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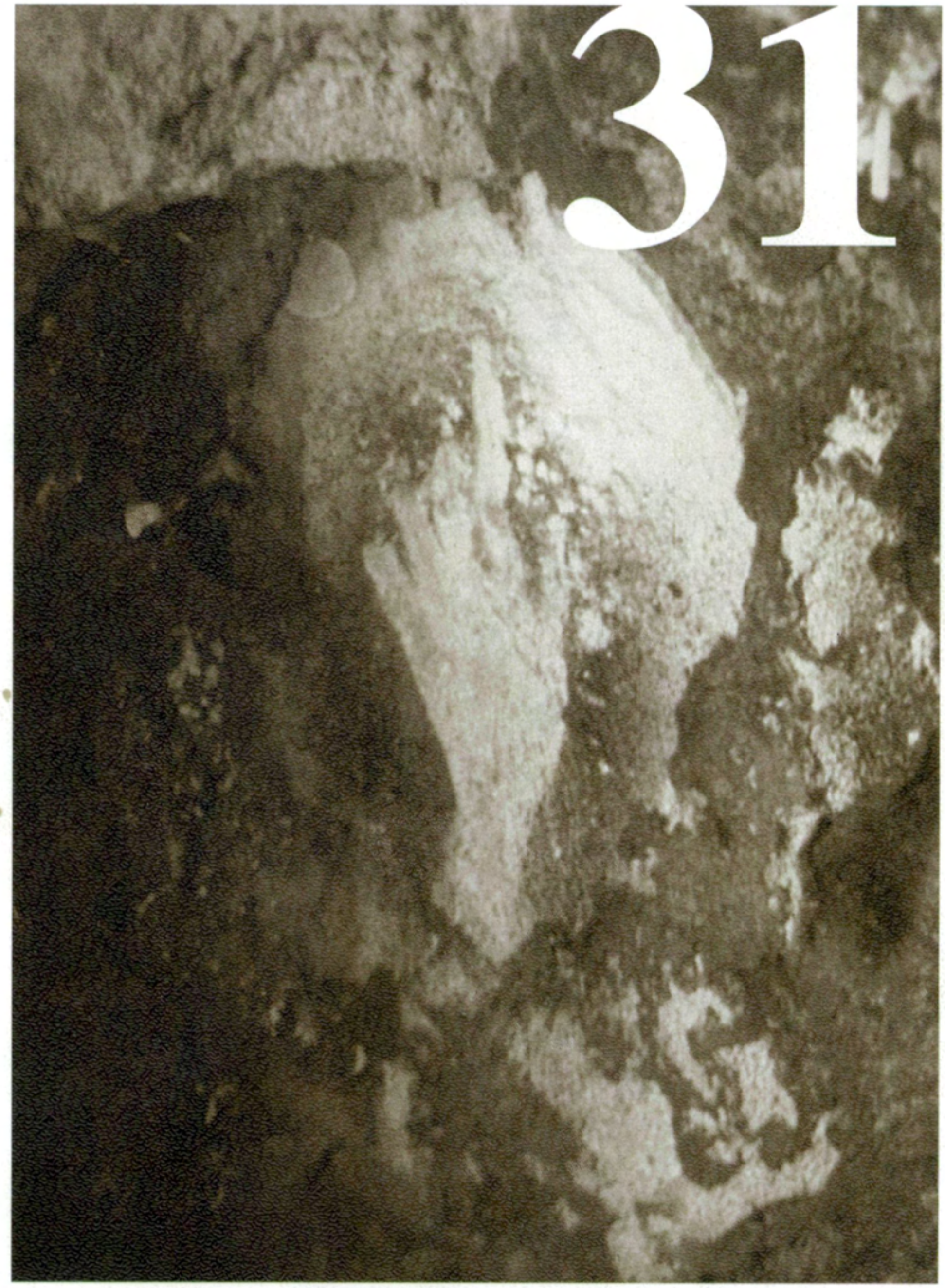

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HUNTERS OF THE GOLDEN AGE

THE MID UPPER PALAEOLITHIC OF EURASIA 30,000 – 20,000 BP

EDITED BY WIL ROEBROEKS, MARGHERITA MUSSI,
JIŘÍ SVODOBA AND KELLY FENNEMA

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Faculty of Archaeology
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Margherita Mussi
Wil Roebroeks
Jiří Svoboda

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1. Introduction

In the last two decades palaeoanthropologists have paid considerable attention to the emergence of modern humans, and in archaeological terms, to the Middle to Upper Palaeolithic transition (e.g. Farizy 1989; Mellars and Stringer 1989; Mellars 1990; Cabrera Valdés 1993). One of the consequences of this focus has been the fact that differences between the two periods were underlined and investigated, while the variability *within* the periods at stake has been overlooked and underestimated (cf. Gamble and Roebroeks 1999). This last issue was one of the explicit research topics of the Network on the Palaeolithic Occupation of Europe, a group of researchers who organised a series of workshops dealing with various aspects of the European Palaeolithic, within a programme funded by the *European Science Foundation*[1]. Their work on the Lower and Middle Palaeolithic has been reported in two earlier volumes published by the University of Leiden (Roebroeks and Van Kolfschoten 1995; Roebroeks and Gamble 1999).

This volume is the outcome of a workshop dedicated to the period 30,000 to 20,000 bp[2], though the total number of contributors is significantly larger than those originally present at the meeting, which took place near one of the key sites for this period, Pavlov in the Czech Republic[3]. A wider geographical coverage is presented here, together with important case studies and papers dealing with general topics.

One of the reasons to focus on this period was the fact that its rich record had seen relatively little scientific attention yet. The final phases, around and after the Last Glacial Maximum (LGM), have actually had their share of attention (e.g. Gamble and Soffer 1990; Soffer and Gamble 1990), but the preceding ten millennia had been rather neglected in terms of general syntheses, except for one notable exception (Amirkhanov 1998). This is even more striking if one realises that most European citizens are to a certain degree 'familiar' with some of the archaeology of this period, as they would certainly recognise the famous female figurines as dating to the 'Stone Age'.

The complex evidence from this period has often been interpreted as basically reflecting human responses to the deteriorating climate, while the latter was turning more extreme at its end, i.e. at the LGM (Gamble 1986; Soffer and Gamble 1990). One of the aims of our workshop was to test this basic assumption, by collecting and combining information on ecology and material culture from various key regions in Eurasia. What became immediately clear was that the cultural developments of this period were not simply triggered by climatic stress (Mussi and Roebroeks 1996 – see below), and that the archaeological record displayed both a large-scale uniformity and a high diversity in such domains as art and ritual, subsistence and settlement structures (see below). The period at issue is one in which we have for the first time a rather fine chronological resolution, which allows to consider presence and absence of human populations in various regions of Eurasia, as well as to chart periods of intense occupation against those of more ephemeral presence of humans. This gives us the exciting perspective of starting to study cultural developments as historical processes, rather than as mere reflexes to climatic developments.

2. The Golden Age: What's in a name?

Belief in progress is a relatively recent phenomenon in western civilisation. As mentioned by Cartmill (1993), western – as well as far eastern – discourse on the history of civilisation was for a long time dominated by the idea of degeneration. In such a perspective, a hypothetical Golden Age – or, in the Far East, the time of 'Masters' and 'Ancestors' – was followed by culturally much poorer periods. In fact, the use of the term 'Golden Age' still carries the feeling that things have got worse since a specific point in time. In this case, our time of departure is the period 30,000 to 20,000 bp, the Golden Age of hunter-gatherers. We feel that this period deserves this name for a variety of reasons, all dealing with the unprecedented complexity of the archaeological record from this time span, which will be appreciated by any reader going through this review of the main themes dealt with by the contributors. Suffice here to say that in this period we find, amongst others, the first unambiguous burials left by modern humans after the Middle Palaeolithic, the earliest *bona fide* habitation structures, and an unprecedented sophistication in raw material requirements which involves provisioning strategies over hundreds of kilometres. Furthermore, while this view of the period as a

Golden Age is certainly to a high degree steered by our esthetical appreciation of the material culture, ecological information suggests that the richness and diversity of species thriving on the Mammoth Steppe may have indeed afforded people with an affluent environment. In fact, this is also suggested by the physical anthropologists' studies of the palaeontological remains, which create an image of a well-nourished population experiencing not only a cultural, but also a caloric Golden Age.

The end of the 'Golden Age' is even more clear cut. The major environmental crisis of the LGM, shortly before 20,000 bp, leads to the depopulation of vast stretches of Eurasia, to the disruption of settlement patterns, and, as the physical anthropologists show here, to the end of the large-scale open networks through which genes flowed freely. The Golden Age ended with a classic degeneration phenomenon: inbreeding.

3. Life on the Mammoth Steppe

In their contribution to the volume, Guthrie and Van Kolfschoten stress the "no-modern-analogue" character of the palaeoecology of the period which, furthermore, can be characterised as ecologically unstable. While their perspective encompasses, with the Mammoth Steppe, a super-continent – Eurasia, Beringia and northwestern America –, information gained from specific areas mostly supports their large-scale reconstruction. In Italy, for instance, swift oscillations in the percentage of arboreal pollen are known throughout OIS 3 (Follieri *et al.* 1998). In northern Europe, Kolstrup (1995) likewise concludes, after a thorough analysis of palaeobotanical evidence, aeolian deposits, frost wedge casts and other periglacial processes, that the 30,000 to 20,000 bp period is characterised by swift environmental changes and a high diversity of sub-environments, even over short distances (see also Haesaerts *et al.* 1996). Ecological instability would have selected for large herbivore behaviour which was rather nomadic than territorial. This, in turn, must have had important implications for human mobility strategies, as well as for the changing distributions of human populations over Europe. In fact, this may be the driving force behind the pattern observed by Pettitt, who notes that when the number of radiocarbon determinations for northern Europe decreases, they increase in southern Europe, and vice versa (Pettitt, this volume). On a smaller scale, ecological instability and the resulting higher mobility of game must have set an extra premium on the choice of strategic hunting locations. This may explain the richness and complexity of the aptly named "megasites", such as Pavlov and Dolní Věstonice, overlooking the Moravian geomorphological corridor (Svoboda *et al.*, this volume). Comparable factors may have been behind the striking consistency in location of for instance the much poorer Belgian and British cave and abri sites in the norther periphery (Roebroeks, this volume).

This brings us to the topic of the importance of hunting in this period. This is a subject somewhat difficult to evaluate as most studies dealing with subsistence simply assume – rather than demonstrate – that the presence of bones of large mammals at a site testify to former hunting activities. This approach is in sharp contrast with studies of the Middle Palaeolithic, where the impact of human activity on bone assemblages is rarely taken for granted and usually discussed at great length (Roebroeks and Corbey, this volume). Notwithstanding this state of affairs, there is plenty of evidence for hunting of medium to large sized herbivores, even though some ambiguity still surrounds human involvement with the largest member of the Mammoth Steppe guild, the mammoth itself (see Musil 1994 vs. Soffer 1993). Mammoth hunting is dealt with by several contributors to the volume, but especially so by Hahn and Oliva. As already mentioned, the final outcome of human interaction with their variable and unstable environment was a well-nourished and healthy human population, which is demonstrated by the analysis of Churchill *et al.* (this volume). That same study also undermines the well-established view of males as hunters provisioning dependent women and children – such as visualised by Zdenek Burian and countless other reconstructions of palaeolithic life: they actually suggest that palaeolithic women could have been engaged in regular weapon-use behaviour. Following another line of evidence, the exceptionally well-preserved record from Moravia, Soffer (this volume) also challenges this idea of male-dominated food procurement strategies. In her interpretation, net hunting of smaller game was practised with the active participation of women and children. Likewise, the evidence for grinding from these Moravian sites (Svoboda *et al.*, this volume), just as from the Rhineland and Kostenki IV (Bosinski, this volume) indicates that there was more than just meat at stake in the Mammoth Steppe menu.

A comparable complexity characterises other aspects of life in the Mid Upper Palaeolithic. Soffer (this volume) discusses at great length both textile and ceramic production, well-documented at the Moravian sites, while Mussi *et al.* (this volume) stress the complexity of ivory working and the ingenuity in transferring working techniques from one class of raw materials to another, i.e. from ivory to soft stone. The first unambiguous evidence for habitation structures dates from this period, with Iakovleva as well as Svoboda *et al.* presenting data from the gravettian sites in the Russian plain and Moravia. Vasil'ev (this volume), however, mentions that Mid Upper Palaeolithic habitation structures from Siberia are more problematic. New developments in the study of palaeolithic parietal art show that an increasing amount of parietal art can be positively attributed to the Mid Upper Palaeolithic (Clottes, this volume; Djindjian, this volume), once again underlining its cultural richness and complexity. Comparable information can be derived from the intricacies of personal ornaments (Taborin, this volume), as well as from the rich burials.

Dealing with a period of 10,000 years only, and taking into consideration the relatively large number of buried individuals, one can start discussing variability in mortuary behaviour. While regional patterns seem to emerge in this period (Mussi 1995), Oliva's contribution on the Brno II burial (this volume a) clearly shows that considerable variation can be expected, apparently reflecting differences in individual status. In the same perspective, a recent study of the spatial distribution of scattered small human bone fragments from Dolní Věstonice points to differential treatment of individuals after death, possibly reflecting social differentiation (Trinkaus *et al.* in press). At Grotta Paglicci in southern Italy, where two well-defined burials were discovered, fragmented and dispersed human remains were similarly reported (Borgognini-Tarli *et al.* 1980). This might also point to differences in the status of the deceased, in accordance with the hypothesis put forward by Mussi (1986, 1990) that the gravettian burials of Italy refer to a well-defined segment of palaeolithic society only. Two thousand kilometres to the east, Iakovleva' s study (this volume) shows how different sets of figurines are bound to specific locations within a site, suggesting that the spatial distribution might reflect a population which was articulated into sub-groups.

The large distances over which lithics were transported are underlined in several contributions, dealing with regions located from the Atlantic to Siberia. It is a recurrent pattern, for instance, in the Rhine valley (Bosinski, this volume), the Danube valley (Scheer, this volume), Moravia (Oliva, this volume b; Svoboda *et al.*, this volume) and the Russian plain (Boriskovskij 1963; Mussi and Roebroeks 1996). Shell transport, which at times exceeds 1000 kilometres, as from the Mediterranean shores to the German Rhineland (Bosinski, this volume; see also Taborin, this volume), provides further evidence of transfers over long distances. Another indication for such direct and indirect contacts can be found in the strikingly formal and technical similarities in anthropomorphic figurines, as detailed by Mussi *et al.* (this volume). Corroboration of the existence of continuous exchanges comes from the physical anthropologists' contribution to the volume. They quite convincingly show that not only ideas and materials were travelling, but that genes were also flowing freely between the various regions (Churchill *et al.* this volume).

4. A regional survey

The regions dealt with in this volume vary significantly in terms of density of traces of human occupation. Some are even devoid of such traces or have only a very poor record yet, while others are extremely rich, though in most cases this only applies to a part of the period at stake here (see below). Absence of evidence is not evidence of absence, and Larsson (this volume) underlines that in the context of herbivore presence, the lack of traces of humans is a striking phenomenon in Scandinavia, which may have been caused by the destructive processes of glaciation and deglaciation in this area. That temperature indeed cannot have been the only factor behind void areas is dramatically illustrated by Pavlov and Indrelid (this volume). They present sites from the very northeast of Europe, even from north of the Polar Circle, up to 68^0 N. The northernmost one has actually only been recently discovered, once again suggesting that current site distribution might be a pale reflection of past patterns – especially so in areas which either have become the focus of archaeological investigation in the last few years only, and/or have been subjected to large-scale destructive natural processes. The small number of sites is scattered between 36,000 and 20,000 bp, and the affinities of the various lithic assemblages with those from elsewhere in Eurasia is still subject to debate. Destruction of sites by geological processes and lack of research are also at stake in the record from Siberia, presented in the up-to-date synthesis by Vasil'ev (this volume). Despite this, Siberia is quite rich in terms of art, burial and dwelling structures, an eastern counterpart of the megasites west of the Urals. Vasil'ev, however, stresses that as far as the lithic assemblages are concerned, there are marked differences with Europe, and that within Siberia itself the lithic assemblages display considerable variability. The Siberian record further shows that site density somehow increased between 25,000 and 20,000 bp, although temperatures were lower than during the preceding 5000 years.

