks? What significance did the marks have in the Aurignacian social system in the Swabian Jura?

In this article an overview of Swabian Aurignacian research history will be given, with special attention to Vogelherd and the other find spots that have delivered figurative art from this period. A summary of the main responses to these findings and a contextualization of their cultural significance follow. A new research approach that focuses on the sign system of the Swabian Aurignacian will be presented at this point.

The discovery of the cave and excavation at Vogelherd

It was 23 May 1931 when Hermann Mohn, an interested amateur researcher from Heidenheim, found flint artefacts in the backdirt of a badger den on a hill near Stetten by Niederstotzingen. Mohn had discovered the site Heidenschmiede in Heidenheim in 1930 and participated in the excavations there and could therefore determine the archaeological material safely (Huber, 2010). Soon after the discovery, he informed the members of the University of Tübingen about the discovery of another potential Palaeolithic cave, which was named ‘Mohnloch’ – ‘Mohn’s hole’ firstly (Figure 1), and became later known as Vogelherd Cave. A short time later, the junior researcher and later Professor Gustav Riek was sent to Stetten to inspect the site. In the company of Mohn he went to the approximately 30 cm high and 40 cm wide entrance to the badger den on 4 July 1931. As early as the 5 July Riek opened the first test trench. On the evening of the second day they found evidence for a Palaeolithic settlement. Subsequently, a large systematic excavation was undertaken and in the course of just three months, the cave was excavated completely. As a reason for the high speed of excavation Riek called the fear of illegal excavations.

Die Fundmasse unserer Fundstätte ist daher nicht der so beklagenswerten Zerreibung, wie sie in früheren Jahrzehnten anderen Diluvialstationen der Alb schon zuteil geworden ist, anheimgefallen und die wissenschaftlichen Beobachtungen konnten seit dem Aufdeckungstage lückenlos aneinander gereiht werden¹ (Riek, 1934, VIII).

¹ ‘The mass of finds from our archaeological site is not in such regrettable disruption as other diluvial stations of the Jura have become in previous decades, and the scientific observations have been arranged in order from the first day on without gaps’.
The excavations began on the 15 July 1931 and were completed the 1 October of the same year. Riek, who was constantly on the site, led the diary, measured the finds, made profile drawings and photographed during the excavation. Four local fieldworkers, A. Bamberger, H. Feiertag, K. Gring and E. Bamberger were employed for the excavation (see Bolus, 2014, Figure 3, this volume). Riek had planned a three-volume publication, of which only the first volume, ‘Kulturen’, was published in 1934 (Riek, 1934). Therein, Riek presents a detailed description of the geological processes, the petrography of the sediments and the traces of Palaeolithic settlement of this site. He published a cave plan with the expansion of the various layers (Riek, 1934, 11) and five profile drawings (Riek, 1934, 41–49). According to the cave plan twelve profiles were drawn. All of them are described individually, but not all are published as a drawing.

New excavations at Vogelherd

During the 1931 excavation the backdirt from the Vogelherd Cave was driven out by workers in wheelbarrows and poured down the slope in front of the cave. The fresh debris mound is clearly visible in old photos (Figure 2). This debris mound also attracted many amateur collectors, so that further discoveries were made after 1931, such as two fragments of a little lion head made of mammoth ivory and a possible figurative representation of sandstone, which is difficult to determine (Riek, 1954; Hahn, 1986). The first official excavation in the backdirt after 1931 was conducted by Eberhard Wagner in 1978. Two small test trenches in front of the two cave entrances were undertaken, but no significant results were obtained (Wagner, 1978). Seventy-four years after the first excavation, a team from Tübingen University under the direction of Prof. Nicholas J. Conard began a systematic investigation of the backdirt. The aim was to save objects that must have been overlooked during Riek’s relatively fast excavation (Conard, 2007, 324–325). The excavation ran from 2005 to 2012 and supplied numerous finds, including new figurines, fragments of figurines, as well as stone artefacts, faunal remains and an important number of personal ornaments (Conard and Malina, 2006; Conard et al., 2007; Conard and Malina, 2008; Conard et al., 2009; Conard and Zeidi Kuleh parcheh, 2011; Conard et al., 2010; Conard et al., 2013; Conard and Malina, 2012; Wolf, 2013; Conard, 2014, this volume; Wolf, 2014, this volume).

The significance of Vogelherd Cave for the Swabian prehistory

The Vogelherd Cave is one of the most important prehistoric sites in Germany. It is located on a limestone offset in the middle of the Lone Valley, about 20 m above the valley bottom. It possesses a surface of approximately 170 m² and a ceiling height of about 3-4 m. The Y-shaped cave has three openings: the south entrance, the southwest entrance and a small opening in the north, which is too small to serve as an entrance. Riek distinguished a total of eight Palaeolithic layers. Four of these are Middle Palaeolithic deposits and four belong to the Upper Palaeolithic. Two of the latter, layer V and VI belong to the Aurignacian (Riek’s ‘middle’ and ‘upper’ Aurignacian). The two Aurignacian layers are the richest of the site and form the cultural level for which Vogelherd is famous. The Magdalenian is also represented in two layers. The Gravettian is not present, as in almost all the cave sites of Lone Valley. Remains from the Neolithic are the last traces of human activity at Vogelherd.
The Middle Palaeolithic

The Middle Palaeolithic at Vogelherd is documented in four layers (VI-IX) and provides one of the most complete stratigraphic sequences for West Germany, with the receipt of Early Mousterian, Mousterian and Late Mousterian (Müller-Beck, 1983, 250-251). The oldest layer IX lies directly on the bedrock and delivered only six stone artefacts. One find makes this layer especially interesting: the molar of a young forest elephant documents the settlement of Vogelherd by the Neanderthals already in the penultimate interglacial period, the Eemian, at least 115,000 years ago (Lehmann, 1954; Niven, 2006, 10, 77). Joachim Hahn, due to erosion processes, does not rule out a younger, Würm glacial age of these finds (Hahn et al., 1985, 86-87). Whether from the Eemian or from the beginning of the last glacial period, these find are the oldest evidence for Neanderthals in this region.

The Upper Palaeolithic

Above a sterile layer, on top of the Middle Palaeolithic, two Aurignacian layers (V and IV) follow. Both yield the largest amount of finds from Vogelherd, for example, a very rich lithic assemblage with 910 tools and 1,223 blanks from 1931 (Hahn, 1977, 87), plus numerous finds from the excavations of 2005 to 2012. This extensive inventory is currently being edited and re-examined in an ongoing dissertation (Chang, 2014, this volume; Chang, in prep.). The osseous industry is also very abundant. Especially the split base points are frequently found. Exceedingly rich are also the personal ornaments that were added, due to careful water screening and sorting, in the 2005-2012 excavations (Dotzel, 2011; Wolf, 2012; Wolf, 2014, this volume). Some find concentrations show an organized use of the cave with designated work areas. The Aurignacian settlement traces were extremely rich, according to Riek's descriptions. Thus, several fireplaces and find concentrations in the form of raw material, tool depots and work waste are reported in the two layers or even an accumulation of mammoth bones that was found nearby the southwest entrance (Riek, 1934, 52-55; Hahn, 1986, 18-22). This bone accumulation is one of the oldest of its kind so far (Niven, 2006, 221; Wolf, 2012, 182). A pyrite (FeS2), with clear traces of shock was recovered in the lower Aurignacian layer V within a burning place in the main hall (Riek, 1934, 161). It represents the earliest archaeological evidence of fire production with shock technology (Weiner and Floss, 2009). Riek described two sculls in the lower Aurignacian V, which were regarded for a long time as the earliest fossil evidence for anatomically modern humans in central Europe. They have recently been dated and show a Neolithic age of about 3,900-5,000 BP now (Conard et al., 2004).

Two layers of the Magdalenian (III and II) are also present at the Vogelherd cave. There were several tool accumulations and worked reindeer antlers. The Magdalenian settlement of Vogelherd takes place in the early phase after the Last Glacial Maximum. The low find density suggests that they were rather short-time stays (Riek, 1934; Niven, 2006, 232).

The figurines

Riek's excavation yielded eleven figurative representations. The lower Aurignacian layer V supplied a total of seven, including the famous horse, the mammoth with the perforations between the legs, the front leg with neck area, which is likely to be the same figure, the animal figure with the striking surface structure but without a head, the sculptured lion figure and the animal figure to which a head fragment from the new excavations in 2012 was refitted (Conard et al., 2013). Four figurines come from the upper layer IV: the lion in relief, the steppe bison, the relief of a mammoth and an anthropomorphic figure. Although the layer of each figurine is known, in his publication unfortunately Riek gives no indication of the exact position of the finds and their context. Riek's personal communication to Eberhard Wagner was that all the pieces were found in the central hall, right at the mouth of the eastern corridor, visible from the entrance at the right cave wall (Wagner, 1981, 42-43). Wagner reconstructs the position seen from the south entrance. Hahn, however, reconstructs the position at the opposite spot at the right wall, seen from the south-western entrance. He refers to Wolfgang Taute who received this information from Riek himself (Hahn, 1986, 20). This position is also confirmed by an oral notification by Erwin Pregel to the author. Pregel knew one of the workers of 1931, Anton Bamberger, who indicated the same position for the figurines.

After Riek's excavations, three further pieces of figurative art have been discovered. On the one hand, there are two fragments of a lion head, which probably originate from one and the same figure, but unfortunately cannot be joined, since the middle lamella of ivory is missing (Wagner, 1981; Hahn, 1986). One of them was found by S. Weber in the dump area in front of the south-west entrance and is, to this day, in private possession (Riek, 1954; Hahn, 1986, 104-106). The other one, the more complete part of the head, derives from the inheritance of E. Scheer and is now in the State Museum of Württemberg (Mauser, 1973). On the other hand, a perforated piece in sandstone was found by K. Bleich. Riek suggests this figure as a mammoth (Riek, 1954) and Hahn remains in the naming of this piece as a pendant, due to the lack of clarity of this presentation (Hahn, 1986, 98-104).
History of reception of the figurines

With regard to the impressive examples of Palaeolithic art from France, Riek was particularly keen on having found works of art from this period in Germany. Riek sets the stratigraphic position of the figures from Vogelherd clearly to the two Aurignacian layers V and IV. He places his Aurignacian sequence in the cultural division according to Henri Breuil (Breuil, 1907) and sees clear parallels to it. Riek’s ‘unteres Aurignacien’ corresponds to the ‘Aurignacien inférieur’ and is no longer addressed as Aurignacian. Hansjürgen Müller-Beck (1957, 26) and Gerhard Bosinski (1967, 150) assign this layer to the Middle Palaeolithic based on the stone artefacts. Riek’s ‘mitteltes’ and ‘oberes Aurignacien’ correspond to the ‘Aurignacien moyen’ and ‘supérieur’ after Breuil and cover the part of the Upper Palaeolithic, which nowadays is referred to as Aurignacian (Riek, 1934, 262-264; summarized: Hahn, 1986, 23-25).

Riek’s cultural assignment of layers IV and V to the Aurignacian on the basis of the lithic and the organic industry was generally accepted, but there were doubts as to the allocation of the figures in this period. As Zotz emphasizes:


He explains this phenomenon with an unidentified region of origin in Western Europe, in keeping with the then generally accepted Franco-centric view:


He clearly sees the figures from Vogelherd Cave as the precursors of the art in Moravia. The temporal gap appears strange to him, but seems irresolvable at this point. His doubts are reinforced by the fact that Riek indicates no exact find location for the figurines.

Gisela Freund follows the same argument:

Les trouvailles les plus importantes sont représentées, sans doute, par une dizaine des statuettes animales, sculptés en ivoire que Riek a daté de l’Aurignacien moyen et de l’Aurignacien supérieur dont les industries appartiennent selon l’auteur à l’interstade Wurm III. Quant à cette date, nous ne sommes pas tout à fait d’accord avec l’auteur et nous supposons que l’habitation aurignacienne dont les couches étaient situées au-dessus d’une strate argileuse que nous datons aussi comme l’auteur, dans l’interstade Wurm III, a commencé plus tard. N’entrons pas dans une discussion sur la chronologie de Vogelherd qui est, sans doute, une des plus importantes stations paléolithiques en Europe centrale. Mais en ce qui concerne les œuvres d’art seulement, une chose est à remarquer : dans l’ample monographie sur le Vogelherd, nous ne trouvons pas d’indications précises sur leur situation stratigraphique. Nous y apprenons seulement que Riek regarde les plastiques rondues comme appartenant à l’Aurignacien moyen et les demi-reliefs comme témoignages de l’Aurignacien supérieur4 (Freund, 1957, 16).

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2 “Some spearheads with a spitted base and other objects made of bone and ivory, partially perforated or decorated with grooved lines at the margins, obviously fit perfectly to our Aurignacian Level I … But what about the animal sculptures with some of the best works of Palaeolithic European art? May we expect, already in this early time in the Central European Aurignacian I, in the first interstadial, such mature works of art?”

3 “Since comparable products [to the figures from Vogelherd Cave] were found nowhere else in Central Europe in that early time, but apparently there does not exist a real Late Aurignacian [Gravettian] at the Vogelherd Cave, one can only conclude that this art would come to the Swabian Jura from the West during the interstadial, to have then only in Wurm III with very similar levels reached Moravia – a strange, but for now unsolvable discrepancy. In the far beyond the necessary width of the Vogelherd monograph, where much less significant finds are precisely fixed by their local position within the layer, one must strike at any rate, that to the circumstances of the finds as significant as the sculptures, nothing is announced”.

4 “The most important findings are represented, no doubt, by a dozen of animal statuettes, carved in ivory, which Riek dated to the Middle Aurignacian and Upper Aurignacian industries, these industries belong to the interstadie Wurm III according to the author. Regarding the date we do not completely agree with the author and we assume that the Aurignacian settlement, whose layer was located above a clay layer, that we too are dating as the author,
Freund assumes that Vogelherd was to be settled later and explains this with the stylistic similarity of the figures with the findings from the Moravian open air sites. While it is true that Riek does not tell anything about the precise location of the figurines, he still indicates the layer where each one was found. Thus, Freund’s critique is not fully justified.

The dating of the figurines to the Aurignacian is not doubted by Graziosi:

Auf französischem Boden sind bis heute in den Schichten des Aurignacien-Perigordien keine Tierplastiken gefunden worden. Tierdarstellungen, die einwandfrei dieser Zeit angehören, wurden dagegen sehr viel weiter östlich, in der Vogelherdhöhle (Württemberg), deren Schichten ins mittlere Aurignacien verweisen und an zwei mährischen, dem Perigordien zugehörenden Fundorten, Predmost und Dolni Vestonice zutage gefördert (Graziosi, 1956, 43).

He even very clearly says that these figures are the oldest known so far: ‘nach unserer heutigen Kenntnis also … die ältesten Beispiele dieser Kunst’ (Graziosi, 1956).

André Leroi-Gourhan established a chronology of Palaeolithic art based on stylistic features in his comprehensive book on Palaeolithic art. He compares the figurines from Vogelherd Cave with the central and eastern European mammoth ivory figurines: ‘Le domaine de la sculpture animalière est le Centre et l’Est européen ou les figurines se trouvent contemporaines des représentations féminines’, thus the Gravettian.

Stylistically, he sets the figurines of Vogelherd into the eastern and central European Gravettian, completely ignoring Riek’s dating to the Aurignacian. For the Aurignacian he mentions only the engraved and painted blocks from the Dordogne, at which he defines his Style I. He clearly assigns the figurines from Vogelherd Cave to his style II, which is chronologically equivalent to the Gravettian (Leroi-Gourhan, 1965, 63, 67-68, 244-245). The fine and elaborate presentation of the figures seems to make a dating to the Aurignacian impossible for him.

In 1939 another figurative representation was found in the Lone Valley, but it was not recognised until 1969. Robert Wetzel began his work at Hohlenstein-Stadel in 1935, from 1937 to 1939 under the local direction of Otto Völzing. Fragments of worked ivory were found on the last day of excavation in 1939 in the back part of the cave. They were collected in a box and were stored together with the rest of the inventory from the Hohlenstein-Stadel in the Museum of Ulm. In 1969 Joachim Hahn, with the help of two colleagues, restored from about 200 fragments, one nearly 30 cm high figure with human and animal attributes, the so-called Lion Man (Hahn, 1970, 1; see also Kind, 2014, this volume, Figure 3). Since then, more fragments have been completed (Schmid, 1989; Wehrberger, 2007), most recently in 2013, after the discovery of new fragments during the excavations of the State Office for Cultural Heritage of Baden-Württemberg under the direction of Claus-Joachim Kind (Kind and Beutelspacher, 2009; Ulmer Museum, 2013). The stratigraphic position of the Lion Man is described by Hahn as followed:

Aufgrund der Tiefenangabe und der Erdspuren an den Elfenbeinfragmenten und an den Tierknochen läßt sich jedoch die ehemalige Fundschicht mit großer Sicherheit ermitteln. […] Die Fundtiefe von 1,00 bis 1,20 m unter der Oberfläche ist die der unteren – röthlichgelben – Aurignacienschicht. Für die Zugehörigkeit zu dieser Schicht sprechen auch die röthlichgelben Erdreste an den Elfenbeinfragmenten und ihre schwach rötliche bis stellenweise braune Färbung (Hahn, 1970, 2-5).

5 ‘On French territory no animal sculptures have been found in the layers of the Aurignacian-Perigordian to that date. Representations of animals that belong to this period, however, were found much further east in the Vogelherd Cave (Württemberg), these layers refer to the middle Aurignacian and in two Moravian sites belonging to the Périgordien, Predmost and Dolni Vestonice’.

6 ‘according to our present knowledge… the oldest examples of this art’

7 ‘The domain of animal sculpture is Central and Eastern Europe and the figures are contemporary to the female representations’.

8 ‘A Vogelherd in Württemberg, a series of ivory statuettes was discovered: felid, horse, and bison, mammoth. Dolni Vestonice delivered in clay paste and crushed bones, figurines of felid, bear, horse, rhinoceros and bird: Predmost in Moravia has a mammoth stylistically very close to those of Kostienki and a Gravettian mammoth in sandstone from Isturitz’.

9 ‘Because of the depth indication and the rests of sediments on the ivory fragments and animal bones, however, the former find layer can be determined with great certainty. […] The find depth at 1.00 to 1.20 m below the surface is the one of the lower – reddish yellow – Aurignacian level. The traces of reddish yellow sediment on the ivory fragments and their thin reddish, sometimes brownish colour confirm their provenance from this layer’.
He excludes an inversion from a younger Gravettian horizon, because there are no deposits from this period reported in the Lone Valley (Hahn, 1970, 5). The Lion Man from Hohlenstein-Stadel is thus further evidence of the early artistic creativity of the Swabian Aurignacian.

The assumed direction of creative influence in the 1950s was from west to east. In the 1970s opinion about this began to change. Züchner, in his thesis on the human representation in the French Palaeolithic, describes:

_Auch die Tierdarstellungen aus dem Aurignacien des Vogelherdes im Lonetal (Süddeutschland) [...] lassen einen Einfluß von außen auf die Kunstentwicklung Frankreichs nicht unmöglich erscheinen, da sie sich weit über die sehr urtümlichen Werke des gesamten Aurignacien Frankreichs erheben_10 (Züchner, 1972).

Slowly, the idea became accepted, that a very early epoch can produce very high-quality works of art. Likewise, a creative influence from east to west is considered, after a long period of a Franco-centric view on prehistory.

As the figures did not fit stylistically in such an early time, Riek’s assignment of them to the Aurignacian has been questioned several times. Especially the excavation method and the shortness of time were strong arguments for the assumption that the figurines could not derive from the Aurignacian. But Riek’s layer assignment is strongly supported by the results of the systematic excavations at Geissenklösterle in the Ach Valley, conducted in 1973 under the direction of Wagner, 1974 to 1991 by Hahn and, after his death, from 2001 to 2002 under the direction of Conard. In the 1970s, several ivory figurines were recovered in the Aurignacian levels AH IIa and IIb (Hahn and Wagner, 1976; Hahn, 1978; Hahn, 1982). This modern excavation brought to light figurines that are stylistically very close to those from Vogelherd and certainly come from the Aurignacian layers. From the layer AH IIa the mammoth figure and the upright bear originate, in the layer AH IIb the so-called Adorant and the bison figure were found. Thus, Riek’s layer assignment for the figurines from Vogelherd Cave to the Aurignacian was confirmed (Müller-Beck, 1987, 10-11).

Although the figures from Hohlenstein-Stadel and the Geissenklösterle were already known, in 1993 Henri Delporte wrote, the new edition of his work from 1979:

_Leroi-Gourhan classe les figurines animales du Vogelherd dans son style II, donc, en principe, dans la même période que celle, qui marque, en France, la fin de l’Aurignaco-périgordien et les débuts du Solutréen. On ne connaît pas la position de la statuette [anthropomorphe] dans la couche 4 ; on ne peut exclure qu’elle ait été associée aux pointes de la Gravette et qu’elle soit contemporaine des statuettes gravetiennes_11 (Delporte, 1993, 128-129).

He refers to the stylistic classification of Leroi-Gourhan and does not exclude an attribution to the Gravettian, although the Gravettian at Vogelherd Cave is not reported. In contrast, in his work on Palaeolithic animal representations, he also refers basically to the stylistic classification of Leroi-Gourhan, but classifies the animal figurines from Vogelherd and Geissenklösterle as Aurignacian, without further discussing this (Delporte, 1990, 145, 246).

In his work on the Ice Age art in Germany and Switzerland, Gerhard Bosinski does not deny Riek’s dating for the figurines from Vogelherd to the Aurignacian (Bosinski, 1982, 11). However, he sees the outstanding design of the figurines as evidence that these figures cannot stand at the beginning of human artistic creativity:


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10 ‘The animal representations from the Aurignacian of Vogelherd in the Lone Valley, Southern Germany, ... appear to have an external influence on the development of art in France, as they rise far beyond the very primitive works of the entire French Aurignacian’.

11 ‘Leroi-Gourhan classes the animal figurines Vogelherd in his Style II, therefore, in principle, in the same period that corresponds in France to the late-Aurignaco-Périgordian and early Solutrean. We do not know the position of the [anthropomorphic] statute in layer 4, and therefore we cannot exclude that it was associated with Gravette points and it was contemporary to the Gravettian statuettes’.

12 ‘The animal representations, especially the examples from Vogelherd, are perfect in expression and modelling ... It is unthinkable to see here an initial phase of artistic design. There must have been objects of art before the Aurignacian. From our region no corresponding findings are known, but it appears that the figures from Sungir’... have essential features of such a preform to our animal statuettes’. 
Accordingly, the mobile art of Sungir in style and content provide for him a possible precursor of the art from Swabian Jura, ‘denn es ist faktisch unmöglich, in den vollkommenen Vogelherdstatuetten den Anfang der Kunst zu sehen’\textsuperscript{13} (Bosinski, 1987, 32). Chronologically, Bosinski places the figurines from Sungir anterior to the Aurignacian (Bosinski, 1982, 19; Bosinski, 1987, 13; Bosinski, 2013). New dating shows, however, that Sungir, at approximately 26,000 to 27,000 BP, is significantly younger than the Swabian Aurignacian (Kuzmin et al., 2004; Dobrovolskaya et al., 2013).

New finds from Hohle Fels substantiate the fact that the earliest, highly elaborate Aurignacian art tradition is to settle in the region of the Swabian Jura. In 1999, a horse’s head in mammoth ivory was found at the top of the Aurignacian layers (Conard, 2000). Other discoveries followed, for example, a piece from the AH IV in 2001 and in the following year its head, which allowed identifying this figure as a water bird. In 2002 a figure only 2.5 cm high was found in the same layer, which has strong similarities with the figure of the Lion Man from Hohlenstein-Stadel and is therefore called the ‘Little Lion Man’ (Conard, 2007; Conard et al., 2003). In 2008, at the base of the Aurignacian (AH Vb), the Venus from Hohle Fels was found (Conard and Malina, 2009). This figure shows distinctive sexual characteristics and has a bail instead of a head. It was probably worn as a pendant. It represents the oldest human representation to date. Recent finds from Hohle Fels clearly show that small figurative art made of mammoth ivory was a widespread phenomenon in the Swabian Aurignacian. So far nothing comparable in quality and quantity has been found in any other region. Although their quality is surprising, it has to be admitted that this sort of art is no exception, but probably more the rule in this region. The figures stand at the beginning of artistic creation of humankind and they bear witness to the astonishing ability of their creators.