The rich Central European evidence and its chronology provides us with a mirror image of the Siberian and East European record. As a result of settlement density, long history of research and good preservation, we have a detailed view of the Mid Upper Palaeolithic of the area, which allows making inferences on the chronology and direction of shifts in occupation (Neugebauer-Maresch 1999; Dobosi, this volume; Oliva, this volume; Svoboda *et al.*, this volume). Whereas a few sites such as Willendorf II provide continuous stratigraphic sequences, the large number of radiocarbon dates from Moravia and Lower Austria shows that most settlements date from the pavlovian period, shortly before 25,000 bp. Later, there is a slight eastward shift in occupation from Moravia to western Slovakia (Hromada 1998). By the same time, we also observe more direct relationships in lithic tool-types, such as the Kostenki projectiles and other cultural patterns of the willendorfian-kostenkian period, between Central and Eastern Europe – as if, by the LGM, human groups were more and more centring on the East European river valleys (cf. Soffer and Praslov 1993; Amirkhanov 1998).

There is also a sharp contrast between the megasites offering a complex archaeological record, which are strategically located within the Moravian geomorphological corridor, and sites further away. Dobosi (this volume) follows the limited site distribution into the Carpathian basin, up to the mountain ranges. To the south, site density is even lower: Montet-White, while mentioning the impact of widespread erosion on site preservation, presents a reconstruction in which the Sava Basin was largely depopulated. The shift in population – towards the north and to the Carpathian basin – apparently happened as early as 28,000-27,000 bp. This is in good accordance with Perlès' (this volume) detailed presentation of the near absence of archaeological evidence from Greece and the southern Balkans after 30,000 bp.

In the western periphery of Central Europe, i.e. in southern Germany and in the Rhine valley, the record is poor if compared to Moravia (see contributions respectively by Hahn, Scheer and Bosinski). Another striking difference is that, just as in most of Western Europe, the south German record is mainly a cave one. In Moravia caves do exist, which were settled before and after the Gravettian. Humans, however, only very rarely made use of the natural shelters during the period considered here. In the Rhineland open air sites are actually known, together with caves (Bosinski, this volume), a pattern of settlement which also applies to northwest Europe, as reported by Roebroeks (this volume). These are all well-researched areas, and the small number of sites is certainly not the outcome of lack of investigations even if, once again, geological processes may have played a destructive role, as discussed by several contributors. Thanks to a very fine-grained chronology, which includes both AMS ^{14}C dates (Street and Terberger, this volume) and evidence of real contemporaneity when sites are connected by refitting (Scheer, this volume), these regions give us a high resolution image of scattered human groups. The extensive survey by Street and Terberger (this volume) also shows that most of the German gravettian sites date from before 25,000 bp. Smaller pulses of human presence are known later, as elegantly underlined further to the northwest by recent dating work at Paviland Cave in Wales (Aldhouse-Green and Pettitt 1998; Roebroeks, this volume). Quite poor in art, the northwest has yielded all the same an unambiguous burial, the 'Red Lady of Paviland', which is actually a young and tall male. In the North European plains, the lack of any evidence of occupation on the northernmost fringes, when compared to the archaeological record at the southern border (southern Belgium, the Middle Rhine area, etc.), suggests that environmental constraints indeed played a role in site distribution, and in the discontinuous peopling of the region. This might also put the absence of traces in Scandinavia in a different perspective (see above).

Southern France is a unique area in this regional synthesis, as it is the only region where the record suggests (near) continuous occupation over the whole period at stake. This is mainly a cave and abri record, as underlined by Djindjian (this volume), though among the few open air sites some have yielded very clear-cut remains of habitation structures. The richness of parietal art of this area, as also underlined by Clottes (this volume), needs no further elaboration here. French archaeologists have invested a considerable amount of energy in the study of the flint industries from this period, which here include solutrean assemblages. The contributions by Djindjian and Rigaud show that there is still debate on the intricacies of the established schemes. Long-distance transfers of raw materials are common, and Djindjian suggests that some of the open air sites in northern France, dealt with by Roebroeks (this volume), may have been the result of seasonal hunting expeditions by groups based in the south. Given the richness and the long research history of the Mid Upper Palaeolithic of this area, it is noteworthy that no burial can be unambiguously attributed to the period 30,000 to 20,000 bp.

The Iberian record is a very different one. Continuous occupation possibly occurred in some areas, but recent research has highlighted that this could have been because of a complex scenario, in which modern humans were contemporaneous with the very last Neanderthals (Vega Toscano, pre-circulated paper; Vega Toscano 1990; Villaverde and Fumanal 1990; Zilhão, this volume). Late Mousterian as well as late Aurignacian co-occur in the south of the peninsula at around 30,000 to 28,000 bp. Then, they both disappear, 'wiped out', so to say, by the Gravettian, which is followed by the Solutrean. In this highly articulated sequence of lithic assemblages, apparently related to competing groups, ritual and symbolic activity is relatively scarce. It is mainly documented by cave painting at a limited number of aurignacian, gravettian and solutrean sites (Clottes, this volume), and by a single indisputable burial, the recently discovered Lagar Velho child (Duarte *et al.* 1999). Parietal art, however, is known here also in the open, with the most important site cluster recently found in the Côa valley of Portugal. As mentioned by Zilhão (this volume), a significant part of these petroglyphs could date to the latter part of the period examined here.

Turning to the other southern peninsulas of Europe, the changes from 30,000 to 20,000 bp produce an even different scenario. Greece, as already noted, seems to have been more or less abandoned because of the extreme aridity, while Italy, just as Iberia, experiences a peopling from the north, but under very different conditions (Mussi, this volume): there is no late Mousterian there, and there is even an occupational hiatus after the Aurignacian, which does not seem to have lasted after 30,000 years ago. The number of gravettian sites definitely increases after 25,000 bp, and all over the period there seems to be an influx of people arriving from north of the Alps. Compared with a relatively low number of sites, both portable art ('Venus figurines') and burial practices are documented with a richness unknown elsewhere in Western Europe.

5. Diversity and uniformity

The survey of the themes dealt with in this volume clearly shows that the Mid Upper Palaeolithic is characterised by both diversity and uniformity in various domains of life. To start with, the evidence from Iberia – and from Croatia as well (Smith *et al.* 1999) – strongly suggests that there was not even one single human species around. On the other hand, the palaeontological evidence suggests that the modern human population of this period was very uniform, freely exchanging genes over large areas. These human groups created a diverse archaeological record, both through time – e.g. the sequence of Aurignacian, Gravettian and Solutrean in western Europe – and in space – e.g. the lithic assemblages of Europe which are very different from those of the Urals and beyond. And even within the general uniformity of the Gravettian, the best represented tradition in this period, differences in time as well as in space are conspicuous. Notwithstanding this fragmentation, we have all kinds of evidence that groups scattered over vast stretches of Eurasia were able to articulate a joint identity by means of large-scale networks, all the more striking because of the very low demographic density.

Thanks to the high resolution of the record, we can observe movements not only of raw materials and artefacts, but also of people. This includes both the colonisation of unoccupied territories, such as northeastern Europe, and a denser pattern of settlement in areas previously characterised by ephemeral human presence, such as eastern Europe and Siberia. The European record also allows us to follow shifts of occupational centres, especially in the second half of the 30,000 to 20,000 time range: most notably, those from central to eastern Europe, and the population influx into Italy and Iberia. Meanwhile, northwestern Europe and the Balkans were less and less often visited.

While these large-scale movements may have been steered by the deteriorating climate of the second half of the period, this volume shows that clear-cut correlations between climate and human adaptations are not warranted, except at the very peak of the LGM. Because of the overall ecological instability, human groups probably did not even have a direct perception of a steadily deteriorating climate. The fact that the marginal and 'difficult' areas of the northern plains of Europe were never totally abandoned can also be seen in this perspective. Overall, the studies reported in this volume challenge simple environmental perspectives and deterministic explanations of the gravettian record.

Throughout the volume, contributors again and again report variability in food resources as well as in their use and choice by humans, within the rich bounty afforded by the Eurasian environments – and especially so by the Mammoth Steppe. For more than a century archaeologists have debated the role of mammoth hunting, and the concept of 'Palaeolithic man the mammoth hunter' has become part of the repertoire of palaeolithic imagery. Several arguments, such as the location of settlements along rivers and in dead end valleys, and various faunal patterns, suggest that Mid Upper Palaeolithic communities might indeed have faced and killed mammoths. It should be stressed that, if they did so, then the hunters of the Golden Age must have been extremely well equipped, not only technologically and physically, but psychologically as well. Appropriate rituals would have been a powerful tool to mitigate the stress of close encounters with mighty creatures, as well documented among recent whale hunters (e.g., Harkin 1998). While this aspect of human activity is so far highly speculative, several contributors have underlined the subtlety and sophistication of the symbolic behaviour embedded in the archaeological record, as well as the positive evidence of complex ritual activity in burial practices and artistic production.

The artistic production dating between 30,000-20,000 bp also provides another illustration of the variability discussed above, in materials, techniques, styles, themes and uses. Parietal art in the west is related to deep caves, whereas in central and eastern Europe mobile art is made and used in central parts of the open air settlements. In some cases, the production event itself seems to have been important, as with the ceramic figurines. In other instances, vice versa, works of art were made to be seen and to function over long periods. We see this both in mobile art and in cave art, as well illustrated by the adjustments experienced by some of the Balzi Rossi figurines (Bolduc *et al.* 1996) or by the *Megaloceros* panel at Cougnac (Lorblanchet 1994). In addition, we also observe changes through time: in Moravia, most notably, the large and diverse figurine assemblages of the pavlovian sites are followed by single female statuettes in the later gravettian sites of the same region (Svoboda 1995).

Diversity can also be underlined in other aspects of the record, from choice in shells and other materials used for ornamentation, via variability in the size and shape of dwelling structures, to mortuary practices. The latter ones include inhumation as just one of several options, as evidenced in Moravia and also, maybe, in Italy.

Despite all this diversity, there is a kind of continuum in the vagaries of the archaeological record. The transport of lithic raw materials and shells over vast distances connects distant places and people. Technological and stylistic similarities are pervasive in the artistic production, as in female figurines, while there is a thematic link between the (earlier) aurignacian cave paintings, and the (later) gravettian figurines of Moravia. The very fact of burying a dead person, sometimes with a rich assemblage of goods, is innovative enough not to occur by chance in otherwise chronologically, geographically and sometimes culturally related areas. The same can be said when shelters are built, even if following overall different architectural patterns.

6. Final comment

At the beginning of the 30,000-20,000 bp period, at a time when Grotte Chauvet already had many of its magnificent paintings, Neanderthals were still living in some parts of Eurasia, alongside modern humans. While the latest outcome of the Middle Palaeolithic was fading away from the record, the Eurasian scene was occupied by new human groups. In a constantly changing environment, dominated by the animals of the Mammoth Steppe, they developed labour expensive strategies to exploit a vast array of resources. The thriving human groups vigorously expressed their own distinct cultural identity, but this happened within the framework of larger entities spanning all over Eurasia. The novelty of the MUP lies in this very unprecedented capacity of integrating diversity into a functional system of inter-group and intra-group exchange. The ensuing complex and socially articulated way of life allowed people to cope with a demanding and ever changing environment. Overall, the system was resilient to ecological instability. Only when the worsening climate definitely undermined the very bases of survival, of humans just as of many other species, radically different solutions had to be found.

It is a fascinating thought that, more than 1000 generations ago, humans of Siberia may have been aware that many months of walking to the west – actually more than 8000 kilometres away – there were still people, different from themselves, yet in many respects similar – as shown by this volume.

notes

1 The Network's committee consisted of G. Bosinski (chairman), W. Roebroeks (scientific secretary), C. Farizy, C. Gamble, L. Larsson, M. Mussi, N. Praslov, L. Raposo, M. Santonja and A. Tuffreau.

2 For clarity's sake we wish to stress that all dates mentioned throughout this volume are, unless otherwise stated, uncalibrated ones, starting with the subtitle of this volume. Calibration – or rather: "calendric conversion" (cf. Street and Terberger, this volume) – of dates from this time range is still to some degree experimental and controversial.

3 The participants and contributors to the workshop, held at Pavlov (Czech Republic) on 12-14 October 1995, were the following: G. Bosinski (Cologne and Monrepos, Germany); F. Bernaldo de Quirós (León, Spain); I. Campen (Tübingen, Germany); F. Djindjian (Paris, France); C. Gamble (Southampton, U.K.); J. Hahn (Tübingen, Germany); L. Jarošová (Brno, Czech Republic); L. Larsson (Lund, Sweden); V. Lepistö (European Science Foundation, Strasbourg, France); M. Mussi (Rome, Italy); M. Oliva (Brno, Czech Republic); P. Pavlov (Syktyvkar, Russia); C. Perlès (Nanterre, France); P. Pettitt (Oxford, U.K.); N. Praslov (St. Petersburg, Russia); L. Raposo (Lisbon, Portugal); J.-Ph. Rigaud (Bordeaux, France); W. Roebroeks (Leiden, The Netherlands); M. Santonja (Salamanca, Spain); A. Scheer (Blaubeuren, Germany); V. Sladek (Brno, Czech Republic); P. Škrdla (Brno, Czech Republic); J. Svoboda (Brno, Czech Republic); A. Tuffreau (Lille, France); K. Valoch (Brno, Czech Republic); L.G. Vega Toscano (Madrid, Spain); A. Verpoorte (Leiden, The Netherlands); J. Zilhão (Lisbon, Portugal).

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Margherita Mussi
Dipartimento di Scienze dell'Antichità
Università di Roma "La Sapienza"
Via Palestro 63
00185 Roma
Italy

Wil Roebroeks
Faculty of Archaeology
Leiden University
P.O. Box 9515
2300 RA Leiden
The Netherlands

Jiří Svoboda
Department of Paleolithic and Paleoethnology
Institute of Archaeology
AS Dolní Věstonice
Czech Republic

Dale Guthrie
Thijs van Kolfschoten

2 Neither warm and moist, nor cold and arid: the ecology of the Mid Upper Palaeolithic

The later part of the Middle Weichselian was an episode of climatic instability with short, staccato oscillations with reduced impact on the generally open, steppic environment: a less intense version of the Mammoth Steppe with a rich biodiversity, occupied by nomadic, wide-ranging large mammals such as woolly mammoth, bison, horse, woolly rhino, reindeer, saiga and the large carnivores lion, wolf and spotted hyena. The Mammoth Steppe environment from Western Europe to Alaska, although very coherent, showed an increase in species diversity from north to south and the maximum number of mammal species occurred in mountainous areas.