The figurines of the Swabian Jura in the European context

Artistic creation is a common phenomenon at the beginning of the Upper Palaeolithic. This is proven by an increasing number of Aurignacian art-related artefacts in Europe. Some have been known since the end of the nineteenth century like engraved blocks from the Dordogne region of France, which show mostly pictographic vulvae representations and animals in simple outlines like in Castanet, Blanchard, La Ferrassie or Abri Cellier (for example, Delluc and Delluc, 1991). Their stratigraphic assignment to the Aurignacian is supported by the latest finds from excavations at Abri Castanet. There, an engraved and coloured limestone block was found in 2007, which had fallen directly on top of the Aurignacian layer and sealed it. Accelerator Mass Spectrometry (AMS) data reveal an average age of 32,400 BP for the Aurignacian settlement (White et al., 2012). Paintings from the Périgord, mostly animals, are also common, for instance, from Les Bernous, La Croze à Gontran and La Cavaille (Chiotti et al., 2007, 181-186). From Grotta di Fumane in Italy some small paintings on limestone blocks are known. The pieces were found within the Aurignacian layer, dating between 36,800 + 1200/-1400 and 30,320 ± 320 BP. Originally the representations were painted on the walls and the ceiling, but fell down on the settlement layers. Due to the break off, many motifs are no longer readable. However, two fragments are clearly recognizable: an animal and an anthropomorphic representation. The 18 cm high anthropomorphic figure is shown in front view with two horns on the head; the arms are stretched laterally from the body carrying an object in the right hand. Within the settlement layer, a large area with ochre scattering was found, indicating an intensive use of this pigment. This proves that the paintings must have originated in Aurignacian and not in an earlier phase of settlement (Broglio et al., 2007). Similarly as in the Grotta di Fumane, several limestone blocks with traces of colour were found in the Aurignacian layers of Abri Pataud, France, probably fallen down from the wall and the ceiling. Although the vast majority of these blocks were found in the Gravettian layers (n = 1414), a total of 9 pieces were found already in the Aurignacian layers 6 and 10/11. These are not specifically identifiable illustrations in red and black colour (Chiotti et al., 2007).

The spectacular parietal art from the Chauvet Cave provides an impressive testimony of Aurignacian art. The cave in the Ardèche Valley, France, was discovered in 1996 and shows a number of outstanding paintings. Direct \textsuperscript{14}C dating of charcoal used as a pigment yielded a time position of 32,500 to 30,000 BP, but there are also more recent dates ranging from 26,000 to 28,000 BP (Valladas et al., 2001a; Valladas et al., 2001b). Stylistically, the paintings are comparable with some paintings from the Solutrean and Magdalenian, and so this early dating has been repeatedly questioned by some researchers (Combier and Jouve, 2012; Züchner, 1995; Züchner, 1998). Although there are quite justifiable doubts as to the dating of paintings with \textsuperscript{14}C (Pettitt and Pike, 2007), the assumption that these paintings were also elaborated for the Aurignacian is not convincing, as the example of mobile art from the Swabian Jura clearly demonstrates. The pure stylistic argument does not work out for the pieces from the Swabian Aurignacian either. Through new radiometric dating, more and more painted caves are considered Aurignacian. charcoal residues in the two horizons from Grotte d’Aldène gave an age of 37,080 ± 620 BP to 30,260 ± 220 BP (Ambert and Guendon, 2005). For the so-called Panel de las Manos El Castillo, northern Spain, a date of about 40,800 years was obtained on uranium-series (Pike et al., 2012); \textsuperscript{14}C dates for the same site gave an age of 32,410 ± 720 BP (Pike et al., 2007). Stylistically, the paintings are comparable with some paintings from Castanet, Blanchard, La Ferrassie or Abri Cellier (for example, Delluc and Delluc, 1991). Their stratigraphic assignment to the Aurignacian is supported by the latest finds from excavations at Abri Castanet. There, an engraved and coloured limestone block was found in 2007, which had fallen directly on top of the Aurignacian layer and sealed it. Accelerator Mass Spectrometry (AMS) data reveal an average age of 32,400 BP for the Aurignacian settlement (White et al., 2012). Paintings from the Périgord, mostly animals, are also common, for instance, from Les Bernous, La Croze à Gontran and La Cavaille (Chiotti et al., 2007, 181-186). From Grotta di Fumane in Italy some small paintings on limestone blocks are known. The pieces were found within the Aurignacian layer, dating between 36,800 + 1200/-1400 and 30,320 ± 320 BP. Originally the representations were painted on the walls and the ceiling, but fell down on the settlement layers. Due to the break off, many motifs are no longer readable. However, two fragments are clearly recognizable: an animal and an anthropomorphic representation. The 18 cm high anthropomorphic figure is shown in front view with two horns on the head; the arms are stretched laterally from the body carrying an object in the right hand. Within the settlement layer, a large area with ochre scattering was found, indicating an intensive use of this pigment. This proves that the paintings must have originated in Aurignacian and not in an earlier phase of settlement (Broglio et al., 2007). Similarly as in the Grotta di Fumane, several limestone blocks with traces of colour were found in the Aurignacian layers of Abri Pataud, France, probably fallen down from the wall and the ceiling. Although the vast majority of these blocks were found in the Gravettian layers (n = 1414), a total of 9 pieces were found already in the Aurignacian layers 6 and 10/11. These are not specifically identifiable illustrations in red and black colour (Chiotti et al., 2007).

\textsuperscript{13} ‘because it is virtually impossible to see the beginning of art in the perfect statuettes from Vogelherd Cave’. 

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et al., 2012). In Altxerri B, northern Spain, recently a very high age was postulated for some of the paintings. A range of 34,370 ± 280 to 29,940 ± 745 BP was obtained by 14C dating of herbivore bones (González-Sainz et al., 2013). A recently discovered cave in Romania, Coliboaia, has given a 14C date of approximately 32,000 BP. The rhino and bear representations are stylistically very similar to the ones from Chauvet Cave (Clottes et al., 2011; Guy, 2012).

Likewise, mobile art from the Aurignacian is abundant. From El Castillo, in addition to the wall paintings, originate some small decorated objects, but these are hard to read and their artificial character is not certain. The beginning of the Aurignacian (level 18) was dated through AMS and ESR (Electron Spin Resonance), dating to an age between 42,200 ± 2,100 and 37,000 ± 2,200 BP. Some other sites in northern Spain delivered decorated objects in simple design (see also: Barandiarán and García Diez, 2007). From Belgium two objects from the site of Trou Magrite are known: a small anthropomorphic ivory figure and a carved reindeer antler decorated with abstract motifs. Since the site was excavated in 1867 by Dupont, the assignment of the two pieces to the Aurignacian is not certain. Their style and content is comparable with finds from West Germany and France and suggest an Aurignacian date. Recent studies of Duponts reports and new 14C AMS dates of 38,000 to 34,000 BP were able to confirm that these pieces are Aurignacian (Dewez, 1985; Lejeune, 2007, 138-140). In 1988, a 7.2 cm large, anthropomorphic relief sculpture was found in Stratzing in Lower Austria. Unlike most other small works of Aurignacian art this is not carved in mammoth ivory, but schist. The layer in which the figurine was found dates back to about 32,000 BP. Because of the attitude and design in relief, a comparison with the Adorant from Geissenklösterle urges (Neugebauer-Maresch, 2007).

Artistic creativity in the Aurignacian was therefore not unusual, but – more and more discoveries confirm this – rather the rule. Although discussions on the dating problems of parietal art are not yet completed, small art from the Swabian Jura, which comes directly from the Aurignacian layers, leaves no doubt on the cultural assignment. The new 14C AMS data from Geissenklösterle starting at maximum 42,500 cal BP prove that the Swabian Aurignacian is currently the oldest known Aurignacian in Europe (Higham et al., 2012). No precursor of these artworks has yet been discovered and thus the findings from the four caves of Vogelherd, Hohlenstein-Stadel, Geissenklösterle and Hohle Fels represent the oldest figurative art worldwide to date. All attempts to find older art forms are unconvincing. At the beginning of the Aurignacian strong changes in material culture are visible. Suddenly, we see ‘at least 600’ documents for artistic creation ‘from a total of at least 20 sites’ (Floss, 2007, 314; see also: Floss, 2005; Conard, 2007). The sites of the Swabian Jura stand at the beginning of human artistic expression and represent with more than fifty pieces the richest region for Aurignacian art.

The marks – a new research approach to the figurines

A striking, though still insufficiently studied feature of the figurative art of the Swabian Jura are the numerous markings. Many figurines bear sequences of marks, usually found in the form of parallel lines, crosses and cross-lines, diamonds, V-shaped signs and points. An important comprehensive study was carried out by Joachim Hahn (Hahn, 1986) in which he categorized and counted all signs on the then-known figurines and discussed them in relation to the representations. Unfortunately his statistical studies could not provide largely interpretable results. In view of the significance of the marks and a possible notation system, the work of Alexander Marshack should be mentioned (Marshack, 1972). He interprets a large part of the marks as notations of astronomical observations. Recent works, which deal with the signs on the figurines of the Swabian Jura, were done by Hansjürgen Müller-Beck (2001) and Harald Floss (2007). Müller-Beck interprets the marks as ‘clearly reflective’ and with an evident ‘scoring’ character, sometimes with astronomical information. Harald Floss emphasises the amount of decorated objects and the importance of the individuality of each figurine and its marks.

In Figure 3, the pieces investigated so far are listed. About half of all hitherto examined figurines bear marks (54%). The ones from Vogelherd are included as far as possible; the figurines for the other sites are to be regarded only as preliminary results. From Vogelherd Cave at least 31 reliable figures and fragments of figures are known, 22 of them bear markings of various kinds. Another 21 potential, not certainly identifiable fragments were recorded, of which 8 bear marks. Thus 58% of the figurative elements from Vogelherd are marked. The finds from this site alone show the enormous importance of marks in the Swabian Aurignacian.
Only little attention has been paid so far to the marks on tools and not precisely definable artefacts made of osseous material (ivory, antler and bone) and personal ornaments. Even if these are not to be found in such large numbers as on the figurines, they are still regularly present. In her dissertation, Sibylle Wolf has dealt with the ivory finds from Hohle Fels and Vogelherd extensively. She recorded many tools and tool fragments with striking patterns. These are mainly cross lines and parallel lines (Hahn, 1977, Taf. 34.2-4, 36.2-3, 37.1, 58.2, 59.2-5; Wolf, 2012, Taf. 41.1, 42.1-2, 4-5, 7, 9-12, 15, 17-31, 43.2-4). Hohle Fels and Geissenklösterle delivered the so called ‘bands’; made in mammoth ivory and bearing parallel notches on the sides and interpreted as decorative elements (Hahn, 1988, Taf. 45.18; Wolf, 2012, 70, 72, 146-147, 171-173, Taf. 32.3). In addition to the figures and the figurative fragments from Hohle Fels, some ornamented rod fragments, points, jewellery and not specifically identified objects are known (Wolf, 2012, Taf. 3.2, 4.1-4, 7.1, 15.14, 15 a.1, 18.2, 19.1-2, 20.1-3, 6-7, 28.6-7, 30.10-11). From Hohlenstein-Stadel a pierced cervid canine with four parallel lines on the front and two on the back is known (Beutelspacher and Kind, 2012, Abb. 36). From the Swabian caves, which have not yielded any figurative art, some other decorated artefacts are known. In Bockstein Törle a ring of siliceous shale with lateral notches was found (Hahn, 1977, Taf. 12.6; Wolf, 2012, Abb. 112.3). From Sirgenstein an ivory rod with notched edges is known (Hahn, 1977, Taf. 67.9) and from the Göpfelstein Cave derives a bone splinter grooved with X-patterns (Hahn, 1977, Taf. 69.10).

Explanatory approaches

Looking at the interpretive possibilities, the first interpretation as fur drawings, especially in the case of animal figures, comes to mind. In some cases, this interpretation cannot be excluded, as, for example, in the case of the horse from Vogelherd, which carries a line of X-marks from the head to the tail, with a break in the part of the front legs. This could reflect the typical dorsal stripe that wild horses and many of today’s horse breeds possess (Figure 5). Also, the irregular crossing lines on the soles of the complete mammoth figurine found in 2006 in Vogelherd could reflect the wrinkles that are clearly visible in elephant footprints (Figure 6).
Despite these rather easily explainable features, other signs are enigmatic and it is not obvious what they could represent. As found, for example, on the mammoth that comes from Riek's 1931 excavation, several parts of the body bear cross lines and other signs. The cross lines are usually located in prominent places, such as the shoulder or the high forehead. This could be explained by the highlighting of those body parts, but many signs on the animal cannot simply be interpreted with natural features. On the right hip area a series of seven points is represented that does not occur on the other side. Also on the lower back, above the cross line on the tail area, a series of three marks appears. On the right head area there is a row of three points (Figure 7). The asymmetry of these markings stands especially against an interpretation as coat pattern – this is rather distinctive information, noted in a specific code.

On the left arm of the Lion Man, seven or eight clearly incised notches appear which are not found on the right arm. Additionally, the left ear bears some incisions that were recognised just recently during the 2013 restoration of the Lion Man (Ebinger-Rist et al., 2013) The situation is similar with the Adorant from Geissenklösterle. Although the relief of the anthropomorphous figure is no longer preserved in the uppermost layer, on the left of the raised arms at least five notches are clearly visible. In addition, the piece bears a total of 39 notches along the edges and 48 points on the back, which are often interpreted as a moon calendar (Marshack, 1972; Müller-Beck, 2001). All these marks cannot be explained so easily by natural features. Rather, it is clear that these marks transmit a certain content of information that has symbolic value and can only be read if one knows the clue. That the marks are not simply just coat patterns is particularly evident in the case of the decorated tools (Figure 4). The cross lines, for example, which are found on many different objects, certainly convey a substantive message.

How can the phenomenon be explained, that some marks look very similar to coat patterns and other or sometimes even the same marks appear to have elsewhere an abstracted symbolic content? Steven Mithen presented a theoretical explanation of such phenomena (Mithen, 1998). He describes a hypothetical evolution of the human brain that has developed certain areas, which have become specialized for certain tasks. To better cope with the many challenges of life, man, next to the general intelligence that is also peculiar to many other mammals, developed prepared intelligences on specific topics to make learning faster than would be possible with general intelligence, which allowed a modification of behaviour only
through slow and very frequent sampling. The areas that are particularly necessary for human life, such as language, social intelligence, technical intelligence and the so-called natural history intelligence are the basic structures for the individual zones. They are equipped with certain ‘before settings’ such as an understanding of grammar, that will be filled by the person during his lifetime. The system is designed for grammar, which language is filled in is secondary. According to Mithen, these different areas of the brain have developed differently in different stages of human evolution and have always acted independently. Only in anatomically modern human brains have these different areas become permeable and information can be viewed simultaneously from different angles. He calls this phenomenon the ‘cognitively fluid mind’. Whether this theory, especially the different stages of development in detail, is founded or not shall not be discussed further in this point. What is important to this paper is the observation that modern humans can perfectly and effortlessly transform objects or ideas into a variety of other fields. It is so easy for us to use a certain object that acts as a basic commodity, such as a knife, as an expression of social ranking. Fortune tellers find it easy to read the flight of a bird and to make conclusions about upcoming events within a social society, and for the society, it is easy to believe this. Diverse examples can be found for it. Taking this into account, it is obvious that certain natural observations, such as the highly visible dorsal stripe in a wild horse, is incorporated in the presentation and probably has a content beyond the mere reproduction of what is seen and has a deeper meaning. Similarly, the appearance of wrinkles in the footprint of a mammoth may carry a broader cultural significance. And beyond, such signs can become independent and be used as a vehicle to transport this or other meanings to other objects. Even if this is difficult to prove, since we do not know the code for these symbols, it is very likely that the application of such marks goes beyond the mere decoration of objects.

What opportunities are available to study the marks on the Swabian Aurignacian figurines? On the one hand, a complete recording of the repertoire and a statistical analysis of the occurrence and absence of certain marks at the sites, the determination of combinations and the appearance of signs in certain representations are to be carried out. Through this, an approach to the ‘grammatical’ structure of the marks is aimed and should lead to a deeper understanding of the semantics of the Swabian Aurignacian signs repertoire. On the other hand, the technological analysis is an important aspect. First, there is the identification of the tools and thereafter the applied movements and gestures, which are used for carving the marks. In a final step it will be investigated whether there are significant differences in the technique so that it will be possible to retrieve certain patterns and to identify characteristic styles of groups of people (for instance, right and left handed) or even individuals (Figure 8). This would help to understand the making of this art, to define if it was done by all group members or by several individuals as well as to comprehend the social context and impact of this artwork. A review of existing models and new models of explanation for the analysis of the sign will follow. These analyses are currently being prepared by the author. No results can be presented at the moment.

Figure 8. Detail of the marks on the lion relief from Vogelherd (© University of Tübingen, photo Hilde Jensen).
Conclusions

The Vogelherd Cave is one of the most important sites in Germany with Middle and Upper Palaeolithic deposits. It was discovered by Hermann Mohn in 1931 and excavated by Gustav Riek in the same year in just three months. In the years 2005 to 2012 new excavations in Riek's backdirt were conducted under the direction of Nicholas J. Conard and completed the inventory with many important discoveries. Vogelherd was inhabited by people since the last interglacial period, the Eemian. First, it was an important station of the Neanderthals, which is demonstrated in four Middle Palaeolithic layers. After the Neanderthals had withdrawn from the area, shown by a sterile layer between the Middle and the Upper Palaeolithic, anatomically modern humans arrived following the Danube Valley about 43,000 years ago (Conard, 2002; Conard and Bolus, 2003) and established themselves in this area with the Aurignacian culture. Here they created art, personal ornaments, musical instruments and there is evidence for religious beliefs. Since its first discovery by Gustav Riek in 1931, the figurative art of the Swabian Jura still remains mysterious. Riek's observations, that the figurines come from the Aurignacian, were not initially universally accepted. Their most elaborate drafting was often the reason for doubts, as the figures stand at the beginning of human artistic creativity. Until the 1980s and beyond this was questioned by some scholars. Even if Riek's descriptions could still be questioned and a false layer assignment remains possible, the strongly resembling finds from modern excavations as Geissenklösterle and Hohle Fels then confirmed the early date of the finds from Vogelherd. A layer assignment to the Aurignacian cannot be questioned nowadays, especially since the stylistic comparisons with Gravettian figurines from Central and Eastern Europe become obsolete, as there is only minimal evidence for the presence of this techno-complex in the Lone Valley. Up to the present day, the figurines of the Swabian Aurignacian represent the oldest evidence of figurative art worldwide. Recent dates show that the Aurignacian of this region starts around 43,000 BP and thus belong to the oldest in the European context. Other sites with Aurignacian art are significantly younger or do not have such an outstanding ensemble of unique artwork and symbolic expressiveness. Due to the eventful history of research the figures from Vogelherd, Hohlenstein-Stadel, Geissenklösterle and Hohle Fels are now displayed in different places (see below: Museum Schloss Hohentübingen, Prehistoric Museum Blaubeuren, Ulmer Museum, State Museum of Wurttemberg Stuttgart and Archäopark Vogelherd).

Although much has been written about the figurines of the Swabian Jura, the striking marks attached to almost all the figures remain enigmatic. Some attempts to interpret them have been made. Joachim Hahn first recorded the sign inventory and presented first statistical analysis (Hahn, 1986). Alexander Marshack examined the marks on their astronomical value and got some interesting results (Marshack, 1972), but these are not convincing for the whole ensemble though. The studies of Hansjürgen Müller-Beck aim for a similar direction, favouring an astronomical interpretation especially for the Adorant from Geißenklösterle (Müller-Beck, 2001). A new recording and reassessment of all accessible marks of the Swabian Aurignacian today is currently undertaken by the author. Besides quantitative and qualitative studies, technological analyses are carried out. A statistical study of the ‘grammatical’ structure of the sign inventory aims to approach the semantic content of the marks, even if a full decryption certainly cannot be achieved.

The Vogelherd Cave stands at the beginning of the history of research in a particular region (see further Bolus, 2014, this volume) that together with its other famous sites – Hohlenstein-Stadel, Geissenklösterle and Hohle Fels – gives us insights to one of the most decisive phases of cultural development of man. The oldest evidence for figurative art, three-dimensionally shaped jewellery (see further Wolf, 2014, this volume), music and religious expressions (see further Conard, 2014, this volume) is found there. These sites shed light on the origins of what is now called the cultural modernity and is visible in a fully developed manner around 40,000 years ago. The value of these four sites for the understanding of human cultural development cannot be rated highly enough.

Whereabouts – the museum presentation of the earliest art

The Museum at the Schloss Hohentübingen

The figurines from Gustav Riek's excavation initially remained in his private collection. After the Second World War, he kept them in a bank vault for a long time. After Riek's death, they passed into the possession of his heirs. In 1978 the University of Tübingen finally bought the figures from Riek's family. Since then, they remain in the possession of the University. First, the figurines from Vogelherd were exhibited in the University library until they were brought to the museum at Hohentübingen Castle in 1998. Today they are exhibited there within a newly designed exhibition that was opened in May 2012.
The Swabian Jura

The Prehistoric Museum Blaubeuren, Urmu

The history of the Prehistoric Museum in Blaubeuren dates back to Gustav Riek. In 1963 and 1964 he set up an exhibition to showcase the finds from Brillenhöhle and Große Grotte. In the years 1979 to 1984, the permanent exhibition was redesigned by Joachim Hahn and Hansjürgen Müller-Beck. In 2002 the museum was extended by the ‘Art Gallery 40,000 years’. Currently, the museum is under reconstruction and will reopen in 2014. The figurines from Hohle Fels will be presented there and the Venus found in 2008 will be a special highlight of this exhibition.

Museum Ulm

Robert Wetzel was, like Gustav Riek, owner of his finds from Hohlenstein-Stadel. He kept his discoveries in the city museum of Ulm where he eventually bequeathed the entire collection. Among them was the box with the carved ivory fragments, found 25 August 1939, on the last day of the excavation in the Stadel Cave. In 1969 Joachim Hahn reviewed the collection and put the ivory fragments together. The 31 cm high figure of the Lion Man was refitted. After several restorations, the figure was completed in 2013 with the newly found fragments from Hohlenstein-Stadel that were recovered during the excavations of State Office for Cultural Heritage of Baden-Württemberg. The newly restored figure of the Lion Man has been displayed in the Museum of Ulm since November 2013.

State Museum Württemberg

Joachim Hahn’s excavations at Geissenklösterle ran on behalf of the State Office for Cultural Heritage of Baden-Württemberg. The figurines from this site have therefore been assigned to the Württemberg State Museum in Stuttgart. Likewise there are two finds from Vogelherd Cave that were found after the excavation by collectors and were brought to the State Museum of Württemberg. Since May 2012, the permanent exhibition has been displayed in a new design.

The Archäopark Vogelherd

On 1 May 2013 the Archäopark Vogelherd was opened. A 6.5 acre outdoor area has been modelled with several Palaeolithic themes and action areas. The site of Vogelherd is located within the park and is incorporated into the trail through the park (Figure 9). In the visitor centre two original finds are presented: the completely preserved mammoth found in 2006 and the lion figure from the same year. Conceptually, the Archäopark is designed as a learning and adventure park, where visitors are able to explore Stone Age hunter-gatherers lifestyle.

Figure 9. Overview of the outdoor area of the Archäopark Vogelherd (©Archäopark Vogelherd, Photo G. Serino).
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Introduction

Six caves of the eastern Swabian Jura, south-west Germany, yielded extraordinary mammoth ivory assemblages, which date to the Aurignacian. These sites are Hohle Fels, Geißenklösterle and Sirgenstein in the Ach Valley between the towns of Blaubeuren and Schelklingen. The other cluster of cave sites is located in the Lone Valley and includes Vogelherd, Hohlenstein-Stadel and the Bockstein-Törle. The inventories of the caves comprise numerous personal ornaments made of ivory, which show a huge variety of forms and sizes. These elements give insights into the cultural background of the Ice Age people 40,000 years ago. In the assemblages the dominating form is the double perforated bead. In addition, the cave site of Wildscheuer in Hess and the open air site of Lommersum, near the town Bonn, yielded personal ornaments from the Aurignacian. The sites are 400 km away in south-western Germany. Thus, a comparison of the personal elements during the Aurignacian in two different geographic regions of Central Europe is possible. (Figure 1 – map)

At the beginning of the Aurignacian, artefacts made of antler, bone and ivory appeared in large numbers in different European regions (for example, Hahn, 1977; Hahn et al., 1995; White, 2003, 2007; Floss, 2007). With regards to the Swabian Jura, the current state of research indicates that these archaeological remains were made by anatomically modern humans (for example, Conard et al., 2006) and the carving of ivory in large quantities is documented there (Riek, 1934; Scheer, 1985; Hahn, 1986, 1988). The finalized products were objects of everyday use like chisels or baits as well as impressive points, figurines, flutes and personal ornaments (Figure 2). The perfect state of the finds is astounding and unique (for example, Conard et al., 2004; Floss, 2007; Wolf, 2015).

The aim of this article is to give a general overview about the ivory assemblages of Hohle Fels Cave and Vogelherd Cave, with a focus on personal ornaments. In addition to the adornment of the Swabian sites of Hohlenstein-Stadel, Bockstein-Törle, Geißenklösterle and Sirgenstein, jewellery from Wildscheuer and Lommersum, is presented. I will also address the advanced technology people used to work ivory. This includes questions about where people worked and how working the ivory in the different cave sites was organized during the Aurignacian. Another question I will discuss is the value ivory possessed in Aurignacian society.

The high quantity and quality of personal ornaments is notable. Ornaments are a social marker and an expression of one’s own identity as well as group identity. People beautify themselves with personal ornaments as signatures of identity in the Aurignacian – the case of the Swabian Jura and western Germany

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Figure 1. The Eastern Swabian Jura with the Cave sites 1) Hohle Fels 2) Sirgenstein 3) Geißenklösterle 4) Vogelherd 5) Hohlenstein-Stadel 6) Bockstein-Törle. Map: M. Zeidi.

Figure 2. Hohle Fels, special finds made of ivory 1) part of base of a solid point 2) half product of a single perforated bead, made of a broken point 3) flake, used a chisel 4) triangular flake. Photos: H. Jensen, Drawing: after Wolf in press.
ornaments; adornment highlights one’s position and highlights social ranking (Hahn, 1992; Haidle, 2003). Jewellery is primarily used to increase one’s appeal or status within a society or group, and it represents a visible status. On the one hand, jewellery is linked to the fascination of the material from which it was produced, whilst on the other hand, it fulfils formal aspects. In general, personal ornaments are primarily a means of communication (Haidle, 2003; Wolf, 2015).

In the present context, the meaning of jewellery is symbolic (as described by Vanhaeren and d’Errico, 2006, for example). The question was to understand what evidence we could gather about the identity of the Aurignacian community with the help of the outstanding personal ornaments of the Swabian Aurignacian.

Material

To obtain mammoth ivory, people during the Aurignacian either hunted mammoths or collected the tusks of perished animals. So far, the evidence for the Swabian Jura points more to the systematic collection of tusks rather than hunting (Niven, 2006; Wolf, 2015, Figure 2). There are different methods for breaking down a tusk to create ivory objects. Manufacturers could 1) etch a notch around the circumference of the tusk and then snap it, 2) split it length-wise into two halves or 3) smash it using direct percussion (Khlopachev and Girya, 2010). These methods could also be used together. After the initial break down, the groove and splinter technique would be used to extract raw forms in the shape of long and slender rods. The material would also be chipped in order to get flakes. After the initial blank extraction, the unfinished objects would have been chopped, scraped, ground and smoothed until the intended size and shape were obtained. The whole production sequence, from acquiring the material to discarding objects was explained several times (Semenov, 1957; Christensen, 1999; Liolios, 1999; Wolf, 2015). All the steps of the production sequence, except for the acquiring of the ivory, are documented in the assemblages of the Hohle Fels, Geißenklösterle and Vogelherd Caves.

In this context, it is important to define the term ‘bead’ and the different stages of bead production. A bead or a pendant is a small object, which people could apply to a substratum (for instance, clothes, bags, accessories and so on). The bead possesses a suspension that could be an eyelet or a grooving. People could have worn these pieces as necklaces, for example. There is no absolute need to sew a bead on a substratum; it could also have been used separately and in different varieties of patterns.

A differentiation of six different stages of bead and pendant production took place (Figure 3):

- Raw form: a discernible base form for a special object is recognizable.
- Half product: the special form is nearly complete.
- Finished product: the special object is finalized, but it does not show traces of usage.
- Used product: the special form is finalized and shows clear traces of usage.
- Damaged product: the half or finished or used product is damaged and broken.
- Recycled product: the broken or unintentional product was fashioned for a different usage.

Research history and dates

It is important to present the dates of the different Aurignacian layers in the different cave sites in order to compare the appearance of the finds within one cultural complex.

The first excavations in the Hohle Fels Cave near Schelklingen date back to 1870/71. The University of Tübingen has conducted yearly excavations at this site since 1977 (for example, Blumentritt and Hahn, 1991; Conard, 2002). The Aurignacian layers, IId/e to Vb provided dates between 29,500 and 35,700 uncal BP (Conard and Bolus, 2003, 2006, 2008; Conard, 2009). This corresponds to a period between 34,000 and 40,500 years cal. BP (Danzeglocke et al., 2012).
In 1906 Robert R. Schmidt excavated Sirgenstein Cave, which lies in the valley between the Hohle Fels Cave and Geißenklösterle on the other site of the Ach River (Schmidt, 1912). The Aurignacian layers IV–VI provide dates between 26,700 and 30,400 years BP (Conard and Bolus, 2003, 2008).

Joachim Hahn excavated Geißenklösterle Cave between 1974 and 1991 (Hahn, 1988). Later, in 2001 and 2002, Nicholas Conard excavated the cave until the excavation team reached the bedrock (Conard and Malina, 2002, 2003). The Aurignacian horizons II and III date between 29,300 and 39,000 uncal BP (Richter et al., 2000; Conard and Bolus, 2003, 2008; Higham et al., 2012). This corresponds to a period between 34,000 and 42,500 years cal BP (Danzeglocke et al., 2012).

Gustav Riek excavated Vogelherd Cave in 1931. Riek had the cave completely emptied of sediments and dumped the backdirt on the hill surrounding the cave (Riek, 1934). The layers richest in finds were the Aurignacian layers IV and V, dating between 30,000 and 36,000 years BP (Conard and Bolus, 2003, 2008). Between 2005 and 2012 the Department of Prehistory and Quaternary Ecology at the University of Tübingen excavated the backdirt sediments of Riek’s excavation. Many finds were overseen in 1931 because of the relatively rough excavation methods. The new excavations were quite successful in finding an abundance of new artefacts, especially small artefacts, due to the careful excavation methods used in the re-excavations (for example, Conard et al., 2007, 2010). However, these finds have no stratigraphic context and must be studied in tandem with artefacts from sites with well-documented stratigraphies.

Hohlenstein-Stadel, known for its famous Lion Man (Hahn, 1971; Schmid et al., 1989; Reinhardt and Wehrberger, 2005), contains Aurignacian layers dated to between 31,500 and 35,000 years BP Between 2009 and 2013 Joachim Kind led excavations inside the Stadel Cave (Kind and Beutelspacher, 2010; Beutelspacher et al., 2011; Beutelspacher and Kind, 2012).

Excavations at Bockstein Cave occurred on and off throughout the late nineteenth century and until the first half of the twentieth century (Schmidt, 1912; Wetzel and Bosinski, 1969). The cave and its entrance, the Bockstein-Törle, have yielded Aurignacian and Gravettian artefacts, but the layers have proven difficult to distinguish from one another (Wetzel, 1954; Krönneck, 2012). The dates for the archaeological horizons VI to VII range between 20,400 and 46,400 BP (Conard and Bolus, 2003, 2008). The young dates are unlikely to be correct, however, while the old dates of layer VII indicate a Late Middle Palaeolithic. Conard and Bolus discuss this in detail in their 2003 publication. Layer VI has provided a date of 31,500 BP, which indicates an Aurignacian age, while no dates are available for layers IV and V.

<table>
<thead>
<tr>
<th>Hohle Fels Layer</th>
<th>Date BP (uncal)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IId/IIe</td>
<td>29,600-30,600</td>
</tr>
<tr>
<td>III</td>
<td>29,700-31,100</td>
</tr>
<tr>
<td>IV</td>
<td>30,000-33,000</td>
</tr>
<tr>
<td>Va</td>
<td>31,800-34,600</td>
</tr>
<tr>
<td>Vb</td>
<td>31,300-35,700</td>
</tr>
<tr>
<td>Geißenklösterle Layer</td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>33,000-35,700</td>
</tr>
<tr>
<td>III</td>
<td>34,000-39,000</td>
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<tr>
<td>Vogelherd Layer</td>
<td></td>
</tr>
<tr>
<td>IV</td>
<td>30,700-34,100</td>
</tr>
<tr>
<td>V</td>
<td>30,200-35,800</td>
</tr>
<tr>
<td>Hohlenstein-Stadel Layer</td>
<td></td>
</tr>
<tr>
<td>20 M, 6. spit (D)</td>
<td>31,750-35,200</td>
</tr>
<tr>
<td>Bockstein-Törle Layer</td>
<td></td>
</tr>
<tr>
<td>VI</td>
<td>31,5</td>
</tr>
</tbody>
</table>

Two selected $^{14}$C dates (rounded youngest and oldest date; Bockstein-Törle only one date available) for the different layers in the Swabian cave sites (after Conard and Bolus, 2003, 2008).

A first excavation took place in the Wildscheuer Cave in 1874 and following excavations occurring on and off throughout the first half of the twentieth century and in 1953 (Kutsch and Mandera, 1954; Hahn, 1977; Terberger, 1993; Bosinski, 2008). The richest layer, ‘Wildscheuer III’, dates to the Aurignacian and was coloured red. The relevant dates lie between 30,050 and 34,200 years BP (Pettitt et al., 1998).

Joachim Hahn excavated the open air site of Lommersum from 1969 to 1974. The dates range between 29,200 and 33,420 years BP (Hahn, 1977; Bosinski, 2008).
Ivory inventory at Hohle Fels

More than 10,000 ivory pieces have been excavated in the Aurignacian layers Id to Vb so far (Wolf, 2015). Most of the pieces derive from layer IV, which is the thickest Aurignacian archaeological-horizon aside from AH Va. The ivory finds range from smashed pieces to hundreds of small splinters and shavings. The splinters are the result of the intensive scraping and ivory working inside the cave. In all excavated square metres ivory remains or ivory products were found (Figure – plot 4). The numerous rods are the raw forms for many other finalized products like points and they also prove the working of ivory at the site. Typical are flakes, which are the results of controlled knapping (Heckel and Wolf, 2014). The flakes were often also used as tools, as chisels or wedges, for example. The Aurignacian people also fabricated massive chisels and percussors of ivory debris. Furthermore, points with massive bases have been found in all layers, except in the oldest layer Vb. One broken raw form for a flute is known and many pieces show traces of aesthetical expressions, like cross patterns or personal markings. Altogether, the team has so far found 217 beads (Figure – diagram 5). The pieces vary in size and shape, but the double perforated bead dominates the adornment inventory with 124 pieces: 18 raw forms, 13 half products, 22 finished products, 46 used products and 25 damaged pieces were excavated. The overwhelming majority of double perforated beads (98 pieces) derive from the layers IV and Va/Vab. The average length of complete pieces is 7.4 mm, the average width is 4.5 mm and the average thickness is 3.6 mm. Other types are the single perforated bead, the double perforated bead with wedge-shaped appendix, the non-perforated, constricted bead, the Swabian basket-shaped bead, the ring-shaped bead, the eight-shaped bead and the discoid bead. In addition, some unique forms exist, which find no similar pieces in other Aurignacian regions. Bands are another interesting type of adornment made of ivory (Figure 6). These objects could have been sewn on clothes or worn in different ways (Didon, 1911; Peyrony, 1927, 1935; Castets, 2008). Such pieces come from the layers IIIb and Va. We also see trends in the fabrication and usage of the beads: during the younger Aurignacian phase (layers Id/IIb) people preferred the basket-shaped bead and the non-perforated, constricted bead, which are not known in the older horizons.

Adornment in the Ach Valley

In Geißenklösterle Cave, in total, eighteen pieces made of ivory were found in the younger Aurignacian layer II and the lower Aurignacian layer III (Hahn, 1988; Conard, 2003). These are three pendants deriving from AH III and fifteen pieces from AH II. In AH II two pieces are raw forms, two pieces are half products, one is a finished product, four are used products and two pieces are damaged. The average dimensions of the finished and used products of double perforated beads are 8.4 cm in length, 5.3 cm in width and 3.7 cm in thickness. Thus, on average, the pieces from Geißenklösterle are a little larger than the double perforated beads from the Hohle Fels. Furthermore, one single perforated bead exists. There are two fragments of narrow ivory bands as well as an ornate bar pendant with incised decoration.
At Sirgenstein, Schmidt discovered one double perforated bead during sorting, which probably came from the Aurignacian layer IV (Schmidt, 1912). One half is lacking and this piece is relatively big in comparison to the other double perforated beads known from the other cave sites.

**Ivory inventory at Vogelherd**

During excavations in 1931 excavators found large ivory pieces. In the southern entrance the team discovered a minimum of five segmented tusks (Figure 7). These pieces had a length of 50 cm each (Riek, 1934). In addition, the excavators found ten ivory plaques placed on top of each other, which was an ivory stock (Niven, 2006). In the south-western entrance a pile of bones was discovered as well as large tusk-fragments. Riek describes a working area for ivory in the south-western entrance; he recognized ivory dust on one stone and interpreted this as proof of grinding this material. The most famous finds are eleven small figurines, ten of which are made of ivory and each individually designed. They mostly depict Ice Age animals, but one anthropomorphic figurine exists (Riek, 1934; Floss, 2007). Interestingly, some of the figurines served as pendants, too (see in detail for example, Hahn, 1986). The nearly complete mammoth possesses perforations between its forelegs and its hind legs (Figure 8). In addition, the oval bone piece, which shows a mammoth relief, displays a broken perforation at one end. This is proof that this find formerly was a pendant, too, and reflects the mobile character of the pieces: they are ‘mobile objects in a mobile society’ (Floss, 2007, 308).

Riek did no water screening and sorting during his excavation and for this reason, did not find any splinters indicating ivory working on the site. In 1931 Riek did not discover any beads made of ivory. Concerning adornments, he mentions only one pierced cervid canine and one pierced brown bear canine. One ivory object, which is drawn-in at the top, could be interpreted as jewellery (Riek, 1934).

During the excavations of Riek’s backdirt and the sorting between 2005 and 2012, 345 beads in all stages of production were found (Figure 9). At present, about two thirds of the sediments from the excavations have been water screened and sorted, so future work at Vogelherd will produce additional finds. Most of the beads have forms also known in the caves of the Ach
Valley. It is for this reason we are certain to date them to the Aurignacian. There are 219 double perforated beads and 4 double perforated beads with wedge-shaped appendix, 43 beads, 35 pendants, 34 single perforated beads, four Swabian basket-shaped beads, 2 complete cone-shaped beads, a broken eight-shaped bead, a fragment of a non-perforated, constricted bead and 3 pieces which clearly belong to jewellery, but their exact allocation cannot be resolved. The double-perforated beads are divided into 23 raw forms, 3 half products, 16 finished products, 73 used products and 104 damaged pieces. The average length of all the pieces perfectly preserved is 8.7 mm, the width is 5.5 mm and the thickness is 3.6 mm. All of these beads are part of one type, namely the double perforated bead, but each piece has very individual characteristics. This suggests that the pieces were made by different people. The narrowest width of the double perforated bead is 3.5 mm. The width of this bead type can be up to 11 mm. The width of about 80% of the 364 rod fragments (293) is ranked in this area. The conclusion is that the rod fragments were the main raw form for the serial production of beads.

The beads from Vogelherd Cave come exclusively from the backdirt at the south-western entrance of the cave. We assume that the sediments were dumped near the respective excavation area during the excavation in 1931. Therefore, one can expect that Aurignacian people sat and worked in the south-western entrance of the cave while stock was stored in the area of the southern entrance. The pieces in all stages of the manufacturing process show that these objects were produced locally at the site. The large amount of other finds speaks for an intensive use of the cave. The jewellery items ended up together with the other objects in the everyday waste.

Adornment in the Lone Valley

Hohlenstein-Stadel and Bockstein-Törle, though not as rich as Vogelherd, also provided few pieces of adornment.

During the 1939 excavation in the Hohlenstein-Stadel two extraordinary ivory beads and six pierced fox-canines were excavated together with the Lion Man (Hahn, 1977; Reinhardt and Wehrberger, 2005; Wolf, 2015). The first bead was a huge, polished basket-shaped form with two broken eyelets at both sides. The second piece was a nearly globular bead, but in this case the
eyelet is not preserved. The recent 2010 excavation yielded nine pierced animal teeth as well as another globular pendant. Neither ivory bead forms so far show any similarities with other forms of the Aurignacian sites.

In 1954 Wetzel found five pieces of jewellery at the former entrance of the Bockstein Cave, the so-called Törle. One was one half of an oval ivory bead, which was broken in length and one oval raw form of a bead made of ivory. In addition, Wetzel discovered one notched ring, one basket-shaped bead and one broken half-product of a basket-shaped bead made of clay shale (Figure 10).

Adornment in Wildscheuer

Three beads were discovered from this site (Figure 11, 1-3). One piece was discovered in 1874 and the other pieces were found by Kutsch in 1953. The site is rich in ivory finds like smashed pieces, massive points or decorated items. Unfortunately no washing and sorting took place during the old excavations and this might be the reason why only a small number of personal ornaments was found (see tooth pendants and others in Terberger, 1993). The first, fully conserved pendant was carved of clay shale and shows the identical form and the same cross section like the basket-shape bead of the Bockstein-Törle. Additionally, the same raw material was used, which was not common during the Aurignacian. The other two pieces were probably carved of nephrite. One is elongated and cone-shaped, while the other one is more rounded.

Adornment in Lommersum

During excavations at Lommersum a raw form of an ivory bead and two ivory beads were discovered. The blank is broken and looks exactly like the raw form from the Bockstein Törle. The first of the two beads is broken and the perforation as well. It resembles a deer canine. The second bead has a broken eyelet and a cylindrical shape, of which the ends are rounded (Figure 11, 4-6). This piece shows most similarities with the cone-shaped pendant of Geißenklösterle (AH III).

Discussion

Ivory working in general, as well as the numerous personal ornaments of the Swabian Aurignacian, testifies to the enormous creativity of the ancient carvers. The huge variety and diversity of forms show the individual purposes of these fascinating finds. Recurrent forms in which these inventories occur in attest to traditions of specific shapes and related fashions.

The whole production sequence is documented for the Hohle Fels and Vogelherd ivory inventory. At Hohle Fels Cave ivory working took place inside the cave. From the very beginning of the Aurignacian to its end, personal ornaments occur, many pieces showing unique forms. At Vogelherd Cave the storage area was apparently in the southern entrance, while the working area was located in the south-western entrance. Many ivory rods and numerous beads show a production series here. The large amount of other finds like thousands of stone artefacts and bone fragments from prey show an intensive use of the cave. Additionally, the adornments from Geißenklösterle and Hohle Fels were excavated along with many other objects. The same can be assumed for the jewellery from the Bockstein-Törle. In principle, ivory possessed enormous value and it was the preferred organic material for tools, personal ornaments and artworks compared with bone and antler (Riek, 1934; Hahn, 1986; Wolf, 2015).

The unification of jewellery for long periods of time indicates an identification of groups with this particular form. This testifies to a stylistic tradition and traditional craftsmanship (see also Wiessner, 1983). Jewellery, such as stone tool...
inventories, was widely used in the European Aurignacian and for this reason, it is comparable. Based on this, there are attempts to define ethno-cultural groups (Vanhaeren and d’Errico, 2006). The richness and variety of jewellery from Hohle Fels and Vogelherd attest to the high intellectual and manual skills of the Aurignacian people. The jewellery is made partly in series, but each piece was worked individually. Thus, the objects reflect the work of an individual. The occurrence of identical forms, like the double perforated bead, proves that, for thousands of years, people in the Ach and the Lone Valleys preferred the same kind of jewellery. This is true at least for the stratified pieces from Hohle Fels. Since this form of jewellery can only be found in the Swabian Jura and the beads are present in large numbers in this region, we assume that they show a specific tradition and/or group membership. Perhaps the area of the two valleys was frequented by people who used the caves as alternate stations in both valleys. It is also conceivable that several small groups inhabited the caves in the Ach and in the Lone Valleys at the same time, and they joined the same material culture. In this case, these people knew each other and exchanged ideas and objects. They had the same lifestyle and beliefs and thereby maintained a common culture in the valleys of the Swabian Jura. However, the temporal depth cannot be detected to confirm one scenario; it is possible that people visited only one valley temporarily.

The pieces from the backdirt at Vogelherd could also have derived from one visit or a few visits. However, the abundance of the pieces found in the backdirt speaks against it. This argues for an accumulation over a long period of time. However, the adornment of the Stadel Cave lay isolated with the Lion Man in a small rear chamber of the cave. The apparent deposition of the unique Lion Man, together with personal ornaments, suggests that this was a place that was visited on special occasions. These finds thus provide presumptive evidence of the religious ideas of the first modern humans in south-west Germany.

The people of the Swabian Aurignacian stand out from different groups in the Aurignacian European regions. This can be seen, for example, from the fact that the preferred, double perforated bead was exclusively used for thousands of years in the Swabian Jura. However, it did not occur in any other region of Europe, even if contacts between the regions were proven by the exchange of raw material, for example (see for example, Burkert and Floss, 2005). Nevertheless, several similarities of other bead types exist. In Germany the adornment of two sites, Wildscheuer in Hess and Lommersum near Euskirchen, show similarities especially with the personal ornaments of the Bockstein-Törle (Kutsch and Mandera, 1954; Terberger, 1993; Bosinski, 2008; Wolf et al., 2013). Few personal ornaments at Belgian sites show similarities with pieces of the Swabian Aurignacian like a half preserved basket-shaped bead from Spy (Otte, 1979). However, in general, the numerous personal ornaments from the Belgian sites possess their own special character. The same is true for the French basket-shaped beads of the Dordogne region. This form is limited to south-western France (White, 2007). Interestingly, more than fifty bands are known so far from this region. Most are made of ivory, but some were also made from bone and antler (Castets, 2008). This special form corresponds only to the ivory bands of the Swabian Aurignacian. There is no explanation for this phenomenon yet. The most logical assumption would be that people moved and passed on their ideas to others. In this case, the counterpart would establish this convincing idea. On the other hand, the same idea could be developed at the same time at two different locations.

The data from the layer III of Geißenklösterle reveal that anatomically modern humans were already in the Ach Valley at a period well before 40,000 years cal. BP (for example, Higham et al., 2012). The ivory industries of the northern Wildscheuer Cave, Lommersum and the Belgian cave sites are younger (Otte, 1979; Pettitt et al., 1998; Semal et al., 2005). This also confirms the Danube Corridor Hypothesis, which means that this river served as a key route to migrate quickly into the interior of Europe (Conard et al., 1999). During the Proto-Aurignacian in France jewellery also exists, but the personal ornaments are not made of ivory during this epoch (for example, Normand, 2007; White, 2007). At the current state of research, the Swabian Jura yields the first ivory industry of the Aurignacian (Wolf, 2015). In the recent phase of the Swabian Aurignacian, several sites with similar ivory assemblages are present contemporaneously. The numerous beads and the adornment in general show few correlations with other forms in other Aurignacian regions in Europe. This supports the idea that the people formed their own identity in the Ach and the Lone Valleys. This idea of a common group membership was expressed particularly by the double perforated bead. People manufactured and used it over centuries, even a time-span of millennia.