1. Introduction

As during all episodes involving many thousands of years, the climate during the Mid Upper Palaeolithic (roughly 30,000-20,000 years ago) was quite variable. In fact, it is that variability which might provide the core insight to the overall mean character of the ecology of that time. Climatic modelling depends on a reasonable steady-state interannual situation, for example the extremes of the generally warmer/moister Holocene or the colder/arid Last Glacial Maximum (LGM). The late Middle Weichselian was neither. In fact its character may be best captured by a model of climatic instability which was responsible for holding the vegetation and faunal composition at some imaginable mean, oscillating around a set-point that was neither the warmer moist Holocene nor the cold and aridity of the LGM.

That being said, the proxy details of the European pollen record, invertebrate and mammalian fossils, loess deposition, and glacial extent suggest that the environment was generally much more open, tending toward steppic, than most modern biomes distributed across Europe. It was virtually treeless yet seems to have been tolerated by a diverse assortment of mammalian species, and of course palaeolithic people. This was not true during the LGM, during which time the European human population was limited to a more southern distribution (see also Street and Terberger, this volume).

Thus it seems to have been a time of amelioration of the Mammoth Steppe base-line, yet retaining much of its open-ground character. If all that is a fair generalisation, then we could profit from looking at the mechanisms maintaining the Mammoth Steppe and see what kind of potential ameliorating elements can be found.

2. Climatic mechanisms for the Mammoth Steppe

2.1 Megacontinental aridity

Evidence for an intense aridity is clear during glacial periods (Hopkins *et al*. 1982; Vrba *et al*. 1995), though its causes on such a megacontinental scale have been clouded in ambiguity. In the far north, aridity during the LGM would have favoured plants which today persist in the north only in the most limited habitats, such as south-facing steep slopes, or other local, especially arid locations and in the southern steppe communities. We need to imagine a late Pleistocene environment in which the tables were turned, with mesic-adapted biota found only in uniquely damp situations and arid-adapted species dominant and widespread. However, the picture emerging is not just a matter of proportional changes from mesic to arid, but one so extreme that many mesic-adapted forests, forest successions, and forest floor animals and plants were driven to regional extinction throughout the north, from Western Europe to Alaska. The northern perimeters of the distributions of many of these plant and animal species, which are dominant northern species today, were, in the late Pleistocene, thousands of kilometres to the south, such as for instance polar fox (*Alopex lagopus*), reindeer (*Rangifer tarandus*), collared lemming (*Dicrostonyx*) and true lemming (*Lemmus lemmus*) (Markova *et al*. 1995).

2.2 Forces producing aridity

Various workers (Hopkins *et al*. 1982; Bartlein *et al*. 1991; Ballantyne and Harris 1994) have treated the specific causes of this cold-arid northern environment during Glacial times, attributing them in a direct way to periglacial effects and the changing earth-sun geometry of Milankovich insolation cycles. But proximate causes were a combination of features; of these, there is an unrecognised, proximate key element throughout the north which seems to have been crucial, a much higher frequency of clear skies than seen today (Guthrie in press). This enhanced evapotranspiration in summer (aridity) and radiation deficit to the black night sky in winter (cold).

2.3 Origin of the megacontinental Mammoth Steppe

The ultimate forcing agents of Pleistocene changes are hotly debated, centring around CO_2 atmospheric concentrations, solar input, oceanic current directions, and many other elements, all of which seem to change in synchrony with the climatic shifts. In the minds of many Quaternary climatologists (Partridge *et al.* 1995), tectonism seems however to be the main frontrunner theory in this controversy (Manabe and Terpstra 1974). Mountain uplift occurred in many continents during the Quaternary, but nowhere was this more pronounced than in Central Asia, which also concerns us here as it seems to have been responsible for much of the aridity of the Mammoth Steppe. Throughout the Tertiary the Indian Plate was driving into southern Asia, creating the largest mountain range in the world. Apparently, the rate of uplift increased during the last 2.5 million years, and especially during the last million (DeMenocal and Rind 1993). As a result, the mountains of the Tibetan Plateau reached their greatest height, and produced their greatest climatic repercussions in blocking atmospheric flow from the monsoons of southeast Asia (Ruddiman and Kutzbach 1989). This orography was responsible for maintaining both the Siberian-Mongolian high pressure and Aleutian low pressure systems in their present locations (Manabe and Terpstra 1974; Ding *et al.* 1992). A core of extreme aridity developed in the blocked monsoonal shadow.

From Western China and Mongolia this core of aridity now extends far to the West and East. However, during the Pleistocene this steppe at times extended much further and it apparently expanded and contracted in synchrony with the Milankovich cycle. A strong winter monsoon is needed to intensify the Siberian-Mongolian high-pressure system; winter monsoons seem linked to intensification of clear skies and cold in the far north (An *et al.* 1995). It is also likely that the intensity of the Siberian-Mongolian high is strongly associated with northern hemisphere ice cover (DeMenocal and Rind 1993; Chen *et al.* 1997). During the Milankovich-predicted low-insolation times, when aridity in Northern Asia intensified (Chen *et al.* 1997) and extended west into Europe, and eastward into northeastern Asia, the landscape took on a quite different character. It became a cold steppe, underlain with permafrost, and dominated mainly by cold-tolerant and arid-adapted species, including mixes of lion, horse, antelope, and rhino combining with collared lemming, arctic fox, reindeer, and muskoxen (Guthrie 1990). Invertebrate fossils also exhibit unusual mixes of species (Berman and Alfimov 1997).

Palaeoclimatic reconstructions of atmospheric flow (see discussion in Soffer and Gamble 1990) point to a latitudionally stable eastward flow of the winter (January) storm track across Europe at about 47^{O} N latitude between the Scandinavian ice sheet and that of the Alps, continuing on that latitude directly across Asia just north of the Tibetan Plateau. This runs down the West-East bore of the Mammoth Steppe. All the data on direction of loess deposition agrees with this (Porter and An 1995).

So several geographic features seem to have worked in a complimentary way to exaggerate the periodic spread of the cold steppes out of central Asia, during Milankovich low-insolation times both by limiting moisture and by promoting clear skies:

(1) the driving force for the core Asian steppe was an enormous and stable high pressure system north of the Tibetan Plateau;
(2) deflection of the larger portion of the Gulf Stream southward, past southern Spain onto the coast of Africa, reduced temperatures (hence moisture and cloud cover) that the Atlantic current brings to Western Europe;
(3) growth of the Scandinavian ice sheet created a barrier to North Atlantic moisture;
(4) likewise, the icing over of the North Atlantic sea surface with reduced flow of moisture over northern America from the east;
(5) the latitudinal winter (January) storm track seems to have swept across Eurasia;
(6) lowered sea levels exposed a large continental shelf to the north and east of the American continent, producing a vast northern plain, which increased continentality to the north;
(7) in the very Far East, North American glaciers shielded interior Alaska and the Yukon Territory from moisture flow.

These physical barriers to moisture flow created a vast arid basin or protected 'inner court' spanning parts of three continents. Undoubtedly innumerable local effects would have shaped local conditions and created special situations, but the coherence of the Mammoth Steppe was much greater than local influences, particularly the local effects of ice sheets.

3. The 'no-modern-analogue' phenomenon

3.1. Unusual associations

Throughout the 1970's and 80's there was a revolution in palaeobiologists' thinking. Data began to show that past communities, even from the recent past, were often composed of species not found in association today (Storch 1969; Davis 1981; Guthrie 1990; Van Kolfschoten 1995). We came to realise that biomes were not reacting to climatic change as units but as individual species. Response to climatic changes was surprisingly individualistic with unexpected species differences. Our faunal and floral evidence revealed species mixes for which we could find few or no modern analogues.

Obviously, these 'no-analogue' associations can be overemphasised and misunderstood. In part, it is a metaphor for saying that biomes do not move around lock-step through time. This concept does not mean to suggest that there are never any valid analogues between the present and past, we would be nowhere without them; the past coexistence of reindeer (*Rangifer*) and saiga (*Saiga*) is informative to our imagination because of the information we can draw from them individually in the present, despite their non-overlap today (Sher 1968; Guthrie *et al.* in press).

There are patches of steppic communities in north-central Asia, some quite expansive, which are scattered into boreal habitats, which do provide some rough analogues to the Mammoth Steppe. In North America there are rare, but similar situations, particularly on steep south-facing slopes. These steppic islands in the ocean of tundra/boreal forest help researchers better understand the tension of forces that produce particular biotic associations and physiognomies (Wesser and Armbruster 1991). Taking the extreme no-analogue position is a little too close to 'Geological Postmodernism'. It is certainly a truism that the co-variance of many species' responses to varying climates is high, and some species pairs are their own interdependent variables – forest floor species which are obviously dependent on the special environment that forest species create. These co-covariant clusters mean that biomes are real coherent entities, in degree. But it is this 'degree' aspect which gives us caution and perhaps insights.

The vast Pleistocene steppe seems to have had a high degree of unusual associations, particularly during Oxygen Isotope Stage (OIS) 3, not only in terms of species composition but also novel assemblages above the level of the community. Pleistocene biomes were different and some apparently had an overall physiognomic character unlike any today.

3.2 The problem of modern analogues on such a megacontinental scale

Plants are limited in the polar extremes by the short cold summer. Cwynar and Ritchie (1980) and Colinvaux and West (1984) were certainly right in saying that a barren and unproductive polar desert could not support a complex large mammal community, such as was described for the Mammoth Steppe. This led them into the wrong horn of a dilemma; if it was a polar desert then there were no large mammals. But the large mammals were there, it was not polar desert. The evidence for the over-all character of the biota of the Mammoth Steppe is remarkably different than that of polar deserts.

This misconception points out the mistake of trying to reconstruct northern and mid-latitude palaeoecology during glacial episodes by simply making it colder. Of course, cold is important in our reconstruction; yet summer LGM Milankovich insolation values are only a little different from modern values (Berger 1978). Exactly why it was cold is an interesting problem, but the answer to that problem may not alone explain the aridity.

It is one thing to reconstruct a past comprised entirely of species that are extinct, a Jurassic Parkland, for example, but it is almost an even greater stretch for the imagination to reconstruct a past environment which includes extant species but in peculiar associations and habitats. It is still counter-intuitive to imagine reindeer, cheetah, muskoxen, hyena, leopard, rhino, horse, ibex, sheep and arctic fox living together. The same is true for the smaller mammals: for example the arctic lemming (*Dicrostonyx torquatus*), now living in the far north (north of 60° N) and the steppe lemming (*Lagurus lagurus*), nowadays widely spread over arid steppes and semi-deserts without permafrost in the area between 45° and 55° N, lived together in for instance southern Germany during episodes of the Late Pleistocene.

4. Nutrient vs. moisture limitations

Because of the present-day flow of the Atlantic current and the resulting flow of moisture across Europe, nutrients are in shorter supply than moisture; from both a physiological and ecological view we can say that nutrients are more limiting than moisture. Spreading standard garden fertiliser (Nitrogen, Phosphate and Potassium) in almost any northern landscape creates a startling effect (perhaps with the exception of a mature closed-canopy coniferous forest). This douse of nutrients changes the species, transforms plant growth, and greatly changes overall appearances of the site. The same is not quite true of moisture. Van Cleve *et al.* (1983) found that, with some exceptions, nutrients and temperature controlled both the type and productivity of taiga forests, not moisture.

5. The problem of 'periglacial effects' at a time when there were no glaciers

Historically, our understanding of the communities of glacial-age biota began in Europe (see review by Ballantyne and Harris 1994). In northwestern Europe the landscape effects of a cold climate (widespread cryogenic geological features, elimination of even cold-tolerant woody plants, expansion of the 'woolly' mammals, and so on) were directly linked to glacial proximity. But this conflation of glacial proximity and biota seems to have created a general misconception about 'periglacial' matters. The cold-arid character and extent of the Mammoth Steppe is more complex than simple glacial proximity. Vast areas of Asia many hundreds or even thousands of kilometres from significant glacial proximity still exhibit features similar to 'periglacial' landscapes.

The word 'peri' implies adjacency, like standing next to an open refrigerator door. Although the large ice masses certainly had a profound effect on weather tracts and moisture depletion, attributing the Mammoth Steppe simply to 'periglacial effects' does not let us understand the complexity of large-scale forces which were responsible. 'Periglacial' could be used appropriately in certain situations where it may actually apply, but on the whole it is an outdated concept built on a misconception and we are better off without it. Certainly, it is of little help to us studying the Gravettian, because the northern ice sheets were quite reduced, yet the landscape still retained aspects of the treeless Mammoth Steppe.

6. Climatic-ecological variations in the late Pleistocene and their implications for the Mammoth Steppe

Climatic proxy information from such sources as North Atlantic marine cores (e.g. Shackleton 1987; Bond *et al.* 1993; Kotilainen and Shackleton 1995), Greenland ice cores (e.g. GRIP 1993), China loess chemistry (e.g. Porter and An 1995; Chen *et al.* 1997), and others have shown larger fluctuations within isotope stages and across a number of different time scales than data had once portrayed, and our earlier models had projected. This is particularly true for OIS 3, and within the later phase of that period, corresponding to the Gravettian. While the variability seems almost globally consistent, the set points across the north are quite different. These variations are particularly significant with regard to the Mammoth Steppe habitats. For example, trees invaded far northward in Siberia and Alaska during OIS 3. Yet in Europe most tree species were trapped beyond the southern mountains (Pyrenees, Alps, and Carpathians) (Van Andel and Tzedakis 1996). This did not mean that in OIS 3 steppic Europe continued to experience peak LGM conditions. For example, during this Interstade (OIS 3) hominids were able to penetrate far north towards northern Russia (Pavlov and Indrelid, this volume) and they inhabited southern England (Pettitt, this volume; Roebroeks, this volume). Likewise, large mammal faunas from Central and Northwestern Europe were more complex and species-rich during OIS 3 than during OIS 2 and 4 (Stuart 1982). That is also true for the smaller mammal faunas, as can be deduced from the OIS 3 smaller mammal fauna from the Sesselfels Cave (southern Germany) (Van Kolfschoten and Richter, in prep.). This same pattern is seen in northeastern Asia and even as far north as Alaska, where during OIS 3 the mesic-arid adaptive spectrum was also very scrambled. As a diagrammatic example, radiocarbon dates from the extinct, mesic adapted, browsing stag-moose, *Alces latifrons*, are contemporaneous with dates from fossils of saiga, *Saiga tatarica*, a much more arid-adapted species, in the very same fossil localities (Guthrie *et al.* in press).

However, one has to be aware of the geographical variation in the diversity of the mammal fauna. The species richness during the Bryansk Interstadial (35,000-24,000 bp) varies from about 10 mammal species in the northeastern part of Eurasia to 33 in the south. The highest number of species can be observed in mountainous areas like the Urals, the Caucasus and the Carpatians (Markova *et al.* 1995).

Overall the Eurasian palaeoecology appears to have been a mix of riparian fingers of woods, but few forests, and uplands covered with a variety of arid tolerant plants and animals (Van Andel and Tzedakis 1996). That is, these steppic species lived within a community enriched by a few, more mesic species. We encounter a complex of ecological associations without extensive modern analogue. But remember, the marine cores, the Greenland ice cores, and deep Chinese loess sections show tremendous climatic variations for the northern hemisphere in the Late Pleistocene – it was not a smooth pattern (see Chen *et al.* 1997 for a comparison). What all this variation meant on the ground is certainly not clear. Did species proportions fluctuate wildly from one century to the next? There would be every reason to predict as much, especially for species near their margins of ecological tolerance.