Bibliography


The Swabian Jura


Different!
European Upper Palaeolithic art:
a cultural heritage of Outstanding Universal Value

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Introduction

On the basis of certain aesthetical expressions in the preceding Middle Palaeolithic period, the first pan-European complex of Ice Age Art emerges in the Early Upper Palaeolithic (Aurignacian). To this period date the fabulous ivory figurines of the Swabian Jura in southern Germany (Riek, 1934; Hahn, 1986; Conard, 2003; Floss, 2007) (Figure 3), parts of the outstanding paintings from Grotte Chauvet-Pont d’Arc in France (Chauvet et al., 1995; Clottes, 2001) (Figure 4), and the archaic pictograms and engravings of animals and sexual symbols in the Dordogne (Delluc and Delluc, 1991) (Figures 5, 6). We can add here some less known items, that is to say, the red paintings from Grotta di Fumane in northern Italy (Broglio et al., 2007) or the newly discovered cave art from Peștera Colibaia in Romania (Clottes et al., 2011) (Figure 7). The subsequent Gravettian period is marked by an enhancement of parietal art and the dispersal of sculptures, in other words, the famous female representations, commonly called Venus statuettes (Figure 8). Newly invented materials come along, that is to say, burnt clay. The following Solutrean is characterized by monumental sculptures of animals and humans forming the backside of rock shelters, particularly in the western parts of France (Charente and the Dordogne) (Figure 11). Finally, the Magdalenian represents to some extent the culmination point of Ice Age Art. This is illustrated by amazing examples of parietal art, for instance, Altamira (Beltrán, 1998) and Niaux (Clottes, 1995) (Figures 17, 18), and by the proliferation of sculptures and engravings on bone, antler, ivory and stone (Figure 14). Palaeolithic art concludes with the mostly non-figurative and geometrical Azilian art on painted and engraved pebbles (Couraud, 1995) (Figure 19). As such, 30,000 years of Palaeolithic art find their end, highlighting one of the most fascinating adventures of human history.

The geographical distribution of European cave and rock art (Figure 1) is partly influenced by cultural and partly by geological criteria, and the intensity of research activities. Cave and rock art show their highest density in the Franco-Cantabrian region in south-western France and northern Spain: starting in the Charente, Dordogne and Quercy in the north, passing by the Pyrenees and ending in the Basque country, Cantabria and Asturias. Other centres of parietal art are to be found in Portugal, Andalusia, central Spain and eastern France (Ardèche gorge) (Combier, 1967; Combier, 1995). Peripheral zones can be observed in Burgundy (Arcy) (Baffier and Girard, 1998), northern France (Mayenne-Sciences) (Bouillon, 1984; Pigeaud, 2004), England (Creswell Crags) (Bahn et al., 2003) and probably in southern Germany (Floss...
and Conard, 2001; Bosinski, 2011), and in Bosnia, Italy and Russia (Ščelinskij and Širokow, 1999) where impressive late Palaeolithic paintings (Leonardi, 1988) occur. Recently, Palaeolithic cave art was discovered in Romania (Peștera Coliboia) (Clottes et al., 2011). A very interesting new result concerns discoveries of rock art in Egypt which is, in form and content,
very similar to late Upper Palaeolithic depictions of Europe (Huyge et al., 2011). In terms of mobile art, distribution patterns are less influenced by geological factors (Figure 2) and other important centres come into focus, such as the Swabian Jura (Conard et al., 2009), Belgium (Lejeune, 2007), the lower Austria (Neugebauer-Maresch, 2007), Moravia (Klima, 1991; Valoch, 1996; Valoch and Lázničková-Galetová, 2009) or the Russian plains (Abramova, 1995).

Figure 4. Parietal art from Grotte Chauvet-Pont d’Arc. Courtesy of Jean-Michel Geneste.
The Swabian Jura

Aurignacian art

At about 40,000 BP, the arrival of anatomically modern humans marks a new era of European history (Floss and Rouquerol, 2007). Following some insignificant middle Palaeolithic precursors, this new period called the Upper Palaeolithic is characterized by the first appearance of figurative art and musical instruments. Its first pan-European cultural phenomenon, dating from about 40,000 to 30,000 BP, is the Aurignacian. Related to art production, there have been two opposing areas with very different types of art for a long time: on the one hand, south-western France with its archaic engravings and paintings on limestone blocks (Delluc and Delluc, 1991) (Figures 5, 6) and on the other hand, south-west Germany with its tiny but perfectly shaped ivory figurines (Floss, 2000; Conard, 2003) (Figure 3). The recent discovery (Chauvet et al., 1995) and the astonishingly early datings of Grotte Chauvet-Pont d’Arc (Valladas et al., 2004) (Figure 4) balanced this putative contrast. The new awareness of a generalized presence of multifaceted Aurignacian art all over the continent started a withdrawal from outdated beliefs that had been largely influenced by structuralist ideas (Leroi-Gourhan, 1965) and by which art production was supposed to be bound by a strict and linear evolution in which only simple and archaic creations ‘had the right’ to be Aurignacian.

This contribution seeks to summarize current thinking on Aurignacian art and takes into account early discoveries before Chauvet, which were suspected of being old although the predominant scholarly opinion at the time did not allow for such an assessment.

To date, the Swabian Jura is by far the most important region in Europe yielding Aurignacian mobile art. The newest dates from Geißenklösterle (Higham et al., 2012) point to the beginnings of the Swabian Aurignacian to even before traditional assessments, with ages dating as far back as 42,000 calendar years ago. Approximately 50 figurines have been discovered since the 1930s in four caves: the Vogelherd and the Hohlenstein-Stadel in the Lone Valley, and the Geißenklösterle and the Hohle Fels in the Ach Valley (Floss, 2007; Floss and Conard, 2010; Conard and Floss, 2013). These include tiny fragments, made mostly of ivory, accompanied by several musical instruments (Conard et al., 2009) and a number of different types of personal ornaments (Wolf, 2013). Recent excavations at Hohle Fels Cave confirm that these features appear since the oldest Aurignacian layers of these caves. The ivory figurines primarily include depictions of large mammals, such as lions, mammoths, horses, bison and bears (Figure 3). Recently a figurine without a head, originally found by Gustav Riek in 1931, was refitted with its head after Nicholas J. Conard identified it in Riek’s excavation of backdirt (Figure 3. 5). Figurines of small animals, such as a water bird and a fish, have been discovered too. The spectrum is completed by the presence of strange human beings or therianthropes that combine features of humans and animals (Figure 3. 7). Most of the figurines are quite small and do not exceed a length of several centimetres, except for the Lion Man from Hohlenstein-Stadel (Wehrberger, 1994) which, after having been recently newly refitted, is now even bigger than before with a size of more than 30 cm (Ulmer Museum, 2013).

The majority of the figurines are carved from ivory, one in bone and one in sandstone. They represent mostly full sculptures, but some are reliefs. The figurines are covered by different types of signs, such as dots, hooks, wavy lines and crosses (see Figure 3. 2). Many of the sculptures show quite individual characteristics as if they reflect personal traits of their artists or owners. Some of the figurines could have been suspended as pendants (Figure 3. 2, 6). The surface is mostly very smooth and polished. Concerning the contextual circumstances of the figurines in their respective archaeological layers, we have to distinguish different situations. Whereas in Geißenklösterle Cave, the objects of mobile art were found in the midst of ordinary faunal remains and flint waste (Hahn, 1986; 1988), some of the Vogelherd figurines were found in a central position of the cave where three galleries meet (Riek, 1934). The ivory fragments of the Lion Man had been found in a niche at the end of Stadel Cave where ordinary findings were scarce. Recently, a headless female figurine with expressive sexual features was recovered from basal Aurignacian deposits at Hohle Fels Cave in the Ach Valley (Conard, 2009). It has a ring on top of its shoulders indicating that it could have been suspended. The object was found very close to another outstanding object; a flute made from a vulture bone. This observation could support the idea that these artefacts had been involved in a common, possibly ritual purpose. To date, the Swabian Aurignacian includes fragments of eight flutes altogether. Alongside the vulture flute, the most spectacular and nearly complete artefacts of this type originate from Geißenklösterle Cave (Conard et al., 2009). There are two flutes, one made of a wing bone of a swan and the other carved in ivory. Taking into account the radiocarbon measurements (Higham et al., 2012) and the stratigraphical record, the Swabian Jura forms are to date one of the oldest, if not even the oldest, assemblage of figurative art and musical instruments in the world.

The second European centre with Aurignacian art is located in the Dordogne, south-western France. This area around the village of Les Eyzies-de-Tayac offers an immense number of caves and rock shelters housing important Palaeolithic sites. The oldest complex of Ice Age Art there is dated to the Aurignacian period (Delluc and Delluc, 1991). It comprises at least seven rock shelters which have yielded roughly engraved and painted prototypical limestone blocks, forming the so-called archaic art of the Périgord (style I after A. Leroi-Gourhan): La Ferrassie, Abri Blanchard, Abri Castanet, Abri Cellier, Abri Pataud, Abri Belcayre and Fongal (Figures 5, 6). The latter is less well known than the others. Located at Peyzac-le-Moustier, it was excavated by Otto Hauser and is currently under investigation by Raphaëlle Bourrillon and Randall White. At Abri Pataud, beside the
prevailing Gravettian art, some painted limestone rock fragments have been found in the context of Aurignacian deposits (Chiotti et al., 2007) (Figure 6.1).

It is probable that in Aurignacian times some of the quoted rock shelters were completely decorated. Others have only single decorated blocks. It is also possible that some caves were already decorated at that time. All in all, we consider the original vibrancy and the role of Aurignacian art in the Dordogne to have been much more significant than their appearance nowadays suggests, for they have been heavily affected by erosion, premature excavations and the dispersal of decorated artefacts into numerous collections. This vision of an ‘artified’ Aurignacian landscape, in the centre of the Dordogne, in our view underlines the artistic take-off which took place at that time; it replies to some recent approaches which tend to minimize the significance of Aurignacian art (Combier and Jouve, 2012). Furthermore, new series of radiocarbon dates confirm its old age. In Castanet, recently discovered paintings and engravings belong to deposits dated to at least 37,000 years BP (Mensan et al., 2012).

The main topics – wherefore the Dordogne Aurignacian art is widely recognized - are signs and sexual symbols (vulvae) (Figures 5. 1, 2, 4). But there are also figurative depictions of animals. These depictions can be simple, such as those from Abri Belcaire, Abri Cellier, Abri Castanet and Fongal (Figures 5. 3, 5, 6; 6. 5) or more elaborate, as the well-known two-coloured depiction of the lower part of the body of a herbivore originating from Abri Blanchard (Figure 6. 3) shows. At the same site, Randall White recently found a fantastic engraving of a bovid with rows of marks on its body. Abri Blanchard is also the place of origin of an important object of mobile art: a sculpture of a phallus, made from a bone of a bovid and found in the context of the old excavations, near to an Aurignacian hearth (Delluc and Delluc, 1979b).

In south-western France, alongside Aurignacian rock shelters, genuine Aurignacian decorated caves have increasingly come into focus since Grotte Chauvet has become known. Pair-non-Pair, Gironde, excavated by François Daleau in the nineteenth century, includes deep engravings of mammals, such as horses (Figure 6. 2), particularly the so-called Agnus dei, a long necked horse looking back (Figure 6. 4). Furthermore, engravings of ibexes and mammoths are recorded (Delluc and Delluc, 1997). A. Leroi-Gourhan (1965) assessed this assemblage and categorized it to the second style of his four style subdivision of Palaeolithic art. Nevertheless, both stylistic arguments, for instance, a comparison of the horse depictions with those from the Swabian Jura and arguments related to stratigraphy which link the Pair-non-Pair engravings clearly with the Aurignacian occupation of the site (Delluc and Delluc, 2010), argue for an early Upper Palaeolithic dating of these depictions.

La Cavaille is a somewhat less known cave, located in the community of Couze-et-Saint-Front, the Dordogne, close to the eponymous site of La Gravette. La Cavaille has yielded some simple engravings (horse, bovid, mammoths, signs) (Delluc and Delluc, 1988) that remind us very much those of Les Bernous (Delluc and Delluc, 1979a) and Pair-non-Pair (Delluc and Delluc, 1997). Immediately next to the cave, a rock shelter yields Aurignacian remains.

Les Bernous is a cave north of Bourdeilles, the Dordogne. It has been known since the beginning of the twentieth century and was studied by Denis Peyrony and later by Brigitte and Gilles Delluc (1979a). It is currently under investigation directed by Stéphane Petrognani. The artistic oeuvre comprises some engravings; the most noted is that of a mammoth (Figure 6. 6). The archaic depictions remind us very much those of Pair-non-Pair. The only Upper Palaeolithic artefacts discovered in the cave, attesting a short occupation, date to the Aurignacian period.

La Croze à Gontran is a small cave in Les Eyzies where there are fine engravings of mammoths, horses, ibexes and bovids. Again, the decoration is quite simple and the only lithic industry found in the cave had been described by Henri Breuil as Aurignacian (Delluc and Delluc, 2010).

Moving from Dordogne to the Quercy, a very important region of Palaeolithic art (Lorblanchet, 2010), we find that art production also started there in the early Upper Palaeolithic. Michel Lorblanchet has made it seem probable that some pictograms of Les Fieux Cave (Lot) belong to an Aurignacian stage of decoration (Lorblanchet, 2007) (Figure 7. 3). He bases his arguments for this on the technical congruencies with the Aurignacian pictograms around Les Eyzies and the typical Aurignacian lithic artefacts discovered near to the wall panels.

Grotte Aldène (Hérault) is another striking example indicating a dispersal of Aurignacian art nearly all over the area covered by present-day France. Dominique Sacchi (2007) has argued, by means of radiocarbon dating and stylistic comparisons with Grotte Chauvet, that it is more than probable that part of these engravings (lions, rhino, and so on) belong to the early Upper Palaeolithic period (Figure 7. 1).

Moving now up the Rhône Valley to the north, La Baume-Latrone, Gard, is a deep cave with scary and strange paintings of mammoths, felids and macaroni lines (Drouot, 1984). The unique style of the depictions (Figures 7. 5, 6) and the absence of archaeological remains made it consequently difficult to conduct a chronological assessment, even if the rough and archaic style of the paintings earlier suggested a very old dating at the beginning of the Upper Palaeolithic (Begouën, 1941). In 2009 things began to change when a scientific team with Marc Azéma and Bernard Gely began a new research programme. Since the discovery of Grotte Chauvet, a very similar choice of the depicted topics (mammoths, horses, felids, bundled signs) and some technical analogies (finger scraping and so forth) have been recognized in La Baume-Latrone and have raised (or confirmed)
Figure 7. Aurignacian cave art in Europe, 1) Engraving of a lion and a circular sign, grotte Aldène (Hérault, France), from Dominique Sacchi, in: Harald Floss and Nathalie Rouquerol (ed.), Les chemins de l’art aurignacien en Europe, p. 424, modified; 2) Red painting of an anthropomorphic being, Grotta di Fumane (Verona, Italy), photo R. Brandoli, courtesy of Alberto Broglio; 3) Drawing of the central block, Grotte des Fieux (Lot, France) from Michel Lorblanchet, in: Harald Floss and Nathalie Rouquerol (ed.), Les chemins de l’art aurignacien en Europe, p. 203; 4) Painted rhino, Callobaia cave (Romania) from Archaeology Magazine January/February 2012, courtesy of Bernard Gely; 5-6) Paintings of a mammoth and a felid, La Baume Latrone cave (Gard, France), courtesy of Bernard Gely and the Wendel Collection, Neanderthal Museum.
the idea that the latter could in fact be Aurignacian too. A piece of charcoal found near the decorated area in the cave has been recently dated to 32,740 ± 530 BP (Azéma et al., 2012), which is in our point of view, a striking confirmation that at least parts of the La Baume-Latrone paintings could actually be Aurignacian. In general, I do not support the hypothesis that Ice Age Art is the creation of children (Guthrie, 2005). Nevertheless, if children anywhere had been guided into scary deep caves, where they had to pass rituals as a dare and where they participated in making cave art as rites of passage, this would have taken place in La Baume Latrone.

The most outstanding archaeological discovery of the last two decades was, without a doubt, Grotte Chauvet at Vallon-Pont d’Arc, (Ardèche, France) (Chauvet et al., 1995; Clottes, 2001; Geneste, 2005) (Figure 4). It was discovered in 1994 by Jean-Marie Chauvet, Eliette Brunel and Christian Hillaire. The original entry was blocked and the cave was found in exactly the same conditions as Palaeolithic people left it in. Today the large, approximately 200 m cave is quite easy to access and is separated into several halls and lateral galleries. The cave is rich in archaeological remains: bones, skulls, tracks and lairs of cave bears, tracks of other animals, even humans, about 20 lithics and a bone point. Also found were artificially composed stone structures and a bear skull, deposited on a limestone block. The artistic creation is very rich, totally breathtaking and the most outstanding assemblage of Palaeolithic art the world has ever seen. The oeuvre can be grouped in two major parts, separated naturally by a bottleneck. The second assemblage is characterized by red paintings of animals (felids, mammoths, bears and rhinos) hand negatives (Figure 4. 8) and signs, some of them similar to birds, butterflies and insects (Figure 4. 1). A particular technique affects animal depictions that are composed of red dots, representing the imprints of the heels of the hand (Figure 4. 4). The second part of the cave is principally characterized by black paintings and engravings. Here mammoths, rhinos, felids, horses, bison and vulvae prevail. The depictions form breathtaking panels, full of movement, perspective and suspense. As it is often the case in Palaeolithic cave sanctuaries, the choreography of the decoration culminates even more when approaching the rear and the immediate end of the cave. In Chauvet the main oeuvre is a hybrid being, half woman, half bovid (Figure 4. 3) (Le Guillo, 2001), placed on an eye-catching calcite formation. In terms of technical skills, Chauvet confirms its outstanding position in demonstrating details that appear only rarely in Palaeolithic art: priming the painted areas by scraping, strengthening the outline of the depictions by scraping, smeared painting (estompe), compositions in perspective view, paintings with the heels of the hands and so forth.

One of the most remarkable results at Chauvet concerns the radiocarbon record (c.f. Valladas et al., 2004). The dating of black paintings in the second part of the cave clearly indicate an Aurignacian age between 33,000 and 29,000 BP. Smoke residues of torches and charcoals have been dated between 27,000 and 24,500 BP. They prove a second occupation phase of the cave in Gravettian times. At least at 21,500 BP the entry of the cave was blocked and therefore effectively locked geologically.

Going farther to the north, over the last few years, Burgundy in eastern France has gained more and more attention in terms of the emergence of early Upper Palaeolithic art and cultural modernity (Floss, 2004). In Grotte de la Verpillière I in Germolles, Saône-et-Loire, excavations under my direction have taken place since 2006. Inside and outside the cave it has been possible to establish stratigraphical observations covering the Middle to Upper Palaeolithic transition. Furthermore, a new cave called Verpillière II has been discovered. In the rear part of the cave I, engravings considered to need more focused studies have been detected. Not far from Germolles in La Grotte des Gorges at Amange (Jura) investigated by Serge David, very fine engravings could be detected on blocks and on the cave ceiling. A strange modified herbivore bone might represent the head of a bear. The radiocarbon record proves an early Upper Palaeolithic presence, beyond 30,000 BP.

By far the most spectacular assemblage in Burgundy, having yielded personal ornaments of parietal art, is the cave complex of Arcy-sur-Cure (Yonne) (Baffier and Girard, 1998). In Grotte du Renne, the Châtelperronian layers X to VIII show modern features, containing an evolved bone industry and objects of personal decoration. In two caves of the Arcy complex, Grande Grotte and Grotte du Cheval, important assemblages of cave art have been discovered. By far the most outstanding example is Grande Grotte where recent investigations, directed by Dominique Baffier, have been able to provide evidence, under a thin layer of calcite, of numerous black and red paintings, depicting mammoth (Figure 9. 5), deer, rhino, bear, ibex, horse, fish, bird and hand negatives. Fragments of bone charcoal originating from a spot near the paintings recently produced radiocarbon dates reaching nearly 29,000 BP.

Astonishingly, until now have not known examples of Aurignacian parietal art. A three-coloured limestone from Geißenklösterle Cave, Swabian Jura (Figure 21. 4), originally published by Joachim Hahn (1986, 1988), is an object of mobile art (Floss and Conard, 2001). Obviously, central Europe is an important region for Aurignacian mobile art. In addition to the Swabian Jura described above, at least two other central European sites enrich the spectrum of Aurignacian mobile art. The Belgian site of Trou Magrite (Lejeune, 2007) produced two art objects assessed to the Aurignacian: an anthropomorphic and hand negatives. Fragments of bone charcoal originating from a spot near the paintings recently produced radiocarbon dates reaching nearly 29,000 BP.
Upper Palaeolithic as well. This is the case, for instance, in Sungir (Floss, 2009a) and Kostenki 14 (Sinitsyn, 2003) where several ivory sculptures of stylized animals and humans have been recorded.

Close to the city of Verona, in northern Italy and south of the Alps, is the very important cave site of Fumane. Investigated under the direction of Alberto Broglio, it offers a fantastic stratigraphy with beautiful early Upper Palaeolithic settlement structures. The outstanding discoveries in the context of early Aurignacian deposits were at least six fragments and blocks of limestone painted with red colourant (Broglio et al., 2007). They represent enigmatic animals, symbols and particularly a bull headed creature (Figure 7. 2), which very much resembles the hybrid beings we meet at other Aurignacian sites like Grotte Chauvet and Hohlenstein-Stadel. The Fumane paintings can be dated by means of radiocarbon dating to about 34,000 to 32,000 BP.

In northern Spain, the situation is somewhat confusing and controversial statements have been published. Nevertheless, there is consensus that the beginnings of the graphical record date to the Aurignacian period (Barandiaran and Garcia Diez, 2007).

Finally, we want to stress a very important recent discovery in Romania. In the partly flooded cave of Peștera Coliboaia in Transylvania, located in the Bihor area, in the western Carpathian Mountains, paintings of animals such as rhino and so on (Figures 7, 4) were recorded that show striking stylistic similarities to depictions of Grotte Chauvet that have recently been dated to about 32,000 BP (Clottes et al., 2011).

All in all, at least thirty European cases, caves, rock shelters and open air sites yield early Upper Palaeolithic and, in particular, Aurignacian art. From the Iberian Peninsula in the west to Romania and the Russian plains in the east, from Belgium and northern France in the north, to Italy in the south Aurignacian art was present all over the European continent. If we take into account that only parts of the former reality and part of the archaeological heritage are preserved, it is evident that the production and use of mobile and parietal art were common features and socially or spiritually driven components of the early Upper Palaeolithic cultures and societies (Floss, 2009b).

Gravettian art

The Gravettian dates from about 30,000 to 22,000 BP (non-calibrated). It is the main cultural complex of the European Middle Upper Palaeolithic. Despite some local cultural features, which caused regional terminologies, for example, Périgordien supérieur in south-western France or Pavlovian in Moravia, and despite an internal chronological subdivision based on distinct stone and bone tools, the Gravettian shows astonishing pan-European unity. Relating to Palaeolithic art, the Gravettian is characterized by an enhancement of the iconographic record which had started in the previous Aurignacian. Whereas Aurignacian and early Upper Palaeolithic mobile art in general was known from the Swabian Jura, the Dordogne, Lower Austria, Belgium and Russia, the Gravettian shows a proliferation of these features. Particularly renowned are the so-called Venus figurines. These are obese female representations with accented sexual characteristics whose facial features and lower parts of the body are commonly under-represented or lacking (Figures 8. 1-2). There are also more gracile depictions, such as the famous Dame à la Capuche de Brassempouy (Figures 8. 3). These figurines disperse all over Europe from the Atlantic coast in the west to the Eurasian steppe in the east. They are made from different materials such as bone, ivory and several stone varieties, for instance, limestone, sandstone, calcite and steatite. Lower Austria and Moravia yield figurines of humans and animals made of burnt clay (Valoch, 1996). In a broader sense, they consequently represent the oldest examples of ceramics in the world. The most famous of these burnt clay objects is the so-called Venus of Dolní Vestonice (Valoch, 1996) whose entire face appears to be covered by a hood except for two slits that are interpreted as eyes. The Swabian Jura, which is of particular interest due to its numerous Aurignacian ivory figurines, is relatively poor in Gravettian art. The most significant items are a phallus-shaped retoucher made from a silt stone (Figure 8. 4) and a figuratively engraved antler pick, both originating from Hohle Fels Cave near Schelkingen.

Gravettian parietal art is particularly common in France (Jaubert and Feruglio, 2013). A clear centre is to be found in south-western France (Dordogne and Quercy) where some of the most impressive examples of Palaeolithic sanctuaries are situated: Pech-Merle (Lemozi, 1929; Lorblanchet, 2010) (Figure 9. 1), Cougnac (Méroc and Mazet, 1956) (Figure 10) and Cussac (Aujoulat et al., 2002). Some other rock shelters and small caves, dating to the same period, have just yielded isolated or few parietal items, for example, Abri Pataud, Laussel (Roussot, 2000) (Figures 9. 2-3), La Grèze and Abri Poisson. Impressive examples of Gravettian parietal art can be found in some peripheral regions of France too, for instance, in the Pyrenees (Gargas) (Foucher et al., 2007) or on the Mediterranean coast (Cosquer) (Clottes and Courtin, 1995). Gravettian cave art is characterized by deep or fine engravings, drawings and paintings. Parietal art is characterized by depictions of animals, humans and signs, but can be distinguished from other periods, particularly the Aurignacian, by a lower number of carnivores and signs. A very typical Gravettian sign is the so-called type Le Placard or signe aviforme (Clottes et al., 1990) (Figure 9. 6), which
The Swabian Jura can only be found in four French sites: Pech-Merle, Cougnac, Le Placard and Abri des Battuts, a less known rock shelter in the Tarn gorge. The Gravettian animal depictions are often generalized and abstain from very realistic details. Gravettian human...
representations are dominated by stylized depictions of women in profile, well-documented by the huge engravings of Cussac Cave and the femmes-bisons of Pech-Merle. Male representations are rare. They occur in the form of bodies that are pierced by spears, for example, in Cougnac (Figures 10. 1-3) and Pech-Merle. An outstanding feature is a natural stalagmite formation in Grande Grotte of Arcy-sur-Cure that has been only slightly modified by red dots and evokes the figure of a Gravettian Venus (c.f. Willendorf) (Figure 9. 4). Finally, a very typical topic of Gravettian art is represented by human hand negatives (Floss and Ostheider, 2013), as we find them in hundreds in Gargas Cave in the Pyrenees (Barrière, 1976). A specific observation of Gravettian caves concerns the co-occurrence of parietal art and burials, for instance, in Cussac (Dordogne).

Solutrean art

The Solutrean represents the best known European cultural complex dating to the period around the Last Glacial Maximum. It dates from about 22,000 to 17,000 BP. Solutrean lithic industries are characterized by small to enormous leaf points. The most famous site with Solutrean leaf points is the cache of Volgu (Saône-et-Loire, France), discovered in the nineteenth century. Solutrean art is much less frequent than that of the previous Gravettian and the forthcoming Magdalenian. This observation is partly caused by the harsh climatic conditions at that time, but is also due to the fact that the Solutrean is, on a prehistoric
scale, a quite short period. Furthermore, it is only present in some parts of Europe, the Iberian Peninsula and the western and central parts of France. Solutrean art is characterized by a threefold archaeological record: 1) monumental rock sculptures, 2) mobile art (multi-engraved slabs and tiny sculptures) and 3) deep parietal engravings and paintings in the Ardèche gorge in eastern France.

Figure 11. Solutrean rock and parietal art, 1) Tête-du-Lion (Ardèche, France), courtesy of Jean Combier; 2) Mammoth panel Chabot cave (Ardèche, France), courtesy of Jean Combier; 3) Horse panel, Grotte Cosquer (Mediterranean sea, southern France near Cassis), from Jean Clottes and Jean Courtin, La Grotte Cosquer, 1994; 4) Fourneau-du-Diable (Dordogne, France), M.N.P., photo Ph. Jugie.
Le Roc-de-Sers, Charente, (Delporte, 1984; Tymula, 2002) and Le Fourneau du Diable, the Dordogne (Aujoulat, 1984) are the two major sites of western France that yield Solutrean rock sculptures (Figure 11. 4). These impressive artworks on limestone blocks which could cover whole rockshelters show depictions of different types of herbivores (horses, bovid, ibex). Of particular interest is a block from Le Roc-de-Sers, which yielded a human being, probably a male hunter, fleeing from a bovid. Some of the blocks reveal remains of paint. The Ardèche gorge in eastern France has produced the most closely spaced area in Europe with Solutrean parietal art. Several cave sites, for example, Chabot and Oulen, have thick Solutrean sequences (Combier, 1967).

Consequently, the Palaeolithic paintings and engravings in these caves located near the occupation areas have been classified as Solutrean too. The most striking features of Solutrean art in the Ardèche gorge are deep engravings, for example, those at the famous mammoth panel in Chabot (Figure 11. 2). Tête-du-Lion is a small cave with a red painted ensemble (Figure 11. 1) that was one of the first European examples of Palaeolithic cave art classified by means of radiocarbon dating. The small red panel that links depictions of a bovid, ibex and signs has been dated by charcoal discovered in front of the paintings to about 21,650 BP. Consequently, the panel belongs to the Solutrean period (Combier, 1995, 2009). Whereas lithic industries tend to show a break between Solutrean and Magdalenian, art production indicates a continuum. This statement is illustrated by the monumental Solutrean rock sculptures of Fournier du Diable and Le Roc-de-Sers that find their slightly younger Magdalenian counterparts in Angles-sur-l’Anglin, Le Cap Blanc, Domme or Commarque (Figures 17. 6, 7). Important painted sanctuaries, particularly the famous cave of Lascaux, traditionally dated to the Lower Magdalenian recently show tendencies to be assessed to the late Solutrean too. The younger part of the Cosquer paintings follows suit (Figure 11. 3).

Related to mobile art, the most striking element of Solutrean art is represented by sites yielding hundreds or even thousands of engraved stone slabs. The most famous of these places is Parpállo, located on the Spanish east coast, near Valencia. Finally, the eponymous site of Solutré, an Upper Palaeolithic hunting site in southern Burgundy, France, also offers some interesting features of Solutrean mobile art (Combier, 1989). These are some small animal sculptures made from a weathered local chert that can be carved exactly like wood. The same site has produced several engravings on stone slabs, particularly some examples that were decorated at their edges by series of notches (Combier, 2009). A little sculpture represents – and this to our knowledge is the first time that this interpretation is made public - a chrysalis or a grub of a bot fly. A similar object is known – made in jet – from the Magdalenian sites of Kleine Scheuer at Rosenstein, in the city of Heubach, south-western Germany (Figure 15. 6) and from the Magdalenian site of Kesslerloch in Switzerland. Many Solutré objects of mobile art discovered during the early excavations of the nineteenth and early twentieth century cannot be assessed to specific deposits.

Magdalenian art

The Magdalenian is by far the most important cultural unit of the European Upper Palaeolithic offering various and outstanding examples of parietal and mobile art. As for the latter, the cave site of La Marche in Lussac-les-Châteaux, Vienne, offers thousands of engraved stones (Pales and Tassin de Saint Pèreuse, 1976). Whereas human representations in Palaeolithic art often bear stereotype characters, the engravings of La Marche show personal streaks, as if the artists wanted to create portraits of specific individuals (Figure 15. 3). Probably, the La Marche engravings date to the Lower Magdalenian. They represent the Magdalenian counterpart of the Solutrean engravings on stone, for instance, those of Parpállo. The first important example of Lower Magdalenian parietal art is that of Le Gabillou in Sourzac, the Dordogne (Gaussin, 1964). Here we find many strange representations such as mixed beings and rare animals, for example, hare and birds. Grid-like signs evoke those of Lascaux (Figure 12. 7). Alongside with Grotte Chauvet-Pont d’Arc, Lascaux still is the most fascinating ensemble of Palaeolithic art in the world (Aujoulat, 2004) (Figure 12). Where if not in Lascaux are mythological tales told? Where if not there can you feel the transcendental spirit of ice age cave art? With exception of the ominous shaft scene where a stiff bird headed being meets a mortally wounded bison (Figure 12. 4), Lascaux presents chronologically and by its iconography a rather homogenous unit. Polychrome paintings, the use and the integration of rock formations, breathtaking configurations: all that makes European Palaeolithic art so unique is in Lascaux at its best. Furthermore, this cave reveals a mass of archaeological information (Leroi-Gourhan and Allain, 1979). Many significant stone and bone tools that date Lascaux in the early Magdalenian and also rare items, such as stone lamps and imprints of textiles, have been discovered.

The Upper Magdalenian is, from our point of view, the most emblematic period of Upper Palaeolithic hunter-gatherers in Europe, characterized by the perfect control of the environment and diverse raw materials. Never before has such an abundance of decorated objects been observed. To use a colloquialism, everything that could not escape within the blink on an eye from the smallest bone splinter to the most complicated tool, was decorated, engraved, sculptured or painted. The main centres of these Upper Magdalenian art activities are to be found in south-western France, particularly in the Dordogne and in the Pyrenees (Figure 14. 5). But also in central Europe very significant centres of mobile art are located, such as the famous open air sites of Gönnersdorf and Andernach in the Neuwied basin, Germany. The Upper Magdalenian is the ultimate
period where numerous types of decorated objects occur for the first time or have their blooming period. This is the case for the famous decorated spear throwers (Stodiek, 1993) (Figures 14. 2,4), contours découpés (Figure 14. 6), decorated discs (Bosinski, 1977), batons percés (Figures 14. 1,3), but as well for decorated herbivore ribs, teeth, scapulas, hyoids, ivory blanks...
or any other limb bone or splinters. Finally, diverse types of stone supports, such as slabs, pebbles or retouchers were used too.

The most bizarre theme in Magdalenian mobile art might be represented by sculptured spear-throwers of the so-called faon type (Figure 14. 2). These objects made in reindeer antler and located at the antler spire depict a herbivore, maybe a doe or an ibex that is defecating. On the leaking chunk of dung sit one or two small creatures, maybe birds. This is a technical masterstroke and it indicates enormous material skills that the dung is translated by the poriferous sponge texture whereas the animal surfaces were created within the compact external parts of the antler. This strange type of object is only known from three sites in the Pyrenees, Bédéilhac, Le Mas d’Azil and Arudy (Floss 2005, Figure 5. 6).
Some distinct types of mobile art link the classical regions of south-western France with central Europe (Bosinski, 1982). An example of these are the *batons percés* whose top is decorated in the form of the head of a bird or a strange animal (Floss 2005, Figure 57). This type of object has been discovered in four sites of south-western France, Le Mas d’Azil, Isturitz, Arudy (Espalungue) and Laugerie-Basse, and also in the important open air site of Andernach-Martinsberg (Neuwied basin, Germany) (Figures 14, 1, 3).

In the late Magdalenian, an important change in art production concerns the way humans and particularly females were represented. There is a new type of stylized female depiction without a head which is put into practice in the form of statuettes and engravings, in mobile as in parietal art (Figures 15, 1, 2, 4, 5). This type of depiction has been labelled the Gönnersdorf type (Höck, 1993; Aujoulat et al., 2011; Bosinski, 2011). The most renowned example of this style is a dancing...
scene with several adults and children originating from the eponymous open air site of Gönnersdorf (Neuwied basin, Germany) (Bosinski et al., 2001) (Figure 15. 1). Female figurines of this type were even sculptured in flint at the Polish site of Wilczyce (Bosinski, 2011, p. 138).

In the Magdalenian record, in contrast to female representations, animal representations are often characterized by many astonishing details (Figure 16. 4). Again Gönnersdorf offers an excellent example. Here the representations of mammoths show many specific items, for instance, their almond-shaped eyes, fur and the typical anal orifice (Figure 16. 3). These details could only be depicted after a very good observation of these animals. In Gönnersdorf this statement is much more than trivial because in the faunal record of this site the mammoth is almost non-present. It seems that the mammoth had been observed in former residential areas before arriving in the Middle Rhine area of Gönnersdorf.

A very important region of Magdalenian art is situated in northern Spain, from the Pyrenees and the Basque country in the east, across Cantabria up to Asturias in the west. The coastal zone of these areas, 200 km long and only 30 km wide, offers one of the densest assemblages of Magdalenian art in Europe. Of worldwide reputation is of course Altamira, discovered in 1868, with its fabulous bison ceiling (Breuil and Obermaier, 1935; Beltrán, 1998) (Figure 17. 3). Another very important
The assemblage of Upper Palaeolithic sites is situated in Monte Castillo, with its famous caves Las Monedas, Las Chimeneas, La Pasiega and El Castillo. This latter cave holds one of the most complete Upper Palaeolithic stratigraphies in northern Spain.
Figure 18. Magdalenian cave art, 1) Two bison modelled in clay, Tuc d’Audoubert (Ariège, France), photo Robert Begouën; 2) ‘Le dieu cornu’, Les Trois Frères (Ariège, France), from Henri Breuil, Les cavernes du Volp; 3-5) Signs and black paintings (‘salon noir’), Niaux cave (Ariège, France), photos Jean Clottes; 6) Black horse, Le Portel (Ariège, France), courtesy of Jean Vezian.
Relating to cave art, huge red grid-shaped signs and long rows of red dots are of particular interest. Here we could add dozens of other painted caves and content ourselves with mentioning the Cantabrian cave of Covalanas (García Diez and Eguizabal Torre, 2003) (Figure 17. 2) and the Basque cave of Ekain with its famous horse panel, the depiction of two following bears and a bird ‘sculpture’, perfectly embedded in a rock formation (Altuna, 1996) (Figure 17. 1).

The French Pyrenees are another particularly interesting region with regards to Magdalenian parietal art. Extraordinary sanctuaries are located here, such as Isturitz, Le Mas d’Azil, Bédeilhac, Le Portel (Figure 18. 6) or Niaux with its fabulous salon noir (Clottes, 1995) (Figures 18. 3-5). Maybe the most fascinating assemblage is that of the so-called cavernes du Volp, Les Trois Frères, Enlène and Tuc d’Audoubert, situated near St Girons in the northern foreland of the Pyrenees (Begouën and Breuil, 1958; Begouën et al., 2009). Whereas Enlène is of particular interest for its objects of mobile art, Tuc and Les Trois Frères yield two of the most fascinating assemblages of parietal art in the world. The still most famous depiction in Les Trois Frères is the
The Swabian Jura

Painted and engraved *Dieuex corru*, a hybrid being with carnivore paws, male genitals, an owl face and a huge antler (Figure 18.2). Tuc d’Audoubert is a cave with difficult access, partly across a subterranean river, the Volp. In recent years, much precious archaeological information has been collected in this cave (Begouën et al., 2009). Still by far the most impressive artwork is a couple of bison, modelled from cave clay, located at the ultimate end of the main gallery (Figure 18.1).

Around the Dordogne and particularly around the villages of Les Eyzies-de-Tayac, Font-de-Gaume (Rousso, 1984), Les Combarelles (Barrière, 1984) and Rouffignac (Plassard, 1999) are the most remarkable caves in regard to Magdalenian wall art. Font-de-Gaume is characterized by a surface covering polychrome paintings (Figure 17.4), resembling Altamira. Les Combarelles is a tubular cave with an entanglement of numerous engraved lines. Carnivores, anthropomorphic creatures, stylized women and signs are particularly worth mentioning. Rouffignac, whose cave walls are characterized by picturesque outcropping flint nodules, is of course the cave that has hundreds of depictions of mammoths (Figure 17.5).

Magdalenian art ends with very typical gracile scenic depictions that often include corteges of humans linked to animals of earth, water and air (Floss 2005, Figures 69-70) (Figures 16.1-2). At the very end of the Pleistocene period, the geometrically painted or engraved Azilian pebbles close the circle of about 30,000 years of European Ice Age Art (Couraud, 1995). In southwestern Germany, a painted pebble of Kleine Scheuer rockshelter in the Hohlenstein massif (Lönetal) belongs to this context (Floss, 2005, Figure 71) (Figure 19.1). Rochedane and eastern France (Figure 19.3) and Birseck-Ermitage in Switzerland do the same (Sarasin, 1918; Floss et al., 2009) (Figure 19.2). Furthermore, over the past years more and more examples of final Palaeolithic (‘Azilian’) figurative art have been reported. Related to mobile art in Germany, of particular consideration is a small elk sculpture made of amber, refitted from fragments, which was found at the open air site of Weitsche in Lower Saxony (Veil and Breest, 2002) (Figure 19.4). Another recently discovered depiction of an elk, originating from the site of Windeck (north Rhine-Westphalia), is an engraving on a stone retoucher which probably also dates to the final Palaeolithic (Heuschen et al., 2006) (Figure 19.5).

The use of pigments – Palaeolithic cave paintings in southern Germany

Given the fact that this paper is a follow-up product of a talk at an international meeting within the framework of the World Heritage Convention in Tübingen (25 February to 1 March 2013), in the context of a section devoted to the case study of Swabian caves, it is clear that this very important area of Palaeolithic art plays a particular role. The Swabian Jura has yielded examples of the oldest figurative artworks and musical instruments in the world. These objects evolved in outstanding conditions. The Aurignacian seems to be characterized by a particular social background and specific motivations generating objects we today call ‘ice age art’. Along with the tiny ivory figurines, the Swabian Aurignacian is characterized by the presence of a three-coloured painting on a piece of limestone (Hahn, 1988; Floss and Conard, 2001) (Figure 21.4). In terms of quantity and significance of art production, the ensuing Gravettian shows aspects of consolidation, even if the decreasing number and variety of artworks seem to indicate a certain downswing. The following Magdalenian of Swabia again shows a high variety of artistic expressions. Of particular interest are small sculptures of stylized female depictions and small animals made of jet (Kleine Scheuer at Rosenstein, Petersfels Cave) (Peters, 1930) (Figures 15.5, 6).

The processing of pigments obviously played an important role in the Swabian Magdalenian too. Their deposits contain numerous pieces of red pigment (hematite) wearing traces of use (Figure 21.2). Hohle Fels Cave has also produced a small colour palette made from a mollusk shell (Figure 21.1). The most significant signature of pigment use is illustrated by the presence of slabs, cave wall fragments and pebbles of limestone, which have been painted with rows of red dots and stripes (Figure 20). Bones were also painted (Figure 21.3). Some years ago, the first important discovery or painted stones gave reason to discuss the possible presence of Palaeolithic parietal art in southern Germany (Conard and Floss, 1999) (Figure 20.3). Since then, continuous studies on these objects have made clear that most of them represent examples of mobile art (Floss and Conard, 2001, 2009). It is true that some of the paintings are found on limestone fragments of the former cave wall. Nevertheless, these detached pieces of the cave wall may have been painted after and not before the process of detachment. This latter interpretation is the case for most of the pieces. The rows of tiny red dots are much too small to be cave art. Furthermore, they have striking resemblances to painted slabs of Jurassic limestone found at the Klausenhöhlen in Bavaria, pieces which can only be mobile art (Figure 20.1). Finally, the Swabian paintings of red dots do find themselves by a majority on pebbles and are painted on several sides, again obvious proof of mobile art (c.f. Figures 20.4, 5).

Nevertheless, two pieces from Hohle Fels Cave differ from this pattern (Floss and Conard, 2001, 2009). First, there is a limestone fragment, which is engraved with parallel lines. Additionally, the artefact is covered with black colour exactly in that same engraved area (Figure 21.5). Apart from a few exceptions in mobile art, the joint presence of engraving and painting is a typical feature of cave art. Another artefact, refitted from two fragments, shows a two-dimensional application of red colour,
fractured at all edges and obviously part of something bigger (Figure 21.6). This feature, also from Hohle Fels Magdalenian, is in our point of view the second object that may attest the presence of Palaeolithic cave art in southern Germany.
We should add here the so-called bear polish as a possible further suggestion for cave art in southern Germany which could, according to Joachim Hahn, contain some anthropogenic depictions (Hahn, 1991) and some recent discoveries in Mäander Cave (Bavaria) where Gerhard Bosinski has detected engraved female depictions on eye-catching, bulged cave walls (Bosinski, 2011), ‘but which are obviously of natural origin’ (personal communication J. Blumenröther).

Figure 21. Magdalenian pigment use in southern Germany. 1) Mollusk shell with pigment residues; 2) Hematite pen; 3) Painted bone; 4) Three-coloured painting on limestone; 5) Painted and engraved cave wall fragment; 6) Painted cave wall fragment, 1-3, 5, 6) Hohler Fels near Schelklingen; 4) Geißentaler (both Baden-Württemberg, Germany), © Hilde Jensen, University of Tübingen.
What’s so special about Europe?

European Palaeolithic art represents cultural heritage of Outstanding Universal Value. But we have to take into account the fact that European research history for more than 150 years might have biased the quantity and quality of results, if we compare Europe with other continents, which have not been investigated so much. For several decades now, these regional differences in research have led to a drastic increase in studies and field activities in other continents, particularly in Africa. That's how African excavations revealed, in the context of the Middle Stone Age for instance, very early examples of elements of personal decoration, engraved pieces of ochre and engraved fragments of ostrich shells (Henshilwood et al., 2002, 2009; Bouzouggara et al., 2007; Texier et al., 2010). Nevertheless, the unique and outstanding record of European Ice Age art, with its radiocarbon record starting at about 40,000 BP, has not been realized in other continents to date. In our point of view, this obvious difference cannot be primarily caused by different preservation conditions and research activities. But if this is so, we have to ask ourselves what the particularity of the European continent is. Considering climatic variations as the cause is not convincing, because climatic oscillations follow global rather than regional (in this case European) trends. Nonetheless, the open plains of Europe in periglacial conditions seem to be a fertile ground for cultural innovations. Structured by important river systems, this open landscape obviously privileged long-term migrations of mammals including humans. Therefore Europe, as a geographical appendix of Asia, might have had a role as a melting pot bringing together several drifts and trends. The fact that immigrating anatomically modern humans met or were at least aware of the outrunning indigenous Neanderthal population, entailed important social and demographic consequences. We are on the verge of creating a competition model in which art is a symbol of social identity (Floss, 2009b). It demonstrates power and serves for maintaining good relationships with the world of the ancestral ghosts.

Concluding remarks

Talking about the Upper Palaeolithic period and particularly the Early Upper Palaeolithic, the Aurignacian deals with the question of the origins of art. In recent years, our scientific community has been influenced by a certain view of research which tries to make us believe that Neanderthals had basically the same symbolic expressions as Anatomically Modern Humans and that the Middle to Upper Palaeolithic transition represents no particular but just any moment in the history of mankind (c.f. Zilhão, 2001, 2003). In contrast to this, we think that (Early) Upper Palaeolithic art evolved in different social and religious circumstances as they existed in the previous European Middle Palaeolithic. The observation of a supposed gradual evolution of cultural modernity at the Middle to Upper Palaeolithic transition obscures the fundamental differences between the involved societies. The Early Upper Palaeolithic record of Europe illustrates a significant shift in picture competence as in social and cultural complexity. Consequently, the Early Upper Palaeolithic and particularly the Aurignacian mark a ‘take-off’ in expression of cultural identity, common values, collective intentions and a symbolic organization. The phenomenon we call Ice Age Art reflects these fundamental social innovations.

Bibliography


The Swabian Jura


Protecting the Stratigraphic Sequences of Caves on the Swabian Jura

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The Caves of Baden-Württemberg, south-west Germany

In the south-west German state of Baden-Württemberg there are numerous archaeological cave sites, most of them located on the Swabian Jura. Long stratigraphic sequences with Palaeolithic and/or Mesolithic layers have been discovered in many of the caves. These layers represent a time period covering thousands to tens of thousands or even hundreds of thousands of years and provide insights into the technological and cultural developments during the Pleistocene and early Holocene, therefore making them an archive of human prehistory.

The archaeological layers are integrated into geological horizons, distinguishable from one another through colour, thickness, grain size, stone content and micromorphological features. The differences reflect varying micro- and macro-climatic conditions that existed during the period when these layers were deposited. The layers often contain ‘natural’ as opposed to ‘human’ inclusions as well, such as faunal remains from voles and other small rodents, which indicate the activities of owls or other birds of prey. Snail shells and pollen have also been uncovered. As with the geological and micromorphological characteristics, the natural inclusions also provide evidence concerning the climatic conditions at the time of deposition. Stratigraphic sequences in caves not only supply clues into cultural developments but also present archives into climatic changes occurring over tens of thousands of years.

Each cave, as well as each stratigraphic sequence, is unique in its features and characteristics. Each one represents a cultural landmark that must be protected. Such protection involves various measures, which are both of a legal as well as an organizational nature.

The legal options for protecting the Caves of Baden-Württemberg

In the federal system in Germany, landmark protection and preservation are regulated on a state level. Each federal state therefore has its own legal framework for protecting monuments. This is also the case in Baden-Württemberg. Caves, as well as their stratigraphic sequences, are protected, as are all cultural heritage landmarks, through various legal measures. These are defined in the cultural heritage protection law (Strobl/Sieche, 2010).