7. Maintenance of Mid Upper Palaeolithic biotas by short periodic staccato of climatic jerks

New evidence suggests that the virtual presence of a large ice-free area in Fennoscandia during the Middle Weichselian (Ukkonen *et al.* 1999) did not bring back interglacial woodlands to Europe. The increased flow of moist air across Europe from reduced glaciation and reduced frozen seas is not sufficient to explain the special open European landscapes during OIS 3. What could then have been the cause? New climatic proxy information highlights saw-tooth climatic switches at shorter time-interval scales, but we know that most biotic changes require some lag time (for example, several thousand years for trees to move northward). Cold-arid snaps on micro, meso, and macro scales could present us with a vegetation not adapted to the mean temperature-moisture regime. It is probable that extreme conditions during the short span (say, 100 years) of one sharp saw-tooth climatic episode may be sufficient to restart (back to zero) time-transgressive changes which would have required thousand(s) of years to complete. However, before that time another short saw-tooth episode may again set the clock back to zero. Thus, it would be possible to maintain a climatic mean of one condition and have many proxy species behave as if it were another. For example, across much of Europe, during OIS 3, it may have been generally warm and wet enough for sylvan elements to re-colonise from the south, but irregular and infrequent episodes of clear skies, and the aridity it produces, kept them out. This kind of phenomenon may have happened widely in the deep past. The causes of this variability may be complex: fluctuations in the Atlantic current, jet-stream shifts for example in the pattern of the winter storm track, or other factors.

8. Human implications of the staccato climatic model

Presuming the record is correct, that the period at stake was a much more climatically unstable time, marked by episodes of rangeland failures sandwiched between long episodes of thick sward richness, life would have been different than during earlier or later times. Human populations would have probably expanded and declined commensurate with their resources. Ecological instability is not necessarily bad for an opportunistic facultative strategy that is fast to respond to rapid and major changes.

In general these changes would have selected for large herbivore behaviour which was less territorial and more nomadic. The nomadism would have resulted in large herds moving through unfamiliar terrain. We know this to now characterise saiga antelope, reindeer, and bison when numbers are large. This potential mobility probably was true for horses as well (the caballoid switch from territoriality to a mobile harem seems to have been a part of that adaptation requiring less attachment to local landscape). This high mobility of large herds would have presented considerable opportunity for large mammal hunting specialists, even though fraught with uncertainty and unpredictability. Frequent back-ups of other supplemental and secondary resources may have been the result. Indeed this is what some of the archaeological sites show.

9. Mammalian biomass during the Mid Upper Palaeolithc

It is not possible to reconstruct mammalian biomass from the fossil record. That being said, one can use modern analogues as rough guidelines to imagine some rough parameters. If we assume that large mammals were important to Upper Palaeolithic economies (this does in no way reflect on the fact that in many instances diverse supplements of other resources were used seasonally), it is relevant to discuss large mammal biomass. Mature woodlands, such as those characteristic of the Holocene of Europe, support relatively low mammalian biomass. The forage is simply out of reach of most large herbivores and the understory is not very productive and also it is heavily defended against browsing. Likewise, the vast arid, Eurasian steppes of the LGM, while extensive, was not very productive.

But, what if some facies of the steppes were maintained by episodic severe weather while the actual mean year was moderate in terms of cold and aridity? One could then predict that the forage would have been at higher concentrations, probably in the kinds of plant species, which were most nutritious. The proxy evidence is straightforward that overall Europe was occupied by a less intense version of the Mammoth Steppe. The result of this would have been a higher standing biomass of large mammals. The increased diversity of European species during OIS 3 lends support to this hypothesis.

Though this less intense version of the Mammoth Steppe dominated most of Europe, the actual sward species composition undoubtedly varied considerably from region to region. In other words there was much internal variability in the details. Many tundra elements were shuffled into the northern fauna and flora and many southern steppic species came into the south. Yet the cold aridity of the openness probably retained much of the same impressionistic character-low sward species, a sea of light green in summer and tan in winter occupied by many of the same species of nomadic or very wide-ranging large mammals – bison, horse, woolly rhino, reindeer, saiga, lion, wolf, spotted hyena and woolly mammoth in particular. Woolly mammoth fossils from Scandinavia with dates ranging from 22,420 ± 315 to 31,970 ± 950 bp (Ukkonen *et al.* 1999; Larsson, this volume) and from the northern Russian locality Byzovaya (65° N) (Pavlov and Indrelid, this volume) support this image.

10. Summary

Ecological and climatological research of the Mid Upper Palaeolithic indicates that the climate of that episode was very unstable, oscillating around a set-point that was neither comparable to that of the Holocene nor to that of the Last Glacial Maximum. Fluctuations in the Atlantic current, jet stream shifts or other factors resulted in short, infrequent saw-tooth climatic switches, with episodes characterised by a higher frequency of clear skies, resulting in arid summers and cold winters. The duration of these oscillations was too short to re-arrange the palaeoenvironment completely as biotic changes require some lag time, thereby weakening the impact of the climatic switches and maintaining a mean climate, which was neither warm and moist nor cold and arid.

The environment from Western Europe to Alaska was remarkably uniform and generally open toward steppic. The fossil floral and faunal communities from this large area show a 'no-modern-analogue', as evidenced by the coexistence of species which do not have an overlap today, as we know from the Mammoth Steppe. It is, with its rich biodiversity, however, a less intense version of the Mammoth Steppe. An environment with a relatively high biomass of larger mammals, mainly nomadic, wide-ranging large herbivores such as woolly mammoth, bison, horse, woolly rhino, reindeer and saiga; an environment with large herds providing considerable opportunity for large mammal hunting specialists, including humans.

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Dale Guthrie,
University of Alaska,
Dept. of Biology and Wildlife
211 Irving Building
Fairbanks, Alaska 99775-0180
U.S.A.

Thijs van Kolfschoten
Faculty of Archaeology
Leiden University
P.O. Box 9515
2300 RA Leiden
The Netherlands

Paul Pettitt

3 Chronology of the Mid Upper Palaeolithic: the radiocarbon evidence

The objectives of this paper are to present the main problems in radiocarbon dating the period 30-20 kyr bp, and to order in a meaningful way the radiocarbon measurements for the period which were available to the author. From these approaches, both the limitations and potential of Mid Upper Palaeolithic chronology is outlined. Problems relate firstly to the methodological limitations of the technique, whereby the effects of sample contamination on resulting ages are greatly enhanced beyond the Last Glacial Maximum and radiocarbon ages should be recognised as minimum ages, and secondly to archaeological factors such as the context of samples which, for example, may be subject to post-depositional movement. It should be remembered that given the size of errors even at one standard deviation, our chronological resolution of this period is coarse and heterogeneous; we should therefore excercise caution when making temporal comparisons between, for example, the Aurignacian and the Gravettian. Our picture of the chronology of Europe in the period considered is furthermore coloured both by regional research traditions, some of which may place more importance on the use of radiocarbon dates, and by available sample materials, whereby more problematic materials may yield chronological signatures at odds with those obtained by more suitable samples. Such factors may, in worst-case scenarios, produce patterns of dates which, when considered on a regional and inter-regional basis, may be taken to indicate illusory population movements. Finally, a coarse attempt is made to plot the available dates with archaeological associations for this period. Although any such analysis must remain necessarily provisional and the database needs to be improved considerably before such analyses can make a useful contribution to palaeolithic archaeology, the results do at least suggest that radiocarbon dates may have a role to play in examining the palaeodemography of palaeolithic groups.

1. Introduction

Any general discussion of radiocarbon dates for a given archaeological period must inevitably be provisional, as many (probably the majority of) dates have not been published, and others, which are available, are not published systematically and often lack laboratory numbers or detailed information about stratigraphic provenance. It is often impossible to evaluate the reliability of published radiocarbon dates with the information that accompanies them. Given this, and the numerous problems with dating palaeolithic materials, it is very difficult to undertake a general survey of the available data and have anything worthwhile to say about palaeolithic societies at the end.

The first section below discusses the various problems encountered in dating archaeological material beyond the Last Glacial Maximum, noting the limitations of the technique. The next section is a coarse attempt to get to grips with such radiocarbon dates as were available and useable to the author. This should be taken as a representation not only of the chronological distribution of palaeolithic technocomplexes (the traditional use to which radiocarbon dating has been put), but also as a representation of research bias, the numerous factors affecting dating in this period, and, to some extent, the element of chance as to what material was available to the author. The database of sites has been constructed from the Oxford Radiocarbon Accelerator Unit's own computer database, published Groningen and Lyon laboratory dates, and from numerous publications, either given to radiocarbon dates (e.g. *Radiocarbon* journal back to 1970) or to more geographically/topically specific archaeological papers written by palaeolithic specialists. Other dates were kindly supplied directly from palaeolithic archaeologists' own databases. It is not possible to publish here explicitly dates which have not been published elsewhere or those which have been published with insufficient detail as to be of use. The 491 dates amassed in the database are therefore not published here, rather incorporated together in the general analyses below. A final section presents an initial attempt to examine how radiocarbon dates may be informative about demographic patterns between 30 and 20 kyr bp.

2. 30-20 kyr: Problems in radiocarbon dating beyond the Last Glacial Maximum

The problems in radiocarbon dating archaeological sites in the period 30-20 kyr relate to two broad factors: dating methodology and archaeological stratigraphy, and these will be discussed briefly in this section.

Dating any archaeological material beyond the range of INTCAL98 (i.e. *c*. 25 kyr BP) encounters a major problem in the lack of known-age material for which a true date is

Table 1. Mean errors per 2 kyr blocks.

	30-28 kyr	28-26 kyr	26-24 kyr	24-22 kyr	22-20 kyr
Mean error	± 800 yrs	± 600 yrs	± 550 yrs	± 480 yrs	± 485 yrs

known by independent means, and therefore the absence of a reliable, or certainly relatively precise, correction curve (Van Andel 1998. See Pettitt 1999 for a discussion of the problems of accuracy and precision in this time range). As a result, researchers are compelled to work in radiocarbon years, accepting that contamination by more recent material is the main obstacle to reaching true (i.e. accurate) radiocarbon ages (Gowlett and Hedges 1986). In the time period we are concerned with here, 1% contamination at 28 kyr would increase ^{14}C activity by over 30% and reduce the date to less than 20 kyr. Such factors should be taken into account when seeking relatively fine-scale resolution for inter-site comparisons. The important point to bear in mind is that *the great majority of radiocarbon dates over 20 kyr will be underestimates*: it is important to remember that one is dealing in *radiocarbon years* bp.

That Mid Upper Palaeolithic radiocarbon dates are underestimates has been supported by the comparison of ^{14}C dates with other dating methods. Comparing Last Glacial ^{230}Th-^{234}U dates from corals, Bard *et al.* (1993: 197) noted that the radiocarbon ages from corresponding core sections were systematically younger than the U/Th ages. An example within the 30-20 kyr time range concerns the Gravettian levels of La Vigne Brun, France, TL dates for which range from 24-30 kyr with an average of 27 kyr, whereas radiocarbon dates for the same levels averaged around 23 kyr, some 15% lower (Valladas and Valladas 1987: 215).

The time-range under discussion is not a homogeneous period archaeologically and certainly not in terms of radiocarbon methodology. One should remember that problems resulting from contamination and low amounts of surviving collagen are much greater at 30 kyr than at 20 kyr, as the two chronological extremes of the period under discussion are almost two half-lives of radiocarbon apart. A major factor which adds to the heterogeneity of the period is the expression of uncertainty in the convention of radiocarbon errors. As these are a function of the resulting age of a given sample, it follows that the greater the antiquity of a sample, the larger the error. Thus, samples dating closer to 30 kyr will have larger errors than those dating closer to 20 kyr. Table 1 shows the mean error of radiocarbon ages falling into 2 kyr blocks for the entire database used here.

It can be seen that errors on dates falling between 30-28 kyr are typically in the order of ± 800 years, whereas those falling between 22-20 kyr are virtually half of that (this time block in table 1 includes some dates measured two decades ago (or more) and for which errors are relatively large by today's standards. Removing these has the effect of lowering the mean error to about ± 400). It follows that our perceptions of the chronological nature of the Aurignacian and the Solutrean will differ simply as a result of the convention of expressing laboratory error, giving rise to vastly differing error ranges. These are conventionally expressed at the 68% level of confidence; expanding them to the 95% level (which should be used as a convention for any meaningful discussion of chronology) renders the use of radiocarbon dates as a resource in their own right coarse at best. One must therefore be wary of making simple comparisons between population dynamics of sociocultural groups over large distances in time.

Bone is inevitably the main material dated for the European Palaeolithic (85% of the dates used below for which information on sample material was available were from bone/antler/ivory/tooth samples), and the purification of amino acids is much more feasible for the smaller samples required for AMS dating. This may be reflected in the tendency observed in the 1980's for Oxford dates to come out older than those from conventional laboratories, although there is generally good agreement, e.g. as at Abri Pataud and Kraków Spadzista Street (Gowlett and Hedges 1986). A large proportion of radiocarbon dates from Eastern European Plain sites may have been obtained from samples of burnt bone (it was impossible to evaluate the extent to which this is true with the information available), and it should be remembered that surviving amounts of collagen in such samples is low and therefore open to greater effects of contamination. In view of this, many of the resulting ages may be underestimates. In this context, it is interesting to note that the majority of radiocarbon dates for the East European Plain fall after 25 kyr (see below, Table 4). One must therefore exercise caution when comparing such dates with others to infer West-East population movements into this area (Soffer 1986, 1993).

The older the sample submitted for dating, the more background radiation will affect the results, a factor which has notable effects on bone. This is simply because low amounts of collagen (from which the carbon is extracted) will remain in samples from this time period. Because of the low amounts of remaining collagen there has been a tendency to use large samples to obtain a necessary precision, and this has often led to bulk sampling which creates mean dates which are often meaningless, especially in dated sequences consisting of relatively fine stratigraphies. One example of this is the large series of samples from La Ferrassie dated at Gif-Sur-Yvette, which resulted in a wide scatter of dates for each archaeological association (*Radiocarbon* 28(1), 1986). In such circumstances it is impossible to answer archaeological questions as to the nature of site occupation as one cannot rule out the contribution of bulk sampling to the resulting ages. The collection of samples from the edges of a long exposed section at La Ferrassie may also have allowed substantial contamination of samples by modern humic materials (Mellars *et al.* 1987). With the dating of Abri Pataud, one of the most intensively dated sites of this period (discussed in Mellars *et al.* 1987), the Groningen dates were obtained from larger, bulked samples of either burnt or unburnt animal bone, whereas the AMS dates were entirely from amino acids extracted and purified from hydrolysed collagen isolated from individual bones. The agreement between the Groningen and Oxford dates is impressive, with results generally coinciding within one standard deviation for particular samples. Where discrepancies do occur, in some of the perigordian IV, VI and protomagdalenian levels, there is a clear tendency for the AMS dates for certain levels to be slightly older than the corresponding Groningen dates, which may have been due to the greater elimination of contaminants in the Oxford laboratory.

As mentioned above, error ranges on dates in the range 30-20 kyr are ± 400 years or more, and a similar, albeit invisible, error must be borne in mind if one assumes that oscillations in the production of ^{14}C in the radiocarbon reservoir visible in the Holocene also existed in the late Pleistocene. There is no reason to doubt that such fluctuation occurred in the Pleistocene. This could have the effect of eliminating 500 year blocks of time, an error of the same level as that which expresses uncertainty of the radiocarbon measurement itself.