General protection exists for cultural monuments as outlined in the following:

- It has been determined that the preservation of sites and monuments is ensured by law. It includes both protection and maintenance of cultural monuments, especially as concerns oversight as well as effective prevention of destruction, and the rescuing and salvaging of monuments (Section 1).
- In Section 2 of the cultural heritage protection law of Baden-Württemberg, it has been established that monuments of cultural heritage are, according to the law, items or collection of items and parts of items whose preservation for the sake of scientific, artistic or local historical reasons is of public interest.
- In Section 8, it has been determined that a cultural monument may only be destroyed or removed with the consent of the State Office for Cultural Heritage.

Beyond this, additional regulations with regard to heritage protection in Baden-Württemberg have been established to offer further protection:

- In Section 12, the law also makes clear that cultural monuments of special significance should enjoy added protection through their inclusion in a registry of monuments.
- In Section 22, excavation of protected regions are defined as areas that are suspected of including monuments of special meaning. In these excavation protected areas, work or excavations may only be carried with the expressed agreement of the State Office for Cultural Heritage.
The Swabian Jura

- In Section 23, it has been determined that movable cultural monuments, either without ownership or concealed for so long that no ownership can be determined, once discovered become the property of the state of Baden-Württemberg when they are found through state investigations or in protected areas or when they are of exceptional scientific value.
- And finally in Section 21, it has been determined that investigations and research with the objective of discovering cultural monuments (especially excavations) must be approved.

With the legal provisions outlined above, optimal legal protection is in theory guaranteed for the caves of Baden-Württemberg. Caves and their prehistoric stratigraphic sequences are cultural monuments that may not be destroyed. Furthermore, the finds from these caves are normally of high scientific value and are therefore, with their discovery, the property of the state of Baden-Württemberg.

In Baden-Württemberg excavations in caves only take place under certain conditions and requirements. They can occur as rescue operations if stratigraphic sequences face destruction. Excavations in caves for reasons of scientific study gain approval only in a few cases. All other caves should be left in situ in order to maintain the present status quo.

Caves in Baden-Württemberg with Outstanding Universal Value (OUV)

Approximately 43,000 years ago modern Homo sapiens (Anatomically Modern humans – AMH) reached Europe and the south-western part of Germany (F.E. Higham et al., 2012; Conard and Bolus, 2008). In Central Europe they were producer of a techno-complex known under the term Aurignacian. Soon after their arrival in central and south-western Europe we find the appearance and development of art. Among the oldest artistic expressions of the Aurignacian are the painted rocks from Fumane (Brogio and Dalmeri, 2005) and possibly some painted caves in Spain (Pike et al., 2012) and south-western France (Azémé et al., 2012). In France and Spain the Aurignacian style developed as defined by A. Leroi-Gourhan (1965; Delluc and Delluc, 1991). The relevant archaeological sites here include La Ferrassie, Abri Cellier and Abri de Belcayre. The find of a dancing woman carved on green serpentine from Stratzing in Austria is also dated to the Aurignacian (Neugebauer-Maresch, 1989). At least some of the paintings of Grotte Chauvet are also attributed to the Aurignacian (Chauvet et al., 1996; Clottes, 2001), even when taking into account the recent discussions on the actual age of these paintings (Pettitt, 2008; Combier and Jouve, 2012).

In some of the caves on the Swabian Jura in Baden-Württemberg with long stratigraphic sequences, layers from the Aurignacian were uncovered. Among these sites are four caves that are especially important: Geissenklösterle (Hahn, 1988), Hohle Fels (Conard, 2009) in the Ach Valley and Vogelherd (Riek, 1934; Conard, 2007a) and Hohlenstein-Stadel (Wetzel, 1961; Schmid et al., 1983) in the Lone Valley. Both rivers are tributaries of the River Danube. In these four caves art objects were found from the Aurignacian layers. The artwork does not include paintings but rather carved animal and human figurines made of mammoth ivory (see contributions in this volume). Additionally, in three of the four sites flutes were discovered, produced from bird bone and mammoth ivory (Hahn and Münzel, 1995; Conard, 2007b; Conard, Malina and Münzel, 2009). Dates from the relevant layers place the artworks and the flutes in the period between c. 35,000 and 40,000, possibly even 43,000 years cal BP (Higham et al., 2012; Conard and Bolus, 2008). The figurines belong to the oldest known representatives of figurative art in the world. The flutes as well are the oldest known musical instruments in the world.

Without doubt, the four caves with their surrounding landscape and the oldest artworks are of Outstanding Universal Value (OUV). This claim is based on the fact that they meet various criteria defined by the UNESCO World Heritage Convention. These include the following:

**Criterion (i)** Animal and human figurines, as well as musical instruments, from the Aurignacian layers of caves from the Swabian Jura represent unique masterpieces of human creative genius. The caves and their surrounding landscape are not only finding spots but also inspiration and context of the figurative art objects. Thus, the three components landscape, caves and figurative art form an inseparable entity. The figurines date to approximately 35,000 to 40,000 years ago and therefore belong to the oldest examples of artistic expression known to early modern humans. The existence of these artworks in several caves demonstrates that figurative art and music were characteristic expressions of Upper Palaeolithic peoples. While the depictions of animals are very naturalistic, highlighting their characteristic attributes, the human representations are more abstract, stylized or both. There are even examples of chimeras, such as the ‘Lion Man.’ Most of the figures reveal symbolic images in the shape of rows of points or crosses. Their meaning remains a mystery, suggesting some as yet undecipherable message.

**Criterion (iii)** The human and animal figurines, as well as the musical instruments, were produced and used during the Aurignacian in Swabian caves. Thus, together with the caves and their surrounding landscape, the figurines
The Swabian Jura are a testimony to a unique cultural tradition, which has disappeared. This is even more significant as they were made immediately after the appearance of the first modern humans in Europe. In addition, some of the figurines must have had a religious component for the Upper Palaeolithic peoples.

**Criterion (iv)** The caves of the Swabian Jura and their surrounding landscape are an outstanding example of a landscape which illustrates a significant stage in human history. Furthermore, musical instruments and figurative art as well as objects of everyday-life, together with the caves and their surrounding landscape form a functional entity which represents an outstanding example of a technological ensemble.

**Criterion (v)** The caves of the Swabian Jura with their early examples of art are an outstanding example of a traditional human settlement. Together with their surrounding landscape, they represent an excellent example of human settlement typical for the Upper Palaeolithic. Particularly through the depiction of animals, we are able to observe the interaction between humans and animals during the last Ice Age. The creation of objects, such as ivory sculptures or musical instruments, demonstrates that early modern humans were capable of cultural adaptation to environmental conditions.

Due to the criteria stated above which justify their Outstanding Universal Value, it seems to be clear that the four caves should be protected beyond regional measures. Different institutions, such as the Ministry of Finance and Economic Affairs of Baden-Württemberg, the University of Tübingen, the State Office for Cultural Heritage and political representatives from local administrations and communities are therefore working on an application for the Swabian Caves with their early artworks to be accepted on the UNESCO World Heritage List. This application should consider not only the caves but also the surrounding landscape in the Lone and Ach Valleys as a means of protecting still undiscovered Palaeolithic sites.

**Legal protective measures for the stratigraphic sequences in the four caves of the Swabian Jura with OUV**

The four caves of Geissenklösterle, Hohle Fels, Vogelherd and Hohlenstein-Stadel already enjoy all possible legal protection that Baden-Württemberg presently has to offer. All four caves are officially listed as cultural monuments of special value in Baden-Württemberg. Beyond this, the parts of the valleys under question here are designated as excavation protected as well as landscape protected areas. Archaeological excavations in the caves are only permitted with the explicit approval of the State Office for Cultural Heritage.

**Excavations in the caves and protection of stratigraphic sequences**

Stratigraphic sequences in caves are unique as well as valuable resources. They provide insights into the cultural and natural past and are therefore cultural monuments, as well as at times natural monuments. They represent archives into prehistory. Their uniqueness rests in the fact that stratigraphic sequences not only provide insights into a specific prehistoric or natural historic period but also shed light on circumstances relating different time periods to one another through the deposits from different ages represented in the sequences. Comparisons of the different stratigraphic layers reveal the developments occurring over tens of thousands of years.

Caves and their stratigraphic sequences should be preserved as cultural monuments and should not be destroyed. This fundamental statement is relatively easy to establish into law, as is the case in Baden-Württemberg as well as other federal states in Germany. In general terms, this should be enough to protect the caves from danger. The problem of archaeological excavations, though, remains. Excavations remove a great amount of sediment from the caves, leading to the harm or destruction of stratigraphic sequences within these protected cultural monuments. This is a well-known dilemma as well as a contradiction within archaeology itself. Archaeology is a science that examines prehistoric cultural monuments or landmarks with its own developed methodologies. At the same time, excavations are often destructive to the monuments under study. After excavations are concluded, even those involving the most modern and advanced methods, integrity and authenticity therefore cannot be guaranteed. The difficulty also arises from the fact that excavation methods and documentation practices are continually changing and improving. Archaeologists in the future will rightfully criticize the methods employed at the beginning of the twenty-first century as we judge the methods at the beginning of the twentieth century.

With regard to excavating in caves, there is always the danger in today's form of archaeology of producing, in general, empty caves. Only after archaeologists develop non-invasive excavation strategies will we avoid this dilemma. Such strategies exist today only in their preliminary stages. Archaeology is furthermore not only an empirical science which employs excavation
but also a descriptive science. There will always be archaeology with object-related analysis. Non-invasive methods, at least according to the present state of development, do not produce describable finds. Until archaeologists develop such methods for studying finds, they will continue to face this dilemma.

At the same time, there are numerous arguments that speak for excavating in caves. An important reason for this is that we can only protect what is already known to us. Without information available to us on whether a stratigraphic sequence exists in a new cave or whether parts of a sequence exist in a cave already excavated, no measures will be taken to protect such caves. Scientific progress is also an important factor. Without the excavations over the past decades, our knowledge of prehistory would not have advanced since the beginning of the twentieth century. The scientific tradition in research concerning a landscape is an important part of that landscape's character and uniqueness.

The decision to excavate in a cave is therefore dependent on many factors. The relevant arguments must be considered carefully. It should also be accepted that, in individual cases, it is more valuable to protect a stratigraphic sequence in a cave than it is to excavate there. But scientific reasons for excavating should not be ignored. So finally we need to insist that excavations may only take place if reasons for excavating are based on conservation as well as on science.

Regarding a decision to allow excavation in a cave, we must keep in mind several factors. Here we need to ensure that only the highest possible standards are employed in terms of documentation. Anything that has been excavated once normally can only be conditionally reconstructed, if at all. Poor documentation, produced for whatever reason, cannot be subsequently re-done. An archaeological cultural monument cannot, as with written sources, be investigated again and again. Especially important is the exact documentation of relations and correlations of finds inside a site. Finds as isolated objects, considered as antiquarian units, is something belonging to the past in the history of research.

Find layers, stratigraphic sequences, features, as well as finds must be documented by the best of modern methods. Scientists from varying disciplines should take part in the excavations, including zoologists, botanists, geomorphologists, soil experts, micromorphologists, anthropologists, physicists and chemists. Ecological processes need to be considered during excavations in caves. The effects of digging on water balance, air circulation and access for animals, such as bats, must be monitored. And of course, all types of finds, whether archaeological, zoological, anthropological, botanical or pedological must be treated with equal importance, regardless of whether they belong to the specific expertise of the excavators or not. The excavations should remain limited to the smallest areas of the caves and their stratigraphic sequences as possible, and only where it is of necessary scientific importance. In each case, representative parts of undisturbed areas must be left in situ as testament to the cave’s stratigraphy. This does not mean only a small area is to remain intact but rather even larger areas which could yield significant information in future excavations should be left alone.

An especially sticky point here is the treatment of a post-excavation. At the end of fieldwork, the current status of the cave’s stratigraphy must be documented using the most advanced techniques available. After documentation is completed, the excavated areas must then be secured. It must be guaranteed that exposed profiles do not break or erode away in the coming months or years. Appropriate measures must therefore be taken to protect the remaining stratigraphic profiles. This can be done in the simplest manner by re-filling the excavated areas or in a more complicated way by constructing walls, even from of Plexiglas, for example. The profiles should also be protected in such a way that when, for example, they are accessible for taking scientific samples, other parts of the sequences are not damaged.

Barring a cave from public access is of course not something desirable. But in certain cases, a barrier such as a fence with iron bars should be considered. This measure serves to protect the existing stratigraphic sequences as well as the remaining fill of the caves, and also present-day animals and plants.
Hohlenstein-Stadel: a case study

Knowledge concerning the four caves with Outstanding Universal Value (OUV)

South-west Germany and the state of Baden-Württemberg have a long history of research. The first scientifically based Palaeolithic excavation took place in 1866 at Schussenquelle, a bog site in the southern part of Baden-Württemberg (Schuler, 1994). Approximately at the same time the first scientific excavations began in the caves of the Swabian Jura.

Through various modern excavations over the past few decades, we have learned a great deal about the stratigraphic situation in the caves of Geißenklösterle and Hohle Fels (Hahn, 1988; Conard, 2009). The caves of Vogelherd and Hohlenstein-Stadel were excavated already decades before. Our knowledge over the actual circumstances surrounding the finds and the stratigraphic situation in these two caves was thus limited. In recent years excavations have taken place at Vogelherd in which the backdirt from the 1931 excavations was examined. More animal figurines were uncovered and the context of the old excavation became more apparent (Conard, 2007a). We can therefore state that enough information is now available on the three sites of Vogelherd, Geißenklösterle and Hohle Fels to verify their integrity and authenticity. This is not the case for Hohlenstein-Stadel. The last excavations there took place decades ago. Moreover, there are only a few publications on the site available, allowing little by way of insight into the stratigraphic and topographical conditions there (Wetzel, 1961; Schmid et al., 1989). Therefore, the Office for Cultural Heritage of Baden-Württemberg in 2008 decided to excavate small and limited portions in and in front of Hohlenstein-Stadel.

The early excavations of Hohlenstein-Stadel

Hohlenstein (‘hollow rock’) is a large rock formation on the southern edge of the Lone Valley (Figure 1). In this formation, three Palaeolithic sites were discovered. All three open to the north. To the west is the Bärenhöhle or cave of the bears. The first excavations in a cave on the Swabian Jura took place here in 1861 or 1862. These excavations were conducted exclusively in order to collect bones from cave bears. Thousands of bear bones were found in the Bärenhöhle. Lithic artefacts were at the time overlooked. Not until excavations took place in the 1950s did researchers discover complex archaeological layers from the Middle and Late Palaeolithic (Wetzel, 1961). Further east on this formation we find the rockshelter of Kleine Scheuer, which means small barn. Excavations here in the twentieth century uncovered layers from the Magdalénian and the Azilian (Soergel-Rieth, 2011; Hahn and Koenigswald, 1977).

Farther in the east we find the Stadel, also meaning barn or shed. In Stadel, or Stadel Cave, the Tübingen anatomist, Robert Wetzel, organized archaeological excavations between 1935 and 1939 and again between 1956 and 1961 (Wetzel 1961). The geologist, Otto Voelzing, led the excavations. The excavation methods were, for that time period, relatively exact. The sediment was divided in metre strips straight across the long axis of the cave. Within each metre strip, spits were removed with a thickness of about 20 cm that determined the location of the finds. During fieldwork all of the excavated sediment was taken out of the cave with wagons. Considerable amounts of sediment were thereby removed from the cave.

The cave contained a relatively rich stratigraphy with a thickness of more than 4 metres. In the lower portion of the stratigraphy, several layers with Middle Palaeolithic artefacts were discovered, in the horizons XIII, IX/VIII and VII (Wetzel 1961) or in the so-called ‘black and ‘red’ Mousterian. The artefacts belong to a later Mousterian, typical for south-west Germany (Beck, 1999). Scrapers predominate in the find inventories. Points are rare and bi-facially retouched artefacts are completely absent (Figure 2, 1-4). The Levallois method is relatively common.

<table>
<thead>
<tr>
<th>Lab. number</th>
<th>Location</th>
<th>Arch.Hor</th>
<th>Techno-complex</th>
<th>14 C BP</th>
<th>Cal BP (oxcal)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ETH-5732</td>
<td>pit</td>
<td>Late Mesolithic</td>
<td>7 835 ± 80</td>
<td>8 449 – 8 979</td>
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</tr>
<tr>
<td>H 3799-3045</td>
<td>III</td>
<td>Magdalenian</td>
<td>13 110 ± 160</td>
<td>15 162 – 16 618</td>
<td></td>
</tr>
<tr>
<td>H 3779-3044</td>
<td>III</td>
<td>Magdalenian</td>
<td>13 550 ± 130</td>
<td>16 093 – 17 008</td>
<td></td>
</tr>
<tr>
<td>KIA 8951</td>
<td>19 m, spit 6</td>
<td>V</td>
<td>Aurignacian</td>
<td>31 440 ± 250</td>
<td>35 194 – 36 529</td>
</tr>
<tr>
<td>H 3800-3025</td>
<td>20 m, spit 6</td>
<td>V</td>
<td>Aurignacian</td>
<td>31 750 ± 130</td>
<td>35 141 – 38 369</td>
</tr>
<tr>
<td>ETH-2877</td>
<td>20 m, spit 6</td>
<td>V</td>
<td>Aurignacian</td>
<td>32 000 ± 550</td>
<td>36 306 – 37 613</td>
</tr>
<tr>
<td>KIA 13077</td>
<td>20 m, spit 6</td>
<td>V</td>
<td>Aurignacian</td>
<td>32 720 ± 270</td>
<td>37 123 – 38 501</td>
</tr>
<tr>
<td>KIA 8949</td>
<td>19 m, spit 7</td>
<td>V/VI</td>
<td>Aurignacian</td>
<td>33 920 ± 310</td>
<td>37 718 – 39 922</td>
</tr>
<tr>
<td>KIA 8950</td>
<td>19 m, spit 7</td>
<td>V/VI</td>
<td>Aurignacian</td>
<td>36 910 ± 490</td>
<td>41 134 – 42 545</td>
</tr>
<tr>
<td>KIA 8948</td>
<td>19 m, spit 8</td>
<td>VII</td>
<td>Middle Palaeolithic</td>
<td>41 710 ± 570/530</td>
<td>44 495 – 46 038</td>
</tr>
<tr>
<td>KIA 8947</td>
<td>19 m, spit 9</td>
<td>VIII</td>
<td>Middle Palaeolithic</td>
<td>42 410 ± 670/620</td>
<td>44 658 – 46 894</td>
</tr>
<tr>
<td>OxA-18455</td>
<td>19 m, spit 9</td>
<td>VIII</td>
<td>Middle Palaeolithic</td>
<td>47 100 ± 900</td>
<td>49 230 – 51 200</td>
</tr>
<tr>
<td>KIA 8946</td>
<td>19 m, spit 10</td>
<td>VIII</td>
<td>Middle Palaeolithic</td>
<td>39 970 ± 490/460</td>
<td>43 141 – 44 746</td>
</tr>
<tr>
<td>KIA 8945</td>
<td>19 m, spit 11</td>
<td>IX</td>
<td>Middle Palaeolithic</td>
<td>40 220 ± 550/510</td>
<td>43 239 – 45 025</td>
</tr>
</tbody>
</table>

Above the Middle Palaeolithic layers, one or possibly three Aurignacian layers were discovered. They correspond to Horizons V and IV (Wetzel, 1961, 51) or to spits 7, 6, 5 and 4. These layers contained carinated pieces (Figure 2, 6-7) as well as Aurignacian points with massive bases made of reindeer antler (Hahn, 1977; Schmid et al., 1989). Several 14C dates present an age between c. 31,500 and 37,000 years BP. This indicates a time period between 35,000 and 42,000 cal years BP.

Above the Aurignacian layers follows Horizon III (Wetzel, 1961, 51), which belongs to the Magdalenian (Figure 2, 8-11). Surprisingly, sediments and finds from the Gravettian are completely absent in the cave between Horizons IV and III. This indicates massive erosion. The Magdalenian inventory includes scrapers and burins. Some backed bladelets were also discovered (Hahn, Müller-Beck and Taute, 1985). Some backed points resemble Azilian points. It is therefore probable that a certain amount of mixing occurred during earlier excavations. Two 14C dates from samples taken from the Magdalenian layer yield an age between 13,000 and 13,500 years BP. This represents a period from c. 15,000 and 17,000 years cal BP.

The sequence of layers ends with the humus Horizon I which includes objects from the Mesolithic, the Neolithic and the Bronze and Iron Ages, the Middle Ages and Modern period (Wetzel, 1961).

Along with hundreds of lithic artefacts and thousands of animal bones (Gamble, 1979), some very important finds were uncovered in Hohlenstein-Stadel. In the lower Middle Palaeolithic (Horizon XIII or ‘black’ Mousterian) a hominid femur was discovered. It is the only skeletal remain of a Neanderthal man yet to be found in Baden-Württemberg (Kunter and Wahl, 1992). In a pit that was dug as deep as the Aurignacian horizon, three human skulls were uncovered. Along with the skulls, upper cervical vertebrae were found that reveal cut marks. These finds indicate a Late Mesolithic head burial (Orschiedt, 1998, 1999). A 14C date places the finds at 7,800 BP (Kind, 2003). This indicates an age of c. 8,500 to 9,000 cal BP (6,500 to 7,000 BC).
Finally, the famous Lion Man was uncovered in the Aurignacian horizon (Figure 3). The Lion Man is carved out of mammoth ivory and stands 30 cm high, making it the largest Aurignacian figurine from the Swabian caves. The figurine reveals a mixture of both human and animal features (Hahn, 1971a, 1971b; Schmid et al., 1989). The body and the legs are human, while the head and arms are clearly that of a lion. On its left arm we can recognize several horizontally cut markings that resemble a tattoo. Such a chimera, which does not exist in reality, indicates an amazing power of imagination and an immense intellectual capability already at the beginning of the Upper Palaeolithic, only a short time after Homo sapiens had spread across Europe. The Lion Man offers us clear insights into the spiritual world of the Upper Palaeolithic and was possibly connected to certain religious practices.

The discovery of the Lion Man has a mysterious quality to it. August 25 was the last day of excavations in 1939 before the outbreak of the Second World War. Work at the site was quickly and hastily ended (Schmid et al., 1989). Exactly on this final day of excavation, the Lion Man figurine was discovered at a place 25 to 30 m away from the cave opening. It lay in the sixth spit of the 20th metre cut and had probably crumbled apart into numerous ivory segments. Approximately 220 fragments were collected and placed in a crate. The crate was brought to Tübingen along with other finds from the 1939 excavation. Later, all of the finds were bequeathed to the city of Ulm. Here the trace of the Lion Man ends. Robert Wetzel appears to have recognized that part of an ivory figurine had been found, but he had not noticed its significance. New evidence surfaced in 1969. The Tübingen archaeologist, Joachim Hahn, was assigned the task of studying the finds from Hohlenstein in the museum in Ulm, where he found a crate with the ivory fragments. He noticed that the ivory carried traces of working, which led to the first refitting of the Lion Man (Hahn, 1971a, 1971b). At this time the head of the figurine was for the most part missing. Hahn recognized though that the figurine represented a chimera, but he could not decide if the upper body was that of a lion or a bear. Final restoration followed in 1987-1988 in the Württemberg Landesmuseum in Stuttgart (Schmid et al., 1989). It then became clear that the figurine clearly represented both a human being and a lion.

Modern excavation methods in Hohlenstein-Stadel

For decades it was accepted that the Stadel Cave in Hohlenstein had been fully excavated, but nothing exact was known. In order to verify the situation, the State Office for Cultural Heritage in Baden-Württemberg decided to open up some small test pits in the area of the cave. This occurred according to the premise that we could only protect what we knew to exist. Excavating a small portion of the cave appeared to be the best possibility for investigating the cave’s condition. This was to represent an initial step in creating a better understanding of the situation in order to be able to improve protection of the cave.

During the new excavations, a number of small sections were opened in the area in front of the cave and in the cave itself. To our amazement, all the opened sections revealed sediments with finds and a clear stratigraphy.

Modern documentation methods were employed during the excavations work. The small excavation areas were divided in square metres. The sediment was dug according to quarters of square metres and placed in buckets. The sediments in the buckets were then screened through a sieve with a mesh size of 1 mm. The
remains from screening were examined during the time of excavation and the small finds were separated. They included, for example, small chips, small bone slivers, bones from micro-fauna and molluscs. During excavation all of the larger finds, including lithic artefacts, ceramic sherds, metal, bones, antler, ivory, stones and charcoal were measured in three dimensions using a total station which was connected to a laptop during fieldwork. It was therefore possible to provide permanent controls of the measurements. Profiles and surfaces were recorded with the total station as well as documented through photographs. The photographs were later corrected and combined in order to comprise a database. Sediment samples were taken throughout the course of the excavation, while sediment probes were taken from some of the profiles for micromorphology studies. The entire cave, along with some of the profiles, was documented with a 3D scan. Additionally, traditional means of documentation were employed, including describing the results of the excavations in journals. It was assumed that these methods, employing the highest standards to date for fieldwork, would guarantee the best documentation of the finds and site formation. Similar methods were also used in the other three caves with Outstanding Universal Value (OUV): Geißenklösterle, Hohle Fels and Vogelherd.

New excavations in the area in front of Hohlenstein-Stadel

In the area in front of Hohlenstein-Stadel, an excavation area was opened between 2008 and 2010 with a surface of 8 m². In four of the quadrat metres excavated, there was undisturbed sediment which revealed a complex stratigraphic sequence (Figure 4). Bedrock was never reached. Archaeological layers 5, 7a, 7b, 7c and 7d filled a channel or gully. They contained sediments and finds that were probably taken from the cave and redeposited in this area. Layers 7a, 7b, 7c and 7d yielded finds from the Middle Palaeolithic, while layer 5 yielded finds from the Aurignacian. Some of the layers showed clear signs of periglacial processes which indicated the artefacts to be no longer in situ. Beside these layers, excavators discovered Horizon 6 which was not disturbed because the channel or gully cut through it. Surprisingly, there were a few meagre remains from the Gravettian in this layer that lay protected in a small niche of the rock wall in Horizon 6 and appeared also to be in situ. As mentioned above, no Gravettian sediments or finds were found in the cave. In the following layers 3 and 4, finds from the Magdalenian and the Late Palaeolithic were discovered. These layers also lay in situ.

<table>
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<th>Lab. number</th>
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<td>ETH-41 222</td>
<td>GL2A</td>
<td>2</td>
<td>Epipalaeolithic</td>
<td>11 945 ± 50</td>
<td>13 654 – 13 960</td>
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<td>ETH-41 223</td>
<td>GL2B</td>
<td>3</td>
<td>Epipalaeolithic</td>
<td>12 175 ± 50</td>
<td>13 846 – 14 192</td>
</tr>
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<td>GL2B</td>
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<td>Magdalenian</td>
<td>13 070 ± 51</td>
<td>15 205 – 16 406</td>
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<tr>
<td>ETH-46 896</td>
<td>GKS1</td>
<td>4</td>
<td>Magdalenian</td>
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<td>16 610 – 17 098</td>
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<td>GKS2</td>
<td>5</td>
<td>Aurignacian</td>
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<td>37 831 – 39 426</td>
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<td>KKS</td>
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<td>Magdalenian ?</td>
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<td>16 861 – 17 440</td>
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<td>12 785 ± 50</td>
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<tr>
<td>ETH-38 795</td>
<td>BG</td>
<td>7b</td>
<td>Middle Palaeolithic</td>
<td>&gt;50 000</td>
<td>out of range</td>
</tr>
<tr>
<td>ETH-41 230</td>
<td>SKS</td>
<td>7c</td>
<td>Middle Palaeolithic</td>
<td>43 805 ± 1 085</td>
<td>45 380 – 49 591</td>
</tr>
<tr>
<td>ETH-41 229</td>
<td>LK</td>
<td>8</td>
<td>Middle Palaeolithic</td>
<td>&gt; 50 000</td>
<td>out of range</td>
</tr>
</tbody>
</table>

The archaeological layers contained numerous finds (Jahnke in prep.). Among these are thousands of animal bones as well as lithic artefacts, which confirm their stratigraphic interpretation.

The site formation process is somewhat complicated. Before the Last Glacial Maximum (LGM), an archaeological layer from the Gravettian was deposited in front of the cave (Layer 6). A $^{14}$C date from Layer 6 was determined at 23,500 BP, which corresponds to an age of c. 28,000 cal BP. The formation of Horizon 6 continues until c. 14,000 cal BP. A channel or gully was then cut into the Gravettian/Magdalenian sediments through periglacial processes. This channel filled with sediments which passed through the cave’s interior and collected onto the area in front of the cave containing finds from the Middle Palaeolithic and the Aurignacian. Finally, sediments found in situ from the late Magdalenian and the Late Palaeolithic overlay over the channel and Horizon 6. Humus horizons from the Holocene cover the entire stratigraphic sequence.

New excavations in Hohlenstein-Stadel

Between 2009 and 2013, another excavation area was laid out c. 25-30 m from the entrance of Stadel Cave (Figure 5). A small chamber-like extension of the cave is located behind a rocky ridge. The excavation area was originally comprised of only 2 quadrat metres, but was extended during fieldwork to contain 13 archaeological layers (Figure 6). Surprisingly, the new archaeological layer sequence corresponded perfectly with the stratigraphy of the older excavations (Wetzel, 1961). There are $^{14}$C dates for some of the find layers. They indicate that the lower part of the sequences up to Horizon C can be placed in the Middle Palaeolithic. The $^{14}$C dates for Layer C, D and E yielded an age between 46,000 and 40,000 BP. This corresponds to a time period between c. 50,000 and 43,000 cal BP. The layers Ao, Am and Au are located in the upper area of the sequence, all belonging to the Aurignacian. The $^{14}$C dates yielded an age between 35,000 and 32,000 BP. This means placing them in a time period between c. 41,000 and 35,000 cal BP.

<table>
<thead>
<tr>
<th>Lab. number</th>
<th>Geol. Hor</th>
<th>Arch. Hor</th>
<th>Technocomplex</th>
<th>14C BP</th>
<th>Cal BP (oxcal)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ETH-41231</td>
<td>Ao 1o</td>
<td>Aurignacian</td>
<td>31950 ± 210</td>
<td>35589 – 36906</td>
<td></td>
</tr>
<tr>
<td>ETH-41232</td>
<td>Am 1m</td>
<td>Aurignacian</td>
<td>33390 ± 245</td>
<td>37286 – 38835</td>
<td></td>
</tr>
<tr>
<td>ETH-38797</td>
<td>Au 1u</td>
<td>Aurignacian</td>
<td>35185 ± 270</td>
<td>39421 – 41105</td>
<td></td>
</tr>
<tr>
<td>ETH-38798</td>
<td>C 3</td>
<td>Middle Palaeolithic</td>
<td>39805 ± 420</td>
<td>43103 – 44555</td>
<td></td>
</tr>
<tr>
<td>ETH-38799</td>
<td>A2 4</td>
<td>Middle Palaeolithic</td>
<td>41920 ± 545</td>
<td>44523 – 46187</td>
<td></td>
</tr>
<tr>
<td>ETH-38800</td>
<td>D 5</td>
<td>Middle Palaeolithic</td>
<td>40560 ± 480</td>
<td>43577 – 45238</td>
<td></td>
</tr>
<tr>
<td>ETH-41234</td>
<td>E 6</td>
<td>Middle Palaeolithic</td>
<td>46440 ± 1050</td>
<td>out of range</td>
<td></td>
</tr>
</tbody>
</table>

As opposed to the older excavations, sediments are absent here that could be dated to the Magdalenian. It could be they were removed during the excavations of 1939 or during the Second World War. Sediments from the Gravettian were also not discovered.

Finds are numerous in all the horizons in Hohlenstein-Stadel. At the same time, direct evidence of human presence here occurs only in isolated forms. Most of the finds represent thousands of bone fragments and teeth, most showing good preservation.

Among the bone fragments there are numerous remains of cave bear. There is also evidence of the presence of cave hyena. This is suggested through both the bones and teeth from hyena, as well as by bones from other animals that carry the typical bite marks from hyena. Therefore, the cave was mainly a sleeping place for cave bear and a hyena den. Besides the bones from these two animals we have the preliminary identifications of, among others, wild horse, reindeer, red deer, wild cattle/bos, rhino, fox, mammoth and cave lion.

Lithic artefacts are rare. In the Middle Palaeolithic layers, some flakes, cores and scrapers have been discovered. The low find density appears to be a typical characteristic of the Middle Palaeolithic layers in south-west Germany. But surprisingly, the Aurignacian layers also revealed only some small chips.

A mixing of disturbed sediments was found north of the area with undisturbed find layers. It appears these sediments are part of the mixed fill from the 1939 excavations. The recent excavations obviously began exactly where the fieldwork on 25 August 1939 stopped. At that time, the excavated sediment was used to refill the last excavation trenches.

In the fill from the 1939 excavations, animal bones occur quite often. It was, however, a great surprise to discover that there are fragments from mammoth ivory in the fill as well. They reveal clear traces of working and belong obviously to the Lion Man. The entire fill of the small chamber in the interior of the Stadel Cave was therefore
carefully examined. In total, more than 6 cubic metres of earth were carefully excavated, revealing another 500 or so ivory fragments or slivers. Many of these are only a few millimetres long, with a few though representing larger broken fragments several centimetres long (Beutelspacher et al., 2011; Beutelspacher and Kind, 2012).

The Lion Man figurine was found in the 6th spit of the 20th slice of the excavation trench. This means that the figurine rested c. 1.20 m under the modern surface. Shortly after its discovery, the excavations were abruptly ended and the excavated sediment was used to re-fill the excavation unit. The modern excavation area is found in the area of the 20th slice from 1939. After removing the back dirt, the situation produced on 25 August 1939 was reconstructed.

It is possible to correlate the spits removed in 1939 directly with the stratigraphic sequence of the modern excavations. It becomes clear that spit 6 from 1939 correlates with the Layer Au of the modern excavation. A $^{14}$C date exists for this find horizon from c. 35,000 years BP or 39,000 to 41,000 years cal BP. Thus, it becomes obvious that the Lion Man actually belongs to the oldest examples of figurine art.

The Lion Man figurine is not complete. On the right side and in the area of the back there is a gaping hole. It occurred as a possibility that the newly found fragments might well belong to this missing segment of the figurine. The first attempts at re-fitting turned out to be successful (Figure 7). The figurine has since then been newly reconstructed. The Lion Man has become more complete and its appearance has changed somewhat (also see Figure 3).

**Interpreting the settlement of Hohlenstein-Stadel**

The Aurignacian settlement in Hohlenstein-Stadel appears to be different from that of the other caves. In each of the four sites of Vogelherd, Hohlenstein-Stadel, Geißenklosterle and Hohle Fels, small carvings of animal and human figurines have been discovered, though the locations of these discoveries are not always similar. In Vogelherd (Hahn, 1986), in Geißenklosterle (Hahn, 1988) or in Hohle Fels (Conard, 2009) the art objects were found in the middle of normal settlement debris together with hundreds of lithic tools and bone fragments. The Lion Man, though, was found in Hohlenstein-Stadel in an exposed place on the periphery of the settlement. It lay isolated in a small chamber. The normal settlement debris was found in the entry area to the Stadel Cave. In the neighbourhood of the place where the Lion Man was found, very little cultural remains

![Figure 8. Hohlenstein-Stadel, Aurignacian. Pendants from the area where the Lion Man was found. Upper row: 1939 Excavation. Lower row: 2009-2012 Excavation.](image)
of the human settlement were uncovered. These few remains include some bone artefacts (Schmid et al., 1989) from the excavations of 1939. Lithic artefacts are very rare. Even after careful wet sieving during the more recent excavations, only a few chips were found. In general, the find density is very low in the small chamber. Exceptions include some ornamental objects that were uncovered both in the 1939 excavations as well as during the modern investigations (Figure 8). Among these we find pendants made of ivory as well as perforated teeth from fox, red deer and wolf. The rarity of other objects among the finds and the frequency of ornaments could be seen as an indication that the figurine was deposited exclusively in a special place far within the interior of the cave and outside the normal work and living spaces. Maybe it was a hiding place and the statue and the other objects were never recovered. But maybe it was a holy location reserved for cultic or shamanistic rituals with the mysterious Lion Man at their centre.

Summary of the modern excavations

In and in front of Hohlenstein-Stadel, archaeological excavations were conducted between 2008 and 2013. Only a few square metres of undisturbed sediment were examined. The excavation areas were very small, the intrusion therefore invasive only on a micro-level. The excavations were carried out to gain a better understanding of the chronological and stratigraphic situation in Hohlenstein-Stadel. After excavating we were able to determine that in front of the cave, as well as in the cave, there are still complex sediments with intact archaeological find layers and numerous finds. This was previously not known. The stratigraphic sequence of the find layers from the earlier excavations was for the most part confirmed. We now have more exact information on the chronological, technological, climatic and ecological context of the known layers from Hohlenstein-Stadel. With our new knowledge we can now consider what would be the most appropriate measures necessary for us to undertake to guarantee the optimal protection of the site, the stratigraphic sequence and the potential future world heritage cultural site.

Conclusions

Excavations have often led to the destruction of stratigraphic sequences in caves. This contradicts the concept of protection for archaeological and cultural monuments. Scientific arguments do exist, though, that endorse excavating in caves. Archaeological excavations in a cave must therefore be carefully considered in terms of whether research or rigorous protection is the better solution. An example here is the attempt of the State Office for Cultural Heritage in Baden-Württemberg to commit to archaeological excavations in caves in a limited manner. Only when a cave or part of a cave is in danger of being destroyed do we endorse rescue excavations. The State Office for Cultural Heritage in Baden-Württemberg grants approval to only a few excavations for scientific purposes. Moreover, it leads its own excavations in caves for purposes of conservation. An example includes the new excavations in Hohlenstein-Stadel that have uncovered new findings related to the status and the stratigraphic conditions in this valuable cultural monument.

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Conclusions and the way forward

Nuria Sanz
Head and Representative of the UNESCO Office in Mexico

From 25 February to 1 March 2013, an international meeting, Human Origin Sites in Eurasia and the World Heritage Convention, was held at the University of Tübingen, Germany, with the participation of 29 experts of 13 different nationalities, representing 25 international institutions. The meeting was organized and financed by the UNESCO World Heritage Centre, the Spanish Funds-in-Trust for World Heritage, the University of Tübingen and the German State of Baden-Württemberg.

The meeting's aims were i) to establish links between scientific research and conservation by achieving recognition of the scientific value of properties related to human evolution; ii) to operate within the framework of the Global Strategy launched by the World Heritage Committee in 1994 to broaden the definition of ‘World Heritage’ and to contribute to an equitable representation of all of our planet’s natural and cultural diversity since its origins; iii) to achieve recognition for sites containing significant traces of early interaction between humans and the earth, early cultural behaviour, cognitive milestones and creative expressions in Eurasia; iv) to conserve listed properties from gradual deterioration on account of their antiquity and the vulnerability of their component materials; and v) to discuss the best practices to preserve the future research potential of records.

Background of the meetings

The meeting was planned as a result of invaluable discussions and recommendations from the UNESCO international meeting, Human Evolution and the World Heritage Convention, which took place from 21 to 25 March 2009 in Burgos, Spain. While the meeting in Burgos focused on sites related to Human Evolution from a global perspective and analysis, this meeting aimed to provide a regional focus in support of the future conservation of human origin sites in Eurasia. It also follows the first and second meetings in a series of regional meetings in the framework of the HEADS Thematic Programme, African Human Evolution sites and the UNESCO World Heritage Convention (Sanz, 2012) which took place from 5 to 12 February 2011 in Addis Ababa, Ethiopia, and Human Origin Sites and the World Heritage Convention in Asia (Sanz, 2014), which took place from 24 to 28 September 2012, at the Jeongok Prehistory Museum in the Republic of Korea.

Within the context of these objectives, three fundamental considerations were requested of participants for the discussions in Germany:

1. The most pragmatic notions to be considered in defining a site related to Human Evolution. Which evaluation features are the most relevant?

2. The most important narrative aspects of the sites in identifying and prioritising possible thematic studies that could be proposed to the World Heritage Committee.

3. Good practice studies to be carried out on an international scale to help the preservation and development of Human Evolution sites (individual sites or clusters of sites benefiting the whole community, and transversal initiatives such as documentation or training networks).

29 participants attended the meeting, including representatives of the Advisory Bodies of the World Heritage Convention, site managers, national, regional and international experts, and representatives of the German Government. At the meeting (as with other UNESCO HEADS meetings), participants were asked in advance to complete a questionnaire seeking their opinions on these issues. The intention was to identify the core issues and values, and the range of concerns expressed by participants from a diverse range of institutions and countries. These opinions have played an important role in informing discussions and in helping us to arrive at a consensus of opinions.
Conclusions and the way forward

The following key areas were elaborated throughout the plenary sessions and Working Groups:
- Narratives
- Criteria
- Interdisciplinarity
- Serial nominations
- Cave Sites and the World Heritage Convention

This meeting provided an important step in strengthening national and regional cooperation and capacities in support of the future protection and sustainability of human origin-related sites in Eurasia. In line with activities of the UNESCO HEADS Action Plan, the meeting also offered a regional platform to evaluate current methodologies for establishing the Outstanding Universal Value (OUV) of related sites for potential future inscription to the World Heritage List as well as developing guidelines on applied research for conservation, and specifically conservation of caves.

This work was primarily achieved through a several multilateral working groups focused on a series of complimentary themes: i) the identification of human evolution narratives for establishing the Outstanding Universal Value of sites; ii) the interpretation of the criteria of the World Heritage Convention in the framework of the principles of the HEADS Thematic Programme and the role of criterion (viii) which states ‘be outstanding examples representing major stages of earth’s history, including the record of life, significant on-going geological processes in the development of landforms, or significant geomorphic or physiographic features’; iii) interdisciplinary approaches for conservation, curation and research; and iv) the viability of serial nomination in the context of the current state of research on Neanderthals; approaches to research in karstic archaeological landscapes, including ethics, techniques and documentation of finds.

The results of these working groups were presented over several days by the invited experts and by means of visits to cave sites in the Swabian Jura of the Ach and Lone Valleys, including the sites of Hohle Fels, Geissenklösterle and the Archaeopark at Vogelherd, where some of the earliest evidence for music (in the form of ivory and bird bone flutes) and figurative art (including mammoths, horses and, most recently, a female figurine) in Eurasia. This multidisciplinary approach to the meeting resulted in a series of outcomes which take into account the exceptional nature of human evolution and, in particular, cave sites when defining a site (as defined by the World Heritage Convention), in addition to determining the best way to identify and preserve its OUV, whilst acknowledging and attempting to ameliorate the tension between the

1 This is covered in a separate document by Dennell, this volume.
Conclusions and the way forward

ethics of site protection and the advancement of scientific knowledge of our shared human origins. To this end, several practical techniques for documentation and conservation were shared, the latest research and theoretical approaches to the Eurasian archaeological record were discussed, and several avenues for interdisciplinary cooperation through all the stages of site research - from discovery to analysis to the permanent curation of excavated artefacts and their attendant records - were established, in light of the implementation of the HEADS Thematic Programme for World Heritage.

Genetic studies

Furthermore, the emerging importance of genetic studies in research on human migrations and dispersals was addressed. Previously, scientists had relied on morphological evidence from human fossil remains, as well as the spread of material cultures, to trace human migrations. The burgeoning field of genetic studies has offered a novel avenue by which to examine human dispersals and migrations. Although it has been cautioned that genetic evidence should be used in conjunction with these traditional methods for tracing dispersals, recent studies have not only been able to pinpoint likely geographic loci for important dispersal and divergence events in the spread of humans across Eurasia, but have been able to place tentative dates on these events, based on extrapolated rates of genetic change. Whilst many of these studies are in their nascence, the field of genetics offers a promising new line of evidence, with provocative new data, that should be considered in concert with traditional biological and material culture based models of human dispersals. A particularly important development that was unthinkable only a few years ago is the extraction of ancient DNA (aDNA) from fossil skeletal remains. As a result, the genetic profiles of several Neanderthals and early H. sapiens have been obtained, and a new palaeospecies – the Denisovans – has been identified solely on the basis of its aDNA.

Narratives of human evolution in Eurasia

In addition to new scientific approaches to the record, certain ongoing narratives of human evolution in Eurasia and their potential OUV were discussed. In Eurasia, narratives of human evolution take place primarily during the Palaeolithic, a human cultural time-period lasting from the first dispersal of our hominin ancestors to Eurasia approximately 2 million years ago, until approximately 18 thousand years ago. This vast swath of human history was notably marked by several migrations and dispersals of hominins out of Africa and across Eurasia, the first evidence and subsequent flourishing of a human symbolic tradition, and witnessed the eventual extinction of every hominin species on earth, save for our own. The working groups took on the task of defining the primary narratives during this major period in human history. Traditionally dividing the period
into the Lower, Middle and Upper Palaeolithic according to shifting material culture phases, the working groups defined the major narratives in ‘becoming human’ for each period. For the Lower Palaeolithic, the initial settlement of western Eurasia was identified. For the Lower and Middle Palaeolithic, the dispersals, interactions and eventual extinction of the different hominin biocultural lineages were identified. For the Late Middle and Upper Palaeolithic, the dispersal and spread of modern humans and the emergence of behavioural modernity were identified. The experts discussed the narratives and the related sites that exemplify them (listed below) and agreed that they constitute the most compelling evidence for Outstanding Universal Value in this period of our heritage.

In particular, the Neanderthal narrative offers potential for a possible serial nomination. Neanderthals were another hominin species that flourished in the cold climates of Eurasia during the Palaeolithic. They serve as a universal symbol for human evolution and are indispensable for our own thinking of human history. Sites throughout Eurasia bear witness to their expansion, their adaptations, their interaction with modern human groups and their eventual extinction. Neanderthals represent our closest relative in the hominin family tree and recent genetic studies have shown that human groups outside Africa all share 2.5% Neanderthal DNA. Neanderthal biology and material culture show the first stirrings of modern brain size, capacity for symbolic thought and burial of the dead that would eventually flourish with modern human groups during the Upper Palaeolithic. Not only are Neanderthals (and their attendant archaeological sites) exceptional among our hominin ancestors, but historically, discoveries of Neanderthal fossils represented the beginning of modern palaeoanthropological discourse, forever altering the paradigms of the story of human origins.

Site protocols

Beyond the compelling human evolution narratives offered in Eurasia and from a practical standpoint, there is still much work to be done concerning protocols for the study, conservation and curation of sites. Though sites are the source and locus of information, the collections of artefacts created by site excavation are an integral part of these sites. This idea that the importance of the movable heritage should be incorporated into the concept of a site and the OUV of a site emerged as an important theme. To this end, several suggestions were made, advocating dialogue between the researchers who discover, excavate and study the materials, and the museum curators who are tasked with the stewardship of the materials for future generations. The extent of these recommendations are detailed below but notably include having a curatorial plan in place from the beginning of excavation campaigns, digitising artefacts as well as excavation records and using technological tools such as cloud technologies to disseminate information in a comprehensive and compatible format.

Because many important human evolution sites are cave sites, owing to the advantageous preservation conditions offered to very ancient deposits by these protected environments, a meeting of experts on issues related to the Palaeolithic was an opportune moment to examine the relationship between the unique case of cave sites and the World Heritage Convention, in terms of the ethics of study and conservation, documentation and techniques. Although the results of these discussions are related in further detail below, several suggestions were made in determining protocols for caves research that take into account their unique and finite nature, their ongoing importance to local cultural traditions, economies and natural ecosystems, as well as the need for flexibility in protocols concerning unexcavated caves, previously excavated caves and rescue and salvage
Conclusions and the way forward

situations. Digital documentation is highly recommended for its comprehensive, low cost and easily transferable nature. The call for interdisciplinary cooperation, and comprehensive recovery and study of materials is of paramount importance, as is the preservation of in situ sediments and stratigraphic sections wherever possible. Caves represent a unique, bounded, often well preserved and finite resource for information about our past, and protocols for their study and conservation should reflect this exceptional nature.

Conclusions from the Working Groups

Three major themes were covered by the Working Groups. These were i) the narratives of human evolution sites in Eurasia; ii) interdisciplinary cooperation for conservation, research and curatorship; and iii) how to improve institutional cooperation standards for research in caves. Each will be considered in turn.

The working groups were invited to support sites that could be considered in the future for possible candidacy, when research has advanced to such a level that the site could meet the requirements of the World Heritage nomination process.