A certain number of radiocarbon dates will lie outside of an expected range/sequence for a particular site, and these often relate to the stratigraphic problems relating to radiocarbon dating palaeolithic materials. Whereas bone samples of great antiquity present problems due to low surviving collagen, the more ideal sample material, charcoal (which is virtually pure carbon) is susceptible to much greater stratigraphic mobility. This vertical movement of sample materials results in residuality or invasivity, a problem which can be encountered in both low and high energy depositional contexts. Contamination by younger, intrusive materials is a major problem. This problem of the mobility of small samples became obvious early on in the life of the Oxford laboratory, where it was noticed that outlying dates in stratigraphic sequences often came from very small samples (Gowlett and Hedges 1986). Dates will be inverted as a result of this, as possibly at Combe Saunière (Geneste in Rigaud 1982), and, one might suggest, for the two outlying dates of 28 and 29 kyr for levels 10 and 9 (on charcoal) in the stratigraphic profile of Molodova V in the Dnestr valley, otherwise consistently dated from 23-10 kyr for levels 10 to 1 (Hoffecker 1988: fig 2). An inversion of dates also occurs at Kraków Spadzista Street C2, where a date obtained on charcoal of 24 kyr is 3-4 kyr older than others obtained on bone and ivory, and is probably due to transport in the sloping solifluction deposits (Kozlowski 1987). In Siberia, Early Upper Palaeolithic materials are redeposited in solifluction deposits dating to 28-25 kyr and to 23 kyr (Larichev *et al.* 1990).

These problems, of course, are not only confined to open sites. One can also observe 'atypical' stratigraphic sections in the cave site of Kent's Cavern, England, where Early Upper Palaeolithic industries containing leaf points have been dated to 28,160 ± 435 (GrN-6201) from a tibia of *Coelodonta antiquitatis* and to 27,730 ± 350 (GrN-6325) from a radius of *Bison*, but to 38,270 +1470/-1240 (GrN-6324) from a radius of *Equus* cf. *przewalskii* from the same stratigraphic spit and grid location (Campbell 1977), which may relate to deposition of each sample in discrete debris flows. Three inverted dates from an as yet unpublished series of Oxford radiocarbon dates from Geissenklösterle, Germany, which fall into the range under discussion, may relate to two residual and one invasive samples (Hahn *pers comm.*).

The sections below present some preliminary results of trying to use the database of 491 radiocarbon dates for the period 30-20 kyr bp which were available to the author. It soon became very apparent in the process of collating this information that the resulting database would be partial and not uniform in nature. This is simply due to the fact that archaeologists do not publish dates according to a convention. Aside from the fact that the database itself is almost definitely an underrepresentation of the actual number of radiocarbon dates with archaeological associations available for this period, there are still numerous problems resulting from varying methods of publishing radiocarbon dates. Most often, the date and error is published with a laboratory number, usually embedded in a text which is site or region specific. The sample material type and $\delta^{13}C$ value obtained are often not published, without which it is impossible to evaluate the integrity of the resulting age. Of the 491 radiocarbon determinations used here, some 150 were listed in various publications without material type, many without a detailed cultural association, and some without laboratory numbers. In view of these problems, one simply has to take the available database on trust, eliminating obvious outliers and problematic results but otherwise treating it as a coarse body of data incorporating numerous errors. This is what has been followed here.

Table 2. Aurignacian radiocarbon dates 30-20 kyr.

30-28 kyr	27-26 kyr	25-24 kyr	23-22 kyr	21-20 kyr
22 (31.4%)	17 (24.2%)	14 (20%)	13 (18.5%)	4 (5.7%)

3. Radiocarbon dates 30-20 kyr

Different countries or regions will have differing traditions of research, and these differences will be reflected to some extent in the radiocarbon database. In this sense, one wonders how much the recognition of the successive cultural traditions of Western Europe for the period concerned (e.g. Fontirobertian, Bayacien, Noaillien, etc. – see papers by Rigaud, this volume and Djindjian, this volume) reflect to some extent the large scale dating projects of major sites such as La Ferrassie and Abri Pataud, whereas the apparently more 'homogeneous' shouldered point traditions to the east reflect a more dispersed state of the database. This regional difference calls to question exactly what we mean by 'centres' of occupation which were often discussed in the workshop, and remind us that 'regions' of palaeolithic Europe were just as much temporal phenomena as spatial. One conclusion of the workshop was that large areas of Europe were empty at stages in the period concerned – Iberia, Italy and elsewhere seem to have been occupied intermittently by humans – a picture of dispersed cultural regions changing over time, which may be reflected in the radiocarbon record. Historicocultural regions are created at many scales, and not only must we question the criteria on which such regions are identified (Boriskovskij 1993) but we must also consider, in the light of the problems raised above, exactly to what scale of historicocultural phenomena radiocarbon dates apply. The question of what radiocarbon dates actually measure will be addressed below, after some examples of dated sites belonging to this period are discussed and a coarse attempt to present the data available to the author has been undertaken.

The French sites of this period that have received relatively intense radiocarbon dating include La Ferrassie, Le Flageolet I and Abri du Facteur (Mellars *et al.* 1987; Rigaud, this volume), but the Abri Pataud is perhaps still the most intensively dated Mid Upper Palaeolithic site, with Groningen and Oxford dates summarised by Mellars and Bricker (1986) and by Mellars *et al.* (1987). The results from the two laboratories were consistent, with only a few outliers, and demonstrated an aurignacian occupation coming to an end by 28 kyr, the perigordian IV occupation extending back to at least 28 kyr, an age of 26-27 kyr for the noaillian layers, a final perigordian occupation extending back to 24-24.5 kyr and protomagdalenian activity at 21-22 kyr. David (1985) supports a mean age of 27 kyr for the Noaillian at Abri Pataud, which he views as an intrusive population movement into the Périgord, interrupting a gradual evolution from Perigordian IV to VI.

Mitoc Malul Galben, Romania, contains deeply stratified Upper Palaeolithic cultural deposits which have been dated extensively by radiocarbon to the 30-20 kyr period. Here, aurignacian occupation seems to have come to an end by 28 kyr, with a substantial occupational hiatus before gravettian occupation commences around 27 kyr. The gravettian occupation ceases with the onset of stadial conditions around 20 kyr. The eastern gravettian sites of Moldavia and the C.I.S. comprise a large proportion of radiocarbon dates from this period, numbering some 76 dates from the Carpathians to the northeastern region of the East European plain (Svezhentsev 1993, and see below).

For the period 30-20 kyr an obvious place to begin a coarse survey of the radiocarbon evidence is to define the available chronological occurrences of the Aurignacian. In view of the problems regarding the stratigraphic mobility of some samples noted above, this is a difficult task in which single dates must be regarded with caution. Table 2 presents radiocarbon dates for aurignacian assemblages which were available to the author in two thousand year time bands within the 30-20 kyr period.

Most of these dates relate to individual assemblages (although many in the 30-23 kyr range relate to the Aurignacian of La Ferrassie), and out of 70 dates, there is a steady decline in numbers over the period, as one might be entitled to expect, with 56% falling before 26 kyr. In view of this, one should be cautious about using the younger dates to infer dates for the terminal Aurignacian, and one should remember the heightened effects of contamination in this time period, which could underestimate dates by several thousand years.

In France, a relatively well understood chronology has been established for the Perigordian V and VI, whereas the Perigordian IV is still poorly defined in chronological terms, although it seems to date between 26-28 kyr (Delporte 1976, but see papers by Rigaud and Djindjian in this volume for alternative cultural groupings/nomenclature) or possibly a little earlier as suggested at Abri Pataud (see above). A large proportion of the radiocarbon dates for Upper Perigordian/ Gravettian assemblages used here comes from the relatively well-dated Eastern Gravettian of Romania and the C.I.S. Table 3 presents these dates, again by two thousand year time bands.

As perigordian/gravettian technocomplexes fall almost entirely within the 30-20 kyr period, they dominate the

Table 3. Perigordian/Gravettian dates 30-20 kyr.

30-28 kyr	27-26 kyr	25-24 kyr	23-22 kyr	21-20 kyr
20 (8.2%)	51 (20.9%)	56 (23%)	62 (25.5%)	54 (22.2%)

Table 4. Solutrean dates 30-20 kyr.

30-28 kyr	27-26 kyr	25-24 kyr	23-22 kyr	21-20 kyr
0	0	0	1	21

Table 5. East European Plain radiocarbon dates.

30-28 kyr	27-26 kyr	25-24 kyr	23-22 kyr	21-20 kyr
5 (6.5%)	8 (10.5%)	13 (17%)	28 (37%)	22 (29%)

sample of available dates as one would expect (of 491 dates, 243 in total have upper perigordian/gravettian associations). These increase in number around 28 kyr after which they are relatively evenly distributed down to 20 kyr. German gravettian dates cluster at 23-24 kyr although they are relatively evenly spread throughout the period, spanning more than 10,000 years (Weniger 1990; Bosinski, this volume). In Moravia, most of the dates for Dolní Věstonice I and II and Pavlov I cluster between 27-25 kyr, generally reflecting repeated settlement of these locations (Svoboda *et al.*, this volume) but pavlovian occupation of this area after 24 kyr is unclear (Svoboda 1990). In northern Central Europe gravettian industries with shouldered points date between 24-23 kyr, with greater evidence for settlement after 24 kyr (Kozlowski 1990). The Italian Gravettian commences around 27 kyr (Mussi, this volume), continuing with the early Epigravettian around the Last Glacial Maximum (Mussi 1990).

Finally, dated Solutrean assemblages are presented in table 4.

As one might expect, no dates for solutrean assemblages date to before 23 kyr (the one date in the 23-22 kyr time block is from the Gruta do Caldeirão (Zilhão *pers comm.*), all others date to after 22 kyr). Solutrean assemblages dating to this period have been found in Portugal, Cantabria and Southern France. One might also include here the Protomagdalenian of Abri Pataud level M2, lens 2, dating to 22,000 ± 600 bp (OxA-162).

Although only a few Upper Palaeolithic sites on the East European Plain have well-preserved, undisturbed archaeological horizons found in clear stratigraphic contexts, a large number of radiocarbon dates exist for the area from the Carpathians, Dnestr basin and Dnepr drainage system to the Mid-Russian Upland and the steppic zone of the plain, with nearly two hundred listed by Svezhentsev (1993). A particularly large series of dates is available for the various Kostenki localities, as well as (for the 30-20 kyr period) Molodova V, Avdeevo, Gagarino, Sungir', and a number of other sites with one or two determinations. These are worth considering in their own right, and table 5 organises the dates presented by Svezhentsev (1993) into two thousand year time bands from 30-20 kyr.

It can be seen that there is a gradual increase in the number of dates through the period, with the majority of dated assemblages (66%) falling after 23 kyr. This is in accord with Soffer (1990) who notes that there is an increase in site density from 26 kyr down to the Late Glacial Maximum in the Central Russian Plain, although the possibility that use of burnt bone samples has affected some of these determinations has been noted above.

Sagaidak I, on the lower reaches of the Bug, was until recently considered to be the oldest Upper Palaeolithic site in the Russian steppe zone, with a radiocarbon date of 21,240 ± 200 (LE-1602A) for an industry which has been described as 'Aurignacoid' (Leonova 1994), but the earliest appearance of, one assumes, modern humans in the region has now been pushed back beyond the concerns of this volume to around 40,000 bp at Kara-Bom in Siberia (Goebel *et al.* 1993). There is however, still a deficiency of well-dated early Upper Palaeolithic sites in Western Siberia, especially in the 30-20 kyr period and only Malaia Syia (33-34 kyr) contains Early Upper Palaeolithic material (Larichev *et al.* 1988), and in the more intensively studied areas of Central and Eastern Siberia much of the material dating to this period is redeposited in solifluction deposits as noted above (Larichev *et al.* 1990). The 'classic' Upper Palaeolithic stage represented by such sites as Mal'ta and Buret' fall towards the end of the period, at 21-20 kyr, although human presence in the area is distributed throughout the 10 kyr under consideration

(Pavlov and Indrelid, this volume).

This brief survey of the radiocarbon dates for Europe at 30-20 kyr bp reinforces the view that occupation of Europe was dispersed and intermittent during this period. The last section aims to follow this a little further as an indication as to where future research might profitably go.

4. Using radiocarbon in the period 30-20 kyr bp

What are radiocarbon dates actually measuring in palaeolithic archaeology, and to what scales of human activity can they be applied? The problems noted above, both in terms of actually obtaining radiocarbon dates for this period and the inherent errors associated with them, will obviously affect the utility of a radiocarbon database for addressing research issues in palaeolithic archaeology. The question still remains, however, whether radiocarbon dates *per se* are of use to palaeolithic archaeology as a resource in their own right. Many aspects of human behaviour that are of concern to palaeolithic archaeologists, such as extinction and demographic shifts are, as Soffer (1993) has called them, 'time-transgressive', that is, they take place as both spatial and temporal phenomena (it seems that the time-transgressive extinction of the Neanderthals was still working through the early part of the period under consideration here – Pettitt 1999). It follows that radiocarbon chronology, in association with spatial data (i.e. the distribution of dated sites) may allow an investigation of such phenomena, and a preliminary investigation along these lines relevant to the period under discussion is presented here.

The size of errors of uncertainty and the heterogeneity of the period naturally restrict the scale at which radiocarbon chronology can be of use. The tables used above present data in 2 kyr time blocks for a reason: given that the range of errors at the 68% level of confidence is between 800 and 400 years, and the possibility that other factors may eliminate 500 year blocks of time, this is assumed to be the finest scale at which radiocarbon dates can be compared in any useful way. A coarser scale would obviously be of little use. A similar method, in which radiocarbon determinations are plotted as totals in one thousand year blocks which overlap by 500 years to smooth out short-term fluctuations is used by Holdaway and Porch (1995), who note cyclical patterns in the number of radiocarbon determinations from *c*. 36 kyr to 10 kyr for Tasmania, which can be correlated to environmental data. A similar method of counting the number of radiocarbon determinations for time blocks was presented for Central Europe by Simán (1990, 1990-1991). Holdaway and Porch's method assumes that radiocarbon determinations are a measure of occupation. They follow Rick's (1987) suggestion that if radiocarbon determinations were obtained randomly from an unbiased archaeological record, the number of radiocarbon determinations will vary with the number of

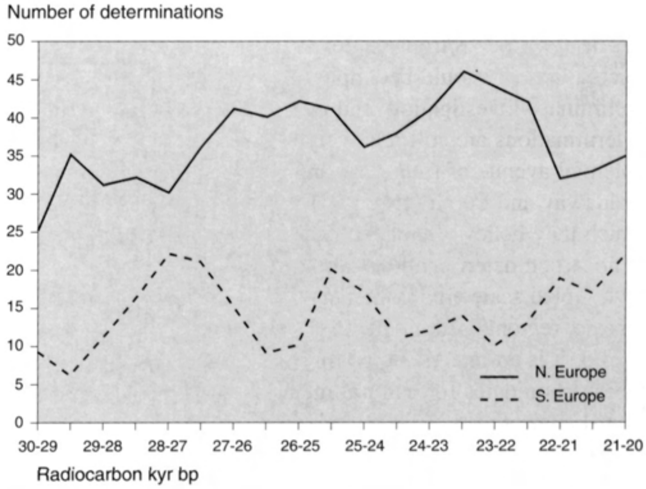

Fig. 1 Moving sum of radiocarbon determinations for southern and northern Europe.

person-years of human existence in a given region. Of course, there are a number of selection biases which have been discussed above, and to a large extent the data will be biased toward sites where a large number of radiocarbon determinations have been obtained without necessarily reflecting more intense occupation, but it is probably fair to assume that the results are at least a very crude measure of regional demographies. The 'moving sum' method advocated by Rick was used here for the Eurasian database covering 30-20 kyr bp. The determinations were divided for comparison into two broad latitudinal regions, that of Southern and Northern Europe. These were divided as follows:

Northern Europe:	United Kingdom, France, Belgium, Germany, Czech Republic, Austria, Poland, Hungary, C.I.S.
Southern Europe:	Gibraltar, Spain, Portugal, Italy, Romania, Croatia, Bulgaria, Greece.

It is obvious that the two latitudinal regions have different patterns of radiocarbon determinations. This supports one of the conclusions of the workshop that behaviour was particularly regionalised in this period (in this context certainly at a gross latitudinal scale), in contrast to the apparent 'uniformity' of the Aurignacian. In view of the apparent patchiness of environmental conditions throughout the period, this is, perhaps, not surprising. What is more interesting, however, is that the two regions appear to covary to some extent; that is, in periods where the number of radiocarbon determinations for Northern Europe decreases, there is a concomitant increase in Southern Europe, and vice versa. These 'oscillations' of radiocarbon determinations seem to vary over relatively similar wavelengths of around 3 kyr between peaks/troughs, despite encompassing minor fluctuations. It should be emphasised that this is only a preliminary investigation, and the absolute numbers of determinations are still relatively low, but it does indicate a potential avenue of future research. It is interesting that Holdaway and Porch (1995: 75) also note 3 kyr wavelengths, which they believe 'strongly suggests that the number of radiocarbon determinations are fluctuating in accordance with global scale environmental changes'. Despite the mosaic, regionalised nature of environmental change in this period, it is an interesting possibility that the pattern of radiocarbon dates for cultural material may relate still to global environmental factors which may be driving human demographic behaviour, but this has to remain largely speculative at present, until the database of available radiocarbon dates increases significantly. Whatever the case, this at least serves to remind us that the natural and cultural regions that were discussed at the workshop are just as much temporal as spatial phenomena.

5. Conclusion

As with the archaeological residues of human groups in operation between 30 and 20 kyr bp, the radiocarbon data form a patchy resource with inbuilt eccentricities and problems, and it is only by appreciating these that the technique may be of use to answer questions of interest to palaeolithic archaeologists. It can, of course, serve to structure the palaeolithic record in time, but the discussion above has sought to isolate exactly what can be done with the *scale* in which this record is organised. This will inevitably be a coarse picture containing inbuilt biases, but it may prove to offer information on human demography and other time-transgressive phenomena. Human behaviour between 30 and 20 kyr bp was scattered and regionally distinct; it was not time-transgressive in any one, uniform way. At a broad level, the available radiocarbon database reflects this, in demonstrating that the number of dated cultural levels does not remain uniform throughout the 10 kyr under consideration, and that two distinct latitudinal regions of Europe have different radiocarbon signatures.

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Paul Pettitt
Radiocarbon Accelerator Unit
Research Lab. for Archaeology and the History of Art
University of Oxford
6 Keble Road
Oxford OX1 3QJ
UK

Steven E. Churchill
Vincenzo Formicola
Trenton W. Holliday
Brigitte M. Holt
Betsy A. Schumann

4 The Upper Palaeolithic population of Europe in an evolutionary perspective

This paper, resulting from the collaboration of five researchers working on different aspects of the skeletal biology of Upper Palaeolithic populations, examines patterns of variation in cranial morphology (B.A.S.), body shape (T.W.H.), stature (V.F.), robusticity and bony architecture of upper (S.E.C.) and lower (B.M.H.) limb bones. Analysis of cranio-facial morphology suggests a relative stability among regions and some restructuring over time of the major dimensions, particularly those reflecting length and breadth of the skull, a process not necessarily indicative of a decrease in cranial robustness. As concerns body shape, principal components analysis of a variable set representing limb proportions, body mass, and trunk breadth suggests that early modern Europeans exhibit a linear physique, like that of sub-Saharan Africans. This finding points to elevated levels of gene flow from more equatorial regions at the time of emergence of modern humans in Europe. A gradual evolution toward a cold adapted morphology, approaching that of modern Europeans, can only be detected during the Late Upper Palaeolithic. Stature shows a marked decrease over time, and an absence of regional differentiation. The magnitude of the trend suggests the synergistic effect of many factors including selective forces, dietary changes, and possibly inbreeding effects. Like other contributions, this section of the paper underscores the major evolutionary importance of the Last Glacial Maximum. Biomechanical analyses of upper and lower limbs produce a somewhat contrasting picture. Cross-sectional geometric properties of lower limb bones indicate decreased activity levels, i.e. mobility, while those of the upper limb reveal increased biomechanical loads in the Late relative to the Mid Upper Palaeolithic. This latter finding clearly does not support models proposing links between developing technology and postcranial gracilisation, and may reflect resource stress during the Late Upper Palaeolithic. Here again it is possible to hypothesize that the ecological changes that followed the Last Glacial Maximum created a complex situation requiring broad ranges of biological and cultural adaptations. Geometric analysis applied to upper limb bones also provides important information on habitual activities. It can be noted that robusticity measures of the humerus tend to be highly bilaterally asymmetrical, particularly in males, likely an effect of regular weapon use, while changes in shaft shape possibly reflect shifts in habitual hunting technology during the Late Upper Palaeolithic.

1. Introductory remarks

More than a decade ago Frayer (1984: 211) pointed out a general lack of interest among human paleontologists in the fossils of early modern humans associated with European Upper Palaeolithic cultures. This indifference stemmed from the common assumption that human evolution had ceased with the emergence of Cro-Magnons. In recent years interest in the biology of Upper Palaeolithic peoples has renewed, in part due to a revival of the debate about the origins of anatomically modern humans and the fate of the Neanderthals, and in part because of a growing appreciation of the wealth of fossil material from this time period and its potential to teach us about population relationships, adaptation and behaviour in the earliest modern humans of Europe. Accordingly, a number of biological anthropologists have in recent years turned their attention to the Upper Palaeolithic period.

Four interrelated issues have emerged as foci for this recent work. The first concerns the larger issue of modern human origins, and whether European Early Upper Palaeolithic populations arose by *in situ* evolution from European archaic populations (the Neanderthals) or by in-migration from other regions (possibly Africa). A second closely related issue concerns the adaptive and evolutionary significance of body form changes, in both stature and body shape, in the European Pleistocene fossil record. Stature, as a genetically determined trait with a large environmental component, is a useful indicator of both life conditions and microevolutionary trends. Body shape, largely genetically determined and highly correlated with climatic variables, can provide clues into both thermoregulatory adaptations and populational affinities of modern humans. Thus examination of body form changes through time serves as a tool both for exploring competing models of origins of anatomically modern populations (Regional Continuity versus Replacement) and for evaluating long-term effects of climatic and environmental changes during the late phases of the Upper Pleistocene.

A third issue concerns the nature of adaptive subsistence and technological shifts during this time, their action as agents of morphological change and their role, if any, in the morphological transition (whether by *in situ* evolution or replacement or a combination of the two) from archaic to modern humans in Europe. Ecological conditions, dimensions and mobility of prey, changes in faunal composition, and improvements both in lithic technology and in weapon efficiency, had important effects on hunting strategies and subsistence patterns. Temporal shifts in adaptive strategies, subsistence organization and technological sophistication can be reflected, indirectly, by changes in skeletal robusticity and structurally important aspects of bone shape. Analyses of upper limb bony architecture (i.e., by geometric analysis of long bone shaft cross-sections) provide insight into subsistence and technological activities of prehistoric populations, while the same techniques applied to the bones of the lower limb provide important information about the degree and patterning of mobility in these peoples. Biomechanical studies of the postcranial skeleton thus serve to illuminate the adaptive characteristics of Upper Palaeolithic hunters and gatherers.

Finally, of interest are patterns of regional differentiation occurring after modern peoples were established in Europe, and the information that these patterns contain about demography, adaptive strategies and the evolution of social complexity in the later stages of the Ice Age. In this regard it is important to know if the spread of apparently small bands of hunter gatherers over vast territories (from western and southern Europe to the Russian Plain and beyond) and attendant genetic isolation of these groups led, via drift phenomena, to a geographic differentiation in biological traits (mostly detectable in cranio-facial morphology). Gamble's (1986) concept of 'open systems' in the Upper Palaeolithic, i.e. a continuous flow of information and of genes (as part of a social adaptive strategy) over a vast depopulated territory, can potentially be tested with available fossil data, since such a system should prevent phenomena of regionalisation. Examination of the patterning of morphological variability among regions during the Upper Palaeolithic is of critical importance for deciding issues of social organization and adaptive complexity in these peoples. Studies of temporal and regional differences in craniofacial morphology play the leading role in addressing these issues. But here again the examination of variations of stature through time provides some critical insights, as such shifts may signal important changes in socio-economic and biodemographic aspects.

The study of the biology and behaviour of Upper Palaeolithic peoples is clearly awakening from a period of dormancy. We have collected together the contributions of five researchers who, in recent years, have addressed the above issues through a variety of approaches. These contributions are intended to summarize the current state of research into the European peoples of the latest Pleistocene, and to more clearly define major points of articulation and discordance in the works of the various authors (rather than to present a unified view of Upper Palaeolithic paleoanthropology). As such, we hope that this work will serve as a springboard for future, broad spectrum collaboration (both among physical anthropologists working on these populations and between them and palaeolithic archaeologists) in the human biology of Upper Palaeolithic peoples.

2. Cranial morphology: temporal and spatial patterning (B.A.S.)

Studies of cranial morphology in the European Upper Palaeolithic have focused either on the relationship between the earliest anatomically modern humans in Europe and the preceding Neanderthals (Frayer 1984, 1992a, 1992b; Smith 1984, 1985, 1991) or the nature of biological change throughout the Upper Palaeolithic (Frayer 1978, 1984, 1988; Van Vark 1990; Van Vark *et al.* 1992; Henke 1992; Sarich 1995; Schumann 1995). While most of these studies examine the Upper Palaeolithic for temporal trends by dividing the hominid fossils into either early (pre-20 kyr) and late (post-20 kyr) periods or by geographical regions, rarely is work focused on Upper Palaeolithic hominids associated with the Aurignacian. While this may be due to the limited or smaller sample size or the lack of clear chronological or archaeological provenance, recent studies by Gambier (1989a, 1989b, 1992) have, however, identified cranial features which reflect differences in robusticity and levels of variation within those hominids from Central Europe and those from Southwest France which date prior to 30 kyr.

While little work has focused solely on the morphological patterns of the earliest Upper Palaeolithic hominids, there persists a consensus that the hominids from the Early Upper Palaeolithic are larger and more robust than those from succeeding periods, including the latest Pleistocene and earliest Holocene populations of Europe (Frayer 1978, 1984, 1988; Frayer *et al.* n.d.; Simmons and Smith 1991). This section seeks to establish the exact nature of cranial morphology in the Early and Mid Upper Palaeolithic by testing a total sample of 58 European Upper Palaeolithic fossil hominids, 34 of which date prior to 20 kyr, for temporal and geographical patterns, using 113 metric cranial, dental and mandibular features. These features are standard variables described in Howells (1973), Lahr (1992) and Schumann (1995).

The earliest Upper Palaeolithic hominids are divided into two chronological groups, one including those hominids associated with (either directly or by inference from the literature) an aurignacian industry (i.e. they date prior to 30 kyr, referred to as the EUP) and the other including those hominids which date between 30 and 20 kyr (i.e. those associated with the Gravettian or Perigordian or Proto-Magdalenian, and referred to as MUP). These two groups are analyzed using a Mann-Whitney nonparametric comparison of group means. Further comparisons are then made in order

Table 1. Upper Palaeolithic specimens used in this analysis grouped according to chronological provenance.

EUP >30 kyr	MUP 30-20 kyr	LUP <20 kyr
Cro Magnon 1-4	Arene Candide 1	Arene Candide 2, 4, 5
Mladec 1, 2, 5, 6	Barma Grande 1, 2, 3, 5	Bruniquel 24
Stetten 1, 2	Brno 1, 2	Cap Blanc 1
Svitavka 1	Cioclovina	Chancelade 1
Zlaty Kun 1	Grotte des Enfants 4-6	Gough's Cave
	Dolní Věstonice 1, 2, 3, 14, 16	Laugerie Basse 1, 2
	Kostenki 2	Maritza
	Pavlov 1	Oberkassel 1, 2
	Předmostí 3, 4	Ortucchio 1
		Le Placard 1-7
		Saint Germain 1
		San Teodoro 3, 4

Table 2. Statistical results of the analysis of 113 cranial, dental and mandibular traits for temporal differences.

ANALYSIS	CRANIAL	DENTAL	MANDIBULAR	TOTAL
EUP -MUP	4 (3.5%)	0	2 (1.77%)	6 (5.31%)
EUP+MUP - LUP	10 (8.85%)	3 (2.65%)	0	13 (11.5%)
EUP - LUP	15 (13.27%)	1 (0.88%)	1 (0.88%)	17 (15.04%)
MUP - LUP	7 (6.19%)	5 (4.43%)	0	12 (10.62%)

to identify any morphological differences between the whole Early and Mid Upper Palaeolithic and those hominids which date to after the Last Glacial Maximum (Table 1).

The geographical analysis for differences in cranial morphology in the EUP and MUP was conducted initially by dividing the hominids into four geographical regions based on their original location. These four geographical groups were analyzed using a nonparametric Chi Square test. Due to small sample sizes, and based on these results and those from an earlier study (Schumann 1995), a Mann-Whitney test was conducted in order to compare the EUP and MUP hominid material from Central Europe with that from all other regions of Europe. Any geographical patterns in the EUP and MUP are discussed within the contexts of spatial patterning in the late Pleistocene.

2.1 Temporal analysis

The comparison between EUP and MUP indicated that there are four cranio-facial features and two mandibular features which are significantly different at the $p<0.05$ level (Table 2). This accounts for 5.31% of all variables examined. Of the 12 mandibular features examined, the height of the corpus and the breadth at the ramus were significantly different. Prior to 30 kyr, the mean height of the mandibular corpus is 7.6 mm higher than it is between 30 and 20 kyr. Accordingly, the mandible is over 12 mm wider across the rami in the EUP. No dental dimensions, however, were identified as significantly different between these two periods.

Four cranial dimensions were identified as significantly different between EUP and MUP. Contrary to the differences in the breadth of the mandible, which is broader prior to 30 kyr than it is between 30 and 20 kyr, the EUP specimens have on average narrower internal palate breadths than those hominids associated with the Gravettian; the breadth at M1/P4 is significantly narrower prior to 30 kyr than it is after. The maximum breadth of the cranial vault (measured across the parietal bones), however, is significantly larger (broader) prior to 30 kyr than it is after. In fact, while not statistically significant, five other measures of cranial vault breadth, including biasterionic breadth, biauricular breadth, bistephanic breadth, minimum frontal breadth and fronto-malar breadth, are greater in the EUP sample.

Other significant differences were identified in the length of the naso-frontal suture (a shortening through time) and in

Table 3. Temporal group means (value in mm), sample size (N) and standard deviation (SD) for the three Upper Palaeolithic periods for the seventeen variables with significant differences between the Aurignacian associated hominids and those from the Late Upper Palaeolithic.