1) Narratives/OUV Human Evolution sites in Eurasia

As background, the following properties on the World Heritage List and the Tentative List have already been identified as some of the most significant Human Evolution related Prehistoric sites in Eurasia:

World Heritage List

France: Prehistoric Sites and Decorated Caves of the Vézère Valley; inscribed in 1979 under criteria i) and iii2); this nomination includes Lascaux, Laugerie Haute and Basse, La Micoque, La Madeline, Font de Gaume, La Mouthe, Le Cap Blanc and Le Moustier
France: The Grotte Chauvet-Pont d’Arc, Ardèche; inscribed in 2014 under criteria i) and iii)
Israel: The Human Evolution sites at Mount Carmel; inscribed in 2012 under criteria iii) and v)
Spain: The archaeological and fossil hominin sites of the Sierra de Atapuerca; inscribed in 2000 under criteria iii) and iv)
Spain: The Cave of Altamira; inscribed in 1985 under criteria i) and iii)

Tentative List

Bulgaria: The Magoura Cave with Drawings from the Bronze, added as a cultural site in 1984
Georgia: the Dmanisi Hominin Archaeological Site; added in 2007 under criteria iii) and v)
Italy: The Lower Palaeolithic Palaeosurfaces at Isernia-La Pineta and Notarchirico; added in 2006 under criteria iii), iv) and v)
Italy: the karstic caves in prehistoric Apulia, including the Grotta Romanelli and Grotta delle Veneri; added in 2006 under criteria i), ii) and iii)
Russian Federation: Bashkir Ural, added in 2012 as a mixed site, under criteria i), iii), vi), vii), viii), x).
Turkey: Karain Cave; added in 1994, under criteria iii) and vi)
United Kingdom of Great Britain and Northern Ireland: Creswell Crags, England; added in 2012 under criterion iii)
UK: Gorham’s Cave Complex (Bennett’s, Gorham’s, Vanguard and Hyena); added in 2012 under criterion iii);

The Working Group considered that there was considerable scope for widening the list of sites, or groups of sites, with Outstanding Universal Value (OUV).
The Main Narrative that was identified was ‘Becoming Human in western Eurasia’ (starting with Homo, and excluding rock art & the Mesolithic).

a) Earliest settlement of western Eurasia (Early Pleistocene, Lower Palaeolithic)

The two obvious ‘flagship’ sites of western Eurasia that contain the most significant hominin skeletal evidence and associated Palaeolithic stone tools are Atapuerca (Spain) and Dmanisi (Georgia). Of these, the Atapuerca group of sites includes Sima
Conclusions and the way forward

Del Elefante, with the earliest skeletal evidence (c. 1.22 Ma) from western Europe; Gran Dolina, with its record of Homo antecessor c. 0.8 – 0.9 Ma, and Sima de los Huesos, with a unique assemblage of 29 individuals of H. heidelbergensis c. 450,000 years old. As noted above, the Sierra de Atapuerca was inscribed as a World Heritage site in 2000 under criteria iii) and iv). Dmanisi, dated at 1.75-1.85 Ma, contains 5 crania and associated post-cranial material of a very primitive form of H. erectus and is currently the earliest site outside Africa with hominin skeletal evidence. Large numbers of stone tools and faunal remains have also been found. This site was placed on the Tentative List in 2007 under criteria iii, v.

Also in Spain, the Orce Basin near Malaga contains the important sites of Barranco Leon and Fuente Nueva 3, dating to c. 1.0 – 1.4 Ma; these contain pre-Achelean, Oldowan type lithic assemblages and associated mammalian remains.

In north-west Europe, evidence as early as c. 1.0 Ma has been found at Happisburgh and Pakefield (UK), and opened a new chapter in the earliest occupation of northern Europe. The site of Boxgrove in southern England is dated to 478-526 Ka, and contains a superlative Acheulean assemblage that is associated with the butchery and possibly hunting of horse and rhinoceros.

There are also important sites that should be considered worthy of World Heritage status in the Jordan Valley. *Ubeidiya* has a long sequence of stone tools associated with a former lake and dated to 1.0 – 1.4 Ma; *Gesher Benot Ya'aqov* (GBY) is dated to c. 0.78 Ma, and contains very early evidence for the hunting of large animals, the use of fire, processing plant foods, and a rich lithic assemblage.

b) Eurasian bio-cultural lineages (Middle Pleistocene/Late Pleistocene and Lower and Middle Palaeolithic)

The Mount Carmel caves of Skuhl, Tabun and el-Wad in Israel are crucial ‘flagship’ sites that document a 400,000 year sequence and the earliest evidence for H. sapiens outside Africa c. 125-100 Ka ago. As noted, these were inscribed on the World Heritage List in 2012 under criteria iii) and v). In neighbouring Syria, there is a very important group of sites at El Khawm, with key sites of Nadaouiyeh Ain Askar and Hummal, that have a long sequence extending back to c. 1.0 Ma. Also in Syria, the rock-shelter of Yabrud has a classic sequence of artefacts extending beyond 200 Ka and the local vicinity contains important Palaeolithic sites.

Europe has the most detailed record of hominin evolution and associated cultural evidence for the Middle Pleistocene (0.78-0.125 Ma). There are several sites or groups of sites that can be highlighted:

Schönningen (Germany): this open-cast coal mine contains numerous lower Palaeolithic sites that include ones with remarkably well-preserved, 350 Ka-old 2-metre long wooden spears and evidence of horse hunting, as well as some of the earliest evidence for using fire.

Torralba and Ambrona (Spain): these two Acheulean sites in the province of Soria are c. 300-400,000 years and are suggestive of the hunting or scavenging of elephants.

The Somme Valley (France): this is the birthplace of Palaeolithic archaeology, as it was here that Boucher de Perthes demonstrated the antiquity of humankind in the 1840’s. Investigations in this valley over the last 160 years has produced
one of the best geological sequences in Europe for the Middle and Upper Pleistocene, and large numbers of Late Middle and Middle Palaeolithic sites.

There are also two groups of sites that could be grouped for a serial nomination. The first are those with evidence of *Homo heidelbergensis*, which was the resident Middle Pleistocene hominin in Europe and the ancestor of Neanderthals. The principal sites that have produced skeletal evidence are Mauer, where the type specimen of *H. heidelbergensis* was found in 1908; Steinheim (Germany), Swancombe (UK), Tautavel/Arago (France), Petralona (Greece); and Sima de los Huesos, Atapuerca (Spain; and already on the World Heritage List).

The second group are those sites with evidence of Neanderthals. In the last glacial period prior to 40 Ka, these lived in all of Europe south of Scandinavia, and eastwards into Israel, Iraq, Iran, and much of Siberia. The principal sites with Neanderthal remains are Forbes Quarry (Gibraltar); La Ferrassie, Le Moustier and La Chapelle-aux-Saints (Perigord, south-west France); Spy (Belgium); Feldhofer Cave (Germany) (where Neanderthals were first recognised as an extinct species in 1856); and Krapina (Croatia). Related ones in south-west Asia are those at Tabun and Kehbara (Israel) and Shanidar (Iraq); and Teschik Tasch (Uzbekistan).

c) The arrival and spread of *H. sapiens* (Late Pleistocene; Late Middle/Upper Palaeolithic).

There are several groups of sites that could be considered in the future as serial candidates:

Kostenki-Borchevo, western Russia: this is an incredibly important cluster of c. 40 upper Palaeolithic sites that provide an almost complete cultural sequence from 40 Ka to 10 Ka. It was discovered in 1879, and excavations here in the 1920’s pioneered the techniques for detailed excavations of open air Palaeolithic sites. In addition to its complex cultural record of stone and bone artefacts, there are numerous examples of structures, hearths, mobiliary Palaeolithic art, and recently, the ancient DNA from an individual that died 36,000 years ago. The importance of these sites is hard to over-estimate.

Pavlov sites (Pavlov, Dolni Vestonice), Czech Republic: this comprises a cluster of sites around the villages of Pavlov, with at least 6 known Palaeolithic sites, and Dolni Vestinice, with at least two sites. The main occupation period dates to c. 29-25 Ka. Besides the evidence for structures and a distinctive material culture (the Pavlovian), the evidence include a unique triple burial at Dolni Vestonice, and some of the earliest evidence for textiles and burnt ceramics,

Swabian Caves, Germany: this is another exceptionally important cluster of sites in the Asch and Lone Valleys of the Swabian Alps, and contains long Middle and Upper Palaeolithic sequences. It is particularly noteworthy for its examples of early sculptures and music The principal sites are Vogelherd, which has produced some of the earliest and loveliest Palaeolithic animal figurines c. 33 Ka-old, Geissenklösterle, which has the world’s earliest flutes, the famous Venus of Hohle Fels (c.38 -33 Ka); and the unique statue of the Lion Man from Hohlenstein Stadel (c. 38 Ka).
Conclusions and the way forward

Wachau sites (Willersdorf I and II, Aggsbach), Austria. This group of site can be regarded as outlier of the Pavlovian sites in the neighbouring Czech Republic. Willendorf is best known for its ‘Venus’ figurine, dating from 25-28 Ka. Pleistocene geologists also know this area well because of its high-quality palaeoclimatic record for the last glacial cycle.

Various other clusters of sites, or individual sites, were also proposed as possible candidates for inscription. Three focused on the late glacial period. These included those in the Paris Basin, with the large and important late Magdalenian camp site of Pincevent; the late glacial sites of Gönnersdorf and Andernach, near Neuwied, Germany, famous for their structures, engravings and figurines; and those in the Neuchatel area of Switzerland, with sites such as Haurteive-Champreveyres, the caves of Kesslerloch and Schweizersbild, as well as large open-air campsites like Monruz and Moosbool.

In occasion of an international meeting, Les Hominidés du Pliocène et du Pléistocène inférieur et moyen dans le monde. La place de l’Homme de Tautavel, un Homo heidelbergensis, il y a 450,000 ans, which took place in celebration of the 50th anniversary of the beginning of palaeoanthropological research in the Arago Cave in France, the world’s most prominent and distinguished palaeontologists came together for a preliminary discussion on the site’s Outstanding Universal Value, how they could develop the site’s unique significance and how to move forward with nominating Arago Cave to the World Heritage Tentative List.

The Crimean Peninsula is another area with several important Middle and Upper Palaeolithic sites that are relevant to narratives about Neanderthal extinction and the appearance of modern humans. Sites include Kiiik-Koba and Kabazi, Starosel’ye, and Ak-Kaya. Another area that was proposed was the Altai region of Siberia, with caves such as Razboinichya Cave, with evidence of domestic dog c. 33 Ka, Okladinov Cave, and Denisova Cave, the source of the Denisovans, known only from their ancient DNA. Finally, there are the ‘Grimaldi sites’ of Italy, with sites such as Arene Candide, Balzi Rossi, Barma Grande and Riparo Mochi. As a ‘stand-alone’ proposal, Sungir (near Moscow, Russia) was
Conclusions and the way forward

mentioned on account of its superlative double burial of two males with ivory spears and thousands of beads that would have decorated their clothing when buried c.30 Ka-ago.

It was evident from the discussions that several other narratives could be developed that encompass the origin, dispersal and adaptability of *Homo sapiens* in Eurasia. Although the data are variable in both quality and quantity, there is potential for developing the Middle and Upper Palaeolithic records into such narratives. Potential areas for such developments are parts of Iberia, Italy, the Caucasus and Zagros Mountains, the Upper Dnepr; northern Spain and south-west France regarding the Solutrean; Siberia, with its rich record of sites such as Mal’ta, Buret and Yana; and Lebanon and southern Turkey, with sites such as Ksar Akil, Beldibi, Belbasi and Ucagizli.

2) Interdisciplinary cooperation for conservation, research and curatorship

a) Protocols for sites

In terms of interdisciplinary cooperation for conservation, research and curatorship, the Working Groups agreed that protocols for sites should be implemented. Sites constitute the locus and focus of all information, even if materials are dispersed throughout the world, as has typically happened in the past and still continues to happen today, with sample and other data ending up in international institutions or in the hands of specialists. It was emphasized that all this data are essential to archaeological sites and protocols must be put in place to properly record, curate and make accessible the data. In addition, sites should be clearly identified with coordinates. The experts suggested that an international coordinate system be established with mechanisms to integrate older, disparate coordinate systems. Whenever possible, it is important to use GIS and other database technologies that facilitate the integration and transfer of, among other things, information about sites, landscapes and objects among researchers. Additionally, stratigraphic sections and a sizeable part of the deposit must be retained at sites. The use of non-destructive techniques for site and artefact recording (laser scanning, remote sensing - geophysics on a smaller-local scale), including technologies that make use of open-access sources are recommended. Special focus was placed on digitalisation, particularly in the case of rock art sites that are at risk, with a call for efforts to be made to digitise raw data, field notes and publications.

It was agreed that raw data, field notes and publications concerning sites.

b) Protocols for Movable Heritage

Concerning movable heritage, context is key to the value of a site (for example, metadata - notes, objects, samples and so on). Collections (movable objects, records of excavations, notes and so forth) are a fundamental part of sites and this notion should be integrated into the concept of a site and its OUV. Furthermore, the potential for site inscription should explicitly take into account the state of the excavated materials, wherever they may be. Therefore, clear, scientifically informed guidelines should be defined for the preservation of artefacts in museums (including, among others, bones, samples of sediments, specialist samples). To this end, communication should be fostered between museums and researchers concerning the optimal nature of conservation and what constitutes useful retention of materials for future researchers. Accordingly, the role of museums is an essential aspect of the preservation of sites. Protocols must be defined for the curation of materials in the long term, from the start of the planning of excavations. As such, it would be useful to provide a network framework that makes expertise of professional conservators readily available to excavators and institutions responsible for finds. With new technologies of documentation, it is less necessary to circulate original materials; the information can be circulated digitally. The use of standard protocols for archives, GIS data, geographical positioning and other numerical data formats is strongly recommended. Taking into account that collections are spread out among many different and far flung museums, records of finds should be hosted at a global level for these sites. New technologies, such as cloud technology, can vastly improve the visibility and dissemination of information to researchers and public.

UNESCO’s role in the process is to centralise and standardise information on an international level and create a platform for interaction with national and international researchers.
3) How to improve institutional cooperation standards to research in Caves - Cave Sites and the World Heritage Convention

a) Ethics

Cave sediments are a unique and finite resource, and the need for their preservation needs to be considered in relation to the need for investigation of research questions by excavation. (Caves here refer to caves in a generic sense, but also to rock karstic fissures, collapsed caves and artificial caves). Excavation should be, therefore, a matter of last resort and justified only by specific research questions. As cave sediments and overall context entrance can form over very long periods and preserve multiple types of evidence on past environments, they are an obvious and major archaeological resource.

Caves are not static entities but are, instead, a continuous process of active cultural and ecological processes, and archaeology should be respectful of these. Caves may evolve and even disappear (for example, Qesem) but the deposits may still be preserved.

Caves may have multiple stakeholders; they may have local economic significance (guano, fossil bone). In some situations (for instance, Australia) caves may possess spiritual or other relevance to present-day residents and their viewpoint must also be respected. Caves may have current economic significance to hunter-gatherers, pastoralists and/or farmers, and their needs should be respected. Caves may also have important ecological significance (for bats, for instance.). They may have or have cultural or iconic significance in the present for both the public and the research community. The protection, conservation and investigation of caves can therefore raise complex and sometimes conflicting demands that need to be addressed on a case by case basis. Some current practices and beliefs can help maintain the authenticity and integrity of a cave; others may have a negative impact. The guiding principle therefore, should be to support all measures by the local and research community that protect and conserve the contents of caves.

Cooperation relating to research in caves should involve speleologists, ecologists and other branches of expertise. To illustrate this point, it is worth mentioning that Sima de los Huesos (Spain) and Peshtera de Oase (Romania) have produced some of the most important human skeletal evidence in Europe, and were discovered by local amateur speleologists.

Concerning unexcavated caves, upon discussion of whether all periods of occupation should be treated as having equal significance and whether archaeologists should decide what deposits are more important than others, it was determined that, ideally, later -Holocene- deposits should be investigated with the same rigour as the underlying Palaeolithic deposits. In many situations, this is difficult when the funding for excavation requires that the pre-Holocene deposits be prioritised. In any event, it was agreed that care must be taken to document the rational used for excavation and to provide information that can be used in at least general interpretation of other occupation levels.

As cave sediments are a unique and finite resource, it is vital to ensure that only the minimum amount is excavated so that they are still accessible for later generations. The experts convened that measures should be put in place to ensure that the circulation of visitors is regulated in order to minimise degradation of the local environment of the cave. Furthermore, it was agreed that it is paramount that cave sediments be protected against any illicit interference. Although it is not possible to protect every cave by, for example, secure gates, there should be procedures in place for regular monitoring. This work may involve other agencies, such as parks and wildlife authorities. Any investigation of cave sediments or contents should be at the highest international standards, and moreover, that that the recording, conservation and curation of excavated materials should be automatic and equally, at the highest international standards. Investigations of caves should also take into account the need to protect the long-term future of the cave as part of the local heritage and not just the immediate research objectives of the excavation. Cave investigations should also include local preservation of the cave, and the interpretive requirements for the local and wider community.

It is highly recommended that research investigations of cave sediments should also maximise the sharing of good/successful practices to ensure the most successful and cost-effective measures for conserving remaining deposits.

With regards to caves excavated a long time ago, experts convened that re-excavation should only be attempted with clear, planned research questions and not simply to recover more material. Priority should also be given to the re-excavation of the deposits removed in their original excavation.

In terms of rescue and salvage investigations, any legislation covering archaeological programmes should also include caves and fissures. There is also a need to assess the type and degree of risk (for instance, climate change, war, earthquakes, quarrying) in situations where caves are threatened. In karstic areas, collaboration with geologists is required as they are vital partners in devising appropriate measures. Although it is rarely possible to conduct investigations at the highest...
international standards in rescue situations, the methods used should be at the highest standard in relation to the immediate situation.

Regarding documentation, the goal is to digitalise it, making it easier to combine in a general database and thus, making it more accessible. Furthermore, this accessibility makes it easy for the public to obtain information of the location of data. Digitalised, documentation and objects, items (artefacts, environmental samples and so on) are easy to combine.

It is essential that back-ups and copies of everything that is digitalised be secured in the different responsible institutions (for example, in museums, excavators and so forth). All this digitalisation calls for decisions to be made on how to deal with the purely digitized documentation and questions such as if it makes paper documentation redundant must be tackled. The issue of what types of software must be used as well as the medium of digital storage must be addressed, as well as the paper copies of central part of documentation.

b) General

Caves are unique, well-defined spatial entities, with detailed cultural-stratigraphical sequences. They provide a space of outstanding preservation for their content and are invaluable natural archives. Long-term research commitments regarding caves should take into account their volume and surfaces.

Objects recovered from caves and their corresponding documentation should be stored in one and the same archive, and security of all digital documentation (curation, software, backups and so on) should be made a priority. If the data is centralised, this location should have an emergency strategy in place and there must be secure access to data within working groups (with a common database structure and central server).

Partnerships must be formed in order to establish a shared basic standard of storage (of materials and documentation) and in the same vein, multidisciplinary studies must be harmonised and correlated. An issue to be addressed is the longevity of the inscription of artefacts.

Explicit recommendations are required in order to deal with different standards (worldwide perspective/partnership/support network) regarding the stage prior to excavating an untouched site. Considered essential within this context are the following: explicit research design; conservation plans (based on several sources of information and materials); long-term plans for handling the data collected; procedure/transparency/contract form documentation if samples/materials are given away; final long-term storage after field work and analysis are finished (objects and environmental data); and the cost-benefit of future excavations.

During ongoing excavations, essential are transparent modernisation of techniques and methods of documentation, integrated datasets (old and new) and a compromise between conventional and digital documentation (for example, limestones hand drawn, digital measurements and photographs).
Conclusions and the way forward

Studying past excavations, research-design (witness blocks, in situ documentation - storage off-site and so forth) are considered paramount, as is the documented monitoring of what is left after an excavation (for instance, change in cave walls and so forth) and the digitalization of older documents. Before starting any new fieldwork, it is essential to analyse existing data and finds.

Salvage excavations require flexible response and pragmatic documentation. Furthermore, there is a need for partnerships and support networks, as well as data collection of sites and cartographies (especially for linear projects).

c) Techniques

The techniques used in cave excavations should be ethical, and two levels of recommendations are necessary and recommended. It is important to start with ethics, continue with techniques and end with documentation. Explicit research, scientific and preservation questions and goals must be clearly outlined. Archaeologists should recognise that caves record not just human materials, but also palaeoenvironmental and landscape change information and the techniques should be appropriately selected. The first step requires non-invasive techniques, then a systematic survey/geological survey and documentation of site location. It must be followed by geomorphology carried out by geologists (a 3D scan of a cave, a geophysical analysis of a cave and the cave sediments). A 3D spatial control of the excavation (grid, total station: including free software for field documentation with total station) is needed to highlight stratigraphic excavation (arbitrary stratigraphic excavations should be avoided whenever possible, even in the case of urgency).

Excavation should be as limited as possible (it should answer the research question and the goal of preserving material for future research) and the excavators should attempt to preserve a connected stratigraphic sequence across the site. This should be supported by the geophysical data.

Essential is 3D measurement (XYZ) of all classes of artefacts and samples, and appropriate tagging and tracking of materials: bucket/abtrag method (measurement of each excavated unit), measurement of stratigraphic contacts, measurement of features, both anthropogenic and natural.

A cave’s profile and features must be documented in the form of drawings, geological descriptions and photographs, and profiles and photos must be linked with 3D plots.

Geological features must be recorded, such as the strike and dip of artefacts.

When dealing with the recovery of microartefacts and microecofacts, screening should be required, and when possible and appropriate wet screening and flotation. Screen size should be selected to appropriately answer the research question.
d) Multi-disciplinarity

Excavations should be a multidisciplinary project and should include experts on geoarchaeology, archaeobotany, zooarchaeology, dating, archaeometry and isotopic research. Members from each specialization should be present at the site when possible and should communicate with other members of the team when sampling and analysing materials.

Useful methods that should be appropriately selected consist of:

- Geoarchaeology: Micromorphology, FTIR, sedimentology (granulometry and so forth), magnetic susceptibility, geochemistry. Examples should be collected from a wide range of methods, including blocks and loose deposits. Future methods or research questions should be considered and site formation processes should be emphasized;

- Zooarchaeology: the recovery of all size classes of faunal material, which highlights taxonomic, palaeoenvironmental, human behavioural and taphonomic analysis;

- Isotopes: faunal, human bone material, speleothems and shells, for diet, migration and climate reconstruction;

- DNA: appropriate considerations must be taken during sampling for DNA in the field to avoid contamination;

- Archaeobotany: anthracology, carpology, phytoliths, pollen and diatoms, integrated within general sampling strategy and emphasizes palaeoenvironment and behavioural analysis;

- Dating: depends on the condition of caves. Dating experts should be made part of the research group when at all possible (OSL, ESR, Palaeomagnetism, TL, U-series).

Physical anthropological analysis should be carried out on human fossils.

d) Post-excavation

Post-excavation, a certain portion of the research budget should be set aside for the preservation of the sequence and this should be carried out on an individual case basis.

There is a lack of expert knowledge in this field. It is thus essential to promote research of the long-term preservation of stratigraphic profiles. The overwhelming response from the Tübingen meeting is that UNESCO should sponsor a meeting on this topic, with the participation of archaeologists, geoarchaeologists, geotechnicians/engineers and conservators.

With regards to caves excavated in the past, an attempt must be made to combine past research with current and emerging research, in order to re-evaluate different aspects, such as dating, in new excavations.

Concerning urgent rescue situations, documentation and conservation must be carried out if possible. Sampling should be highlighted and excavation procedures adapted.

Concluding comments

The Tubingen meeting accomplished a great deal in establishing narratives of human history that could be applied to the rich Palaeolithic record of Eurasia, and also in addressing the complex ethical and technical issues concerning the investigation of the cave sites that are so fundamentally important to those who investigate and promote the study of human evolution and the Palaeolithic. The meeting built on the successes of earlier meeting in Burgos (2009), Addis Ababa (2011) and Jeongkok (2012), and was carried forward to subsequent meetings in Puebla, Mexico (2013, 2014) and Ankara (2014). As such, it was therefore a work in progress, the success of which will be measured by the extent to which the deep history of humankind is properly represented in our World Heritage.
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Conclusions and the way forward


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