VARIABLE	EUP >30 kyr			MUP 30-20 kyr			LUP <20 kyr		
	value	N	SD	value	N	SD	value	N	SD
asterion-bregma (ASTBR)	142.98	9	4.97	141.62	20	8.28	136.42	15	7.20
basion-prosthion length (BPL)	104.58	2	2.29	104.78	11	7.68	93.51	13	5.30
frontal arch (FARCH)	137.38	8	11.62	132.18	21	7.18	127.66	16	6.71
frontal chord (FRC)	119.96	9	11.06	114.83	22	5.82	110.48	18	5.59
glabella-opistocranium length (GOL)	196.20	9	7.05	192.91	19	7.85	185.11	16	8.12
lambda-opistocranium length (LAMOPIS)	40.47	7	5.89	32.03	19	6.82	31.54	15	8.00
external palate breadth (MAB)	64.55	6	1.57	61.24	14	4.85	62.49	15	3.51
naso-frontal breadth (NFRB)	23.04	4	2.17	18.84	13	2.54	17.54	9	5.00
nasion-opistocranium length (NOL)	194.37	7	4.42	189.04	17	7.43	183.96	15	10.50
orbit breadth (OBB)	44.03	4	3.09	40.92	17	3.66	40.41	14	3.02
bistephanic breadth (STB)	122.28	5	10.34	117.89	17	10.01	111.12	14	6.30
temporal fossa length (TFL)	47.56	2	4.57	43.33	10	3.9	39.36	10	2.98
maximum frontal breadth (XFB)	118.76	8	4.65	118.56	20	5.19	114.12	17	5.43
maximum cranial breadth (XPB)	144.47	7	6.93	136.51	17	5.68	138.19	15	5.11
zygo-orbital breadth (ZOZO)	62.24	4	4.47	59.25	14	9.85	55.74	10	4.63
ramus breadth (RAMB)	109.3	7	4.52	96.68	11	8.39	97.84	6	9.57
distance from maxillary P3 to M3 (MAXP3/M3)	43.86	2	3.05	42.53	12	1.93	39.55	13	1.64

the distance from lambda to opistocranium on the occipital bone. This latter difference indicates that the position of the opistocranium is shifting towards a more superior placement (moving towards lambda) from EUP to MUP.

While there are few metric differences which distinguish EUP from MUP hominids, 13 variables (11.5%) can be used to distinguish the former groups from the Late Upper Palaeolithics (LUP). These differences may indicate temporal trends throughout the entire Upper Palaeolithic, for the greatest differences in morphology are found between the earliest (pre-30 kyr) and the latest (after the Last Glacial Maximum) periods of the Upper Palaeolithic. In other words, greater differences exist between EUP and LUP (15.04%; n=17) than between MUP and LUP (10.62%; n=12). This suggests that there are clearer and more significant temporal trends throughout the whole of the Upper Palaeolithic than there are before the Glacial Maximum, as only six variables were found with significant differences between EUP and MUP. Any morphological change which can be identified is therefore most likely accounted for by differences between those hominids associated with the Aurignacian and those which date after the Last Glacial Maximum, with those hominids dating from 30 to 20 kyr falling in an intermediate position for fourteen of those seventeen variables (Table 3). The reduction in size (lengths and breadths), although not statistically significant, in fourteen of these seventeen variables suggests that there are changes in several major cranial vault dimensions through time, specifically in the length (GOL, NOL, FRC, ASTBR) and breadth (STB, XFB, XPB) of the cranium. Other noticeable trends are found in the position of the face relative to the cranial vault (BPL), and upper facial breadths (NFRB, OBB and ZOZO = breadth from the most superior point of the zygo-orbital suture on the inferior orbital margin to the same point on the other orbit). Compared to recent modern European populations, these metric differences are very small; differences in morphology between two of Howells' (1973) European populations, the Norse and Berg, amount to 56.1% of all cranial variables he examined.

2.2 Geographical analysis

The analysis for regional patterns in cranial morphology (Table 4) indicated that there are few differences either within the EUP, between MUP or within LUP. When all pre-20 kyr hominids are grouped together and analyzed as two regions (comparing the hominids from Southwest France to those from Central Europe), only two cranial variables were found with significant differences. These variables include the height of the mastoid (MDH) and the height of the parietal subtense (PAS).

Table 4. Statistical results of the analysis of 113 cranial, dental and mandibular traits for geographical differences.

ANALYSIS	CRANIAL	DENTAL	MANDIBULAR	TOTAL
EUP (two regions)	2 (1.77%)	0	0	2 (1.77%)
MUP (four regions)	3 (2.65%)	0	0	3 (2.65%)
LUP (three regions)	1 (0.88%)	2 (1.77%)	0	3 (2.65%)
EUP+MUP (central Europe vs S.W. France)	2 (1.77%)	0	0	2 (1.77%)
EUP+MUP (central Europe vs others)	5 (4.43%)	2 (1.77%)	0	7 (6.19%)

Based on previous analyses (Gambier 1989a, 1989b; Schumann 1995), the pre-Glacial Maximum Upper Palaeolithic hominids from Central Europe are apparently the most 'different', in terms of both cranial size and the level of robusticity. When the Central European material is contrasted with that from Italy, and Southwestern France, 7 (6.19%) cranial and dental variables are identified as significantly different. These variables include the length from pterion to bregma, the maximum breadth across the zygomaxillary suture, the parietal subtense, the internal palate breadth at both M2/M1 and M3/M2 as well as the bucco-lingual length of the maxillary first premolar and the length of the maxillary lateral incisor. In addition to the patterns in EUP and MUP, using the same geographical regions, the sample of LUP specimens displayed few regional differences, with only three variables (one cranial, two dental) significantly different. This suggests that there are no temporal differences in the regional patterning of morphological variation throughout the Upper Palaeolithic and that overall, there are few geographical differences in metric cranial and dental morphology. This need not, however, indicate anything about regional differences in cranial robustness either within the Early and Mid Upper Palaeolithic or between the Early, Mid and Late.

2.3 In conclusion

Throughout the Upper Palaeolithic, there are more morphological differences between all hominids which date before and after the Last Glacial Maximum. In each case (that is for these 13 variables), the mean value for those hominids living between 30 and 20 kyr falls between the means for the earliest (pre-30 kyr) and the latest (post-20 kyr) groups. These trends, however, reflect the greater differences observed between the aurignacian-associated hominids and those associated with LUP industries (the seventeen variables listed in table 3), rather than differences between either group and the MUP. These results are not unlike those presented by Frayer (1978, 1984, 1988) who found clear, directional trends in the size of the teeth and in the size and morphology of the face and cranial vault. The results of this study suggest that the morphological differences between EUP and MUP specimens are superseded by the number of differences between the whole of the EUP and MUP and the LUP, but this does not necessarily support the notion of significant evolutionary trends in overall cranial morphology throughout this period. Rather than suggesting that strong selective factors were operating on the total cranial and dental morphology of the earliest anatomically modern humans to produce a more gracile hominid by the onset of the Holocene (as suggested by Frayer), it is perhaps better to consider the thirteen (or seventeen when just the aurignacian-associated hominids are compared to the LUP hominids) significantly different variables as indications that there are some skeletal modifications over time which reflect differences between the EUP and LUP.

As the focus of this chapter is morphological patterning throughout the earliest stages of the Upper Palaeolithic, the clearest pattern and most significant changes to emerge prior to 20 kyr are in the breadth of the cranial vault and mandible. Although only maximum cranial breadth across the parietal bones and the breadth of the mandible across the rami are significantly different, there is a reduction throughout this time in overall cranial breadths. There is a consistent decrease, albeit not significant, in the breadth of the upper face (as measured across the fronto-malar suture), in the breadth of the frontal bone (STB and WFB) as well as at the base of the skull (biasterionic and biauricular breadth). In conjunction with the narrowing of the skull, there is also a shortening of the cranium throughout this period. There is not, however, any difference in the height of the cranium, as measured from basion to bregma. This indicates that there is some restructuring of major cranial dimensions, certainly in terms of the length and breadth of the skull, but that these changes are not necessarily indicative of a decrease in overall cranial robustness (Lahr and Wright 1996). The degree of cranial robustness, measured by the presence of cranial superstructures and distinct features such as tori, tubercules and crests, is determined by the size and shape of the cranial vault and the size of the palate and dentition (ibid.). While this analysis did not examine the degree of development of cranial superstructures, the changes in cranial vault breadth (a narrowing) as well as those changes identified in the breadth of the palate (a narrowing) may have lead to the maintenance of high levels of cranial robusticity throughout EUP and MUP.

Contrary to Frayer's find of the loss of robusticity throughout the Upper Palaeolithic, Lahr and Wright (1996) suggest that narrow skulls with large teeth will maintain high levels of robusticity. Previous studies have suggested that the EUP and MUP hominids, and in particular those from Central Europe, display a greater degree of robusticity than those specimens from the LUP (Gambier 1989a, 1989b; Schumann 1995). Interestingly, there is an increase (a broadening) on average of the breadth of the skull at the asterion and across the temporal bones (AUB) by the LUP. These changes combined with the shortening of the cranial vault (as indicated by changes in *GOL* and *NOL*) may have led to the decrease in levels of cranial robusticity by the end of the Upper Palaeolithic, but occurring only after the Last Glacial Maximum.

While this analysis did not attempt to document changes in overall cranial and dental robustness throughout the Upper Palaeolithic, it is clear that any trends or significant differences in cranial and dental morphology are most likely the result of differences between those hominids which date earlier than 30 kyr and those which date after the Last Glacial Maximum (20 kyr). Additionally, these differences may also be affected by sexual dimorphism throughout the Upper Palaeolithic, as these analyses were conducted on unsexed material. Frayer (1980, 1981) has found that throughout the Upper Palaeolithic there is a correlation between overall cranial and postcranial changes and the loss of male robusticity. Nevertheless, there are few morphological changes in the first 25 kyr (45 to 20 kyr) of the Upper Palaeolithic and even fewer regional patterns during this time. Based on this analysis, it may be possible to conclude that the EUP and MUP are periods of relative morphological stability, whereby there are few significant differences in the 114 metric variables examined. It is only after the Last Glacial Maximum when differences in morphology can be detected, especially with respect to the length and breadth of the cranium.

3. Body shape: climatic and phylogenetic aspects (T.W.H.)

Body shape can provide clues into climatic adaptation as well as populational affinity of the early modern humans. Body shape variables provide evidence of the former because in the modern world they are known to be highly correlated with climatic variables (Roberts 1953, 1978; Baker 1960; Crognier 1981; Trinkaus 1981; Ruff 1994). They provide evidence of the latter because human body shape appears to be largely genetically determined (Schultz 1923, 1926; Guilbeault and Morazain 1965; Eveleth and Tanner 1976; Y'Edynak 1978; Tanner *et al.* 1982). Both of these factors (climatic adaptation and populational affinity) have implications for understanding modern human origins in Europe, as discussed below.

Multivariate analyses of body shape begin with the computation of 'log size and shape' and 'log shape' variables (Darroch and Mosimann 1985). Log size and shape variables are merely the log-transformed raw measurements. Log shape variables are computed in the following manner – Darroch and Mosimann (1985) argue that the best measure of overall size is the geometric mean of all an individual's measurements. Thus, to create scale-free variables, ratios of each variable and the geometric mean are computed. These logged ratios are called log shape variables, and are scale-free in the sense that an isometric size component (the geometric mean, or 'log size' for that individual) has been removed from each variable. This has not completely removed the effects of size, however. In fact, size and shape may be correlated, and the Darroch and Mosimann technique can be used to determine if this is in fact the case.

This method is ideal for examining the relationship between size and shape for three reasons. First, in this method, unlike residual methods, shape is intrinsic to the individual, and not a function of the comparative sample. Residuals from allometric lines can change with a change in sample constituency. In other words, an individual's residual from an allometric relationship will change with sample size and/or constituency. However, the individual's own shape has, in fact, remained unchanged.

A second advantage of this technique is its ability to detect allometric relationships. The log shape variables are created by removing an isometric size component. This means that size effects due to allometric relationships (i.e., changes in shape associated with a change in size), have not been removed. In order to elucidate allometric effects, one must simply examine the correlation coefficients between the shape variables and log size (i.e., the geometric mean). A significant negative correlation of a shape variable with the geometric mean indicates a subisometric (negatively allometric) relationship, a significant positive correlation indicates a supraisometric (positively allometric) relationship, and a nonsignificant correlation indicates the shape variable is characterized by an isometric relationship with increasing size.

The third advantage of the Darroch and Mosimann technique involves the separate variance/covariance matrices generated when the 'log size and shape' and 'log shape' variables are subjected to principal components analysis

Table 5. Fossils included in this analysis.

MID UPPER PALAEOLITHIC (MUP) (30-20 kyr)	LATE UPPER PALAEOLITHIC (LUP) (20-10 kyr)	MESOLITHIC (MES) (<10 kyr)
Barma Grande 2	Arene Candide 2	Gough's Cave 1
Grotte des Enfants 4	Arene Candide 4	Gramat 1
Dolní Věstonice 14	Arene Candide 5	Hoedic 8
	Bichon 1	Hoedic 9
	Bruniquel 24	Rastel 1
	Cap Blanc 1	Teviec 1
	Le Peyrat 5	Teviec 11
	Romito 4	Teviec 16
	St. Germain la Rivière 4	

Table 6. Recent human samples included in this analysis.

EUROPE	NORTH AFRICA	SUB-SAHARAN AFRICA
Bohemia (BOH)	Egypt (EGY)	East Africa (EAF)
Bosnia (BOS)	Nubia (NUB)	Pygmy (PYG)
England (ENG)	Sudan (SUD)	San (SAN)
France (FRA)		West Africa (WAF)
Germany (GER)		
Norse (NOR)		

(PCA). Specifically, one can compare the eigenvalues of the two matrices to determine what percentage of the total variance is explained by a combination of size and shape versus shape alone.

The measurements used in the analysis were chosen *a priori* to represent the total morphological pattern of the postcranial skeleton and include all four limb segment lengths (femur, tibia, humerus and radius, or FL, TL, HL and RL, respectively), femoral A-P head diameter (FHAP), bi-iliac breadth (BIB) and clavicular length (CLVL). These variables represent three morphocomplexes known to covary with climate – limb proportions, body mass, and trunk breadth.

The Mid Upper Palaeolithic (MUP), Late Upper Palaeolithic (LUP) and Mesolithic (MES) fossils (Table 5), and 292 recent humans (Table 6) from Africa and Europe (for detailed description of samples see Holliday 1995) were subjected to principal components analysis of the above variable set (FHAP, FL, TL, HL, RL, CLVL, BIB).

Table 7 provides the eigenvalues and eigenvector coefficients for the first two principal components of the log size-and-shape and log shape data. The first principal component (PC1) of the log size-and-shape data explains 70.3% of the variance. It is best interpreted as a size component, since all its eigenvector coefficients are positive, and the PC scores along this axis are highly correlated with log size ($r^2 = 0.998$, $p < 0.0001$). PC2 explains 16.6% of the variance. Scores along this axis are not significantly correlated with log size ($r^2 = 0.004$, $p = 0.7239$), and the component contrasts femoral head diameter and bi-iliac breadth with distal limb segment lengths.

The reduction in variance from the log-size-and-shape to the log shape analysis indicates that 27.8% of the total variance is due to shape. The first shape component accounts for 54.2% of the shape variance, and contrasts femoral head diameter and bi-iliac breadth with limb segment length (particularly distal segments). The scores along this axis are not significantly correlated with log size ($r^2 = 0.005$, $p = 0.2089$). The second component of the log shape data (PC2) explains 20.3% of the variance. It contrasts femoral head diameter with bi-iliac breadth. The scores along this axis are correlated with log size ($r^2 = 0.148$, $p < 0.0001$).

Figure 1 is a plot of the mean PC scores for the log shape data.

PC1 of shape separates recent Europeans and North Africans to the left, who possess relatively cold-adapted bodies (wide trunks, larger femoral heads and shorter distal limbs) from recent Sub-Saharan Africans on the right, who

Table 7. Principal Components of Log Size-and-Shape and Log Shape Variables (seven variables): fossil and recent humans.

	EIGENVECTOR COEFFICIENT			
	Log size-and-shape		Log shape	
	I	II	I	II
FHAP	0.462	0.426	0.385	0.833
CLVL	0.361	-0.030	-0.042	-0.213
BIB	0.278	0.718	0.720	-0.502
FL	0.372	-0.180	-0.193	-0.026
HL	0.377	-0.112	-0.126	-0.021
TL	0.384	-0.333	-0.347	-0.084
RL	0.389	-0.382	-0.398	0.012
Eigenvalue	0.0348	0.0082	0.0082	0.0031
% total variance	70.34	16.58	54.17	20.31

are more tropically-adapted (narrow trunks, small femoral heads and long distal limbs). Interestingly, while European LUP and Mesolithic samples cluster among recent, the MUP sample tends to more closely approximate the Sub-Saharan African condition.

PC2 does not segregate out the groups; rather, it segregates males and females (scores different at $p < 0.0001$), albeit with much individual overlap). This separation is due to the fact that there is a tendency for females to possess smaller femoral heads and wider bi-iliac breadths than males. Thus, the relatively high PC2 scores of the fossil samples merely reflect their male bias. One can see this in figure 2, which is a plot of the individual PC scores for the log shape data for the recent Europeans and Sub-Saharan Africans, and European MUP and LUP samples. This allows one to see where the individual European fossils fall relative to recent Europeans and Sub-Saharan Africans.

Note the positions of the 3 MUP specimens (indicated by dark triangles) relative to the recent groups. Barma Grande 2 and Grotte des Enfants 4 cluster with each other in a region of overlap between the Africans and Europeans. Alternatively, Dolní Věstonice 14 falls squarely among the Sub-Saharan Africans for PC1, although its PC2 score is higher than that of any of the recent Africans. The LUP specimens, on the other hand, cluster squarely among the recent Europeans, although 1 of the 9 specimens, Bichon 1, falls in the region of overlap between the recent regional samples.

While sample size is admittedly small, in this analysis and in other body shape analyses, (most with larger sample sizes; see Holliday 1995, n.d.) the European MUP sample as a whole does not appear to be very 'European-like', but rather

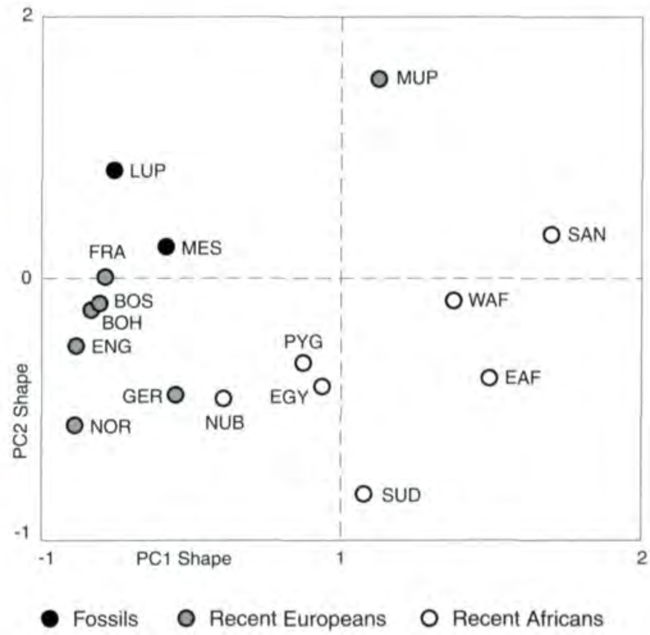

Fig. 1. Scatter plot of PC 2 on PC 1 of the log shape variables. Fossil and recent human mean PC scores are shown.

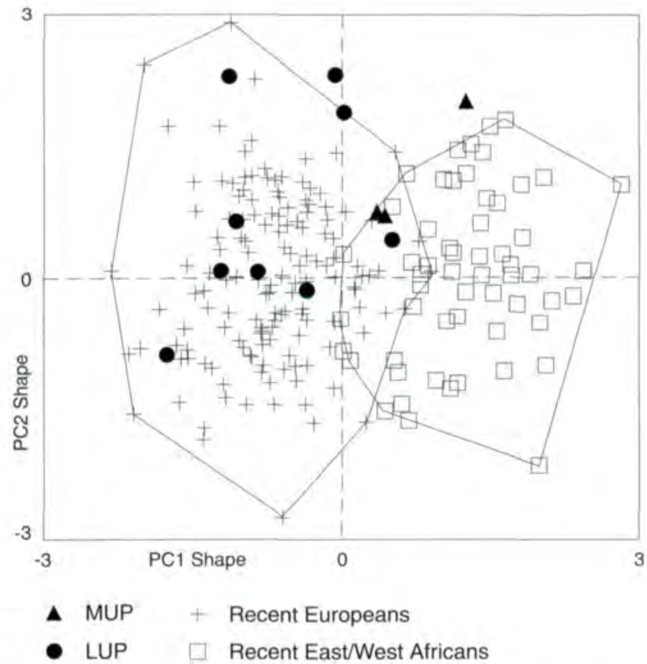

Fig. 2. Scatter plot of PC 2 on PC 1 of the log shape variables. This plot shows the individual PC score data for the MUP and LUP fossils and the recent Europeans and East/West Africans.

tends to possess a longer, more linear physique like that of recent Sub-Saharan Africans. This result fits more easily within a Replacement or Intermediate model framework than within a model of local continuity.

It is important to note, however, that many MUP specimens do not fall outside the range of the recent Europeans. Rather, they tend to fall to the extreme end of the European range, but within the Sub-Saharan African range. In contrast, only one European LUP specimen (Bichon 1) fell within the Sub-Saharan African range in multivariate space. Therefore, if the MUP sample is an unbiased, representative sample, then the early modern humans in Europe were characterized by on average a more tropically-adapted body form than one finds in Europe today.

Size-driven shape differences remain an issue, given that a number of the MUP specimens are large in body size (as reflected in the geometric mean). However, for only two shape features (bi-iliac breadth and trunk height) do the European MUP specimens follow an allometric trend that would tend to make them look more African-like (Holliday 1995). As for the other features in which they look African-like (limb length and relative femoral head size) one cannot easily invoke an allometric explanation, since the pattern exhibited by the MUP sample either violates allometric expectation, or, alternatively, the variable in question is isometric (Holliday 1995).

Additionally, ANOVA's of the fossil samples provide no evidence of a body mass difference between the European MUP and other Pleistocene groups (Holliday 1995). Thus, it is precisely the variables for which the European MUP deviate from the other fossil groups – i.e., limb lengths, and not large body mass *per se* – that are driving their large geometric means. If the European MUP humans are not heavier than other fossil humans, then allometry cannot be easily invoked to explain their different body shape.

The body shape of subsequent European populations is also important to the question of modern human origins. Regional Continuity predicts all European late Pleistocene/early Holocene humans should have a cold-temperate body shape, although minor fluctuations may be expected, given climatic cycles and improvements in cultural buffering. Replacement, on the other hand, predicts that subsequent to the initial appearance of modern humans in Europe, there should be gradual evolution toward a cold-adapted morphology.

The results with regard to this prediction are interesting. There is evidence for a change toward a more cold-adapted body shape from the MUP to the LUP, but there is no solid evidence for a subsequent change to the Mesolithic. Rather, for most multivariate analyses, these two samples cluster with each other (usually well within the spread of recent Europeans). This lack of evidence for later temporal change could be due to the complicating effects of the warmer temperatures associated with the onset of the Holocene, or perhaps to improved cultural buffering.

To summarize how well the body shape results match predictions derived from the two competing models of modern human origins, the predictions of Regional Continuity are not met. There is very little evidence for continuity in body shape, at least in Europe. Again, under the assumption that the small European MUP sample is representative, they have a different body shape from both the Neanderthals who preceded them in the region (Holliday 1995, n.d.), and from later European populations. Since neither climatic change nor mobility may be invoked to explain this pattern (Holliday and Falsetti 1995), by default it appears some degree of extraneous genetic influence was present.

Unfortunately, the interpretation of these data requires some guesswork. While some amount of extraneous genetic influence has been documented, the question of the relative importance or magnitude of this outside influence is difficult to assess from these data alone.

In other words, these data are compatible with either complete Replacement or an Intermediate model of modern human origins, and it is difficult to argue which model best fits the data.

4. Stature: environmental and genetic factors (V.F.)

Converting bone lengths to stature evaluations provides important information both for qualifying a skeletal population from the physical point of view, and for analyses dealing with body size variations and its links to ecological and biocultural variables.

Historically, the first issue has been largely pre-eminent and height has been a basic feature in building up the typological paradigm. During the first decades of the 20th century, a few Upper Palaeolithic specimens, labelled as 'types', were identified as lineally connected with modern Europeans, like the tall 'protonordic' Cro-Magnons, and the short statured 'protomediterranean' Combe Capelle skeleton. Today, analyzing stature of past populations means investigating life conditions, subsistence patterns, and more generally the relationship between Man and his environment by means of an indicator highly sensitive to ecological and socio-cultural variables. The most recent works dealing with stature variations during the Upper Palaeolithic are more than ten years old (Frayer 1981, 1984). New discoveries and developments in stature evaluation methodologies provide the opportunity to carry out a study based on a substantially increased sample and more reliable techniques.

Long bone lengths of European Upper Palaeolithic remains of adult individuals, not showing pathological

Table 8. The samples.

MID UPPER PALAEOLITHIC				LATE UPPER PALAEOLITHIC			
STATE	SITE	M	F	STATE	SITE	M	F
CZECH REP.	Dolní Věstonice	3	1	FRANCE	Bruniquel	-	1
	Pavlov	1	-		Cap Blanc	-	1
	Předmostí	3	2		Chancelade	1	-
ENGLAND	Paviland	1	-		Farincourt	-	1
FRANCE	Abri Pataud 5	-	1		Le Peyrat	1	1
	Cro Magnon	2	1		Le Placard	1	-
	La Rochette	-	1		St.Germain la Rivière	-	1
ITALY	Barma Grande	4	-		Veyrier 1	1	-
	Baousso da Torre	1	-	GERMANY	Dobritz	-	1
	Caviglione	1	-		Neuessing	1	-
	G. des Enfants 4	-	1		Oberkassel	1	1
	Ostuni	-	1	ITALY	Arene Candide	5	2
	Paglicci 25	-	1		G. des Enfants 3	-	1
	Parabita	1	1		Paglicci 11	1	-
RUSSIA	Kostenki 2	1	-		Riparo Continenza	1	-
	Sungir' 2	1	-		Riparo Tagliente	1	-
					Riparo Villabruna	1	-
					Romanelli	1	-
					Romito	1	2
					San Teodoro	-	2
					Vado all'Arancio	1	-
				RUSSIA	Kostenki 1	1	-
				SWITZERLAND	Le Bichon	1	-

changes affecting growth, represent the basic material for this work. The source of the measurements is the literature up to 1995, and information kindly provided by colleagues.

The material is listed in table 8. Long bone lengths have been transformed into stature estimates by means of new regression equations derived from Early Holocene skeletal samples, using Fully's 'anatomical stature', and the major axis regression technique (Formicola and Franceschi 1996). The sample has been split into two groups: the Mid Upper Palaeolithics (MUP), corresponding to the material dating from approximately 30 kyr to the pre-Glacial Maximum, and the Late Upper Palaeolithics (LUP) chronologically placed between the post-Glacial Maximum and the Pleistocene-Holocene transition.

Data reported in figure 3 clearly show the high stature characterizing MUP males, and the marked difference, statistically highly significant, when compared to the LUP group. The amount of the difference between two groups is apparent in figure 3, showing that the lower limit of the variability of the MUP sample corresponds to the mean value of the later group. Moreover, taking into account the individual data, it can be noted that there is very limited overlap between the two ranges and that in particular very few MUP specimens (Předmostí 9, Cro Magnon 3, and Kostenki 2) are shorter than 170 cm, a stature reached only by two LUP individuals (Paglicci 11, and Romanelli). Significant differences also result from statistical comparisons between females. Differences in distributions are shown in figure 3, and in that case too the samples exhibit very limited overlap of the ranges.

The male-female difference in the MUP group (13.3 cm) is higher than in the later group (12.1 cm) as expected on the basis of the positive correlation between height values and degree of sexual dimorphism (Martin and Saller 1959).

The results of testing for possible regional differences within the two periods are reported in figures 4 and 5. In the first case, the comparison involves gravettian male samples from Moravia and from the Grimaldi caves. In the absence of well-identified regional samples, the comparison between LUP groups has been carried out between Central and South Europe. In both cases, the results indicate absence of significant differences, and suggest that the dramatic decrease in stature after the Last Glacial Maximum is a phenomenon affecting the whole European record.

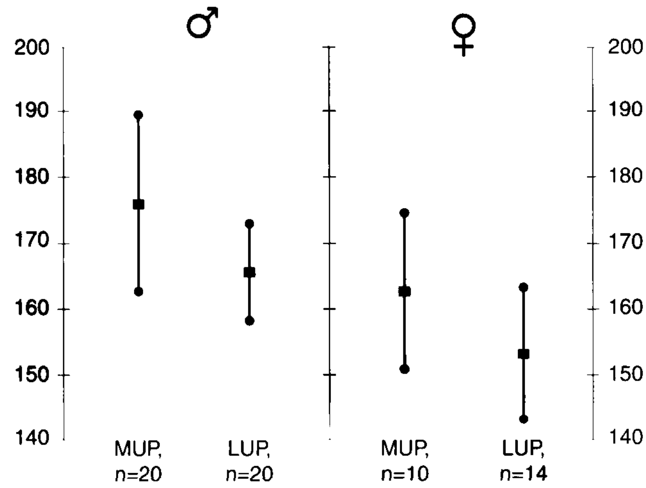

Fig. 3. Comparison (M ± 2σ) between Mid and Late Upper Palaeolithics (significant differences p<0.01).

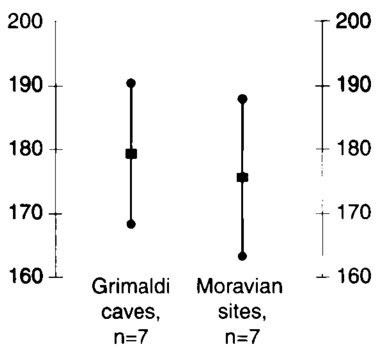

Fig. 4. Comparison (M ± 2σ) between Mid Upper Palaeolithic males from Liguria (Grimaldi caves) and from Moravia (Pavlov, Předmostí). No significant differences.

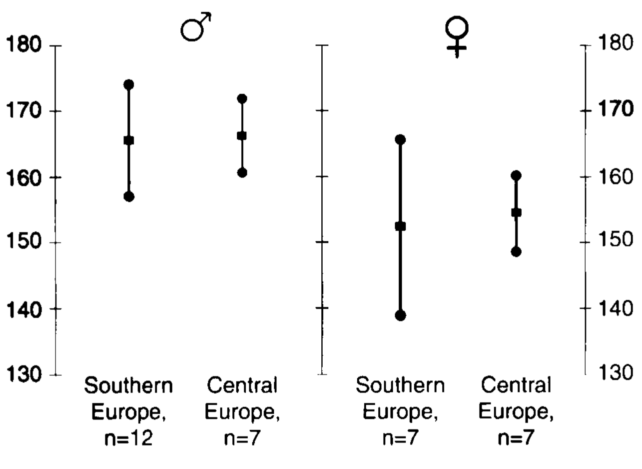

Fig. 5. Comparison (M ± 2σ) between Late Upper Palaeolithics from Southern and Central Europe. No significant differences.

Apparently, the Last Glacial Maximum and not the Upper Palaeolithic-Mesolithic transition, contrary to suggestions of previous works, represents the most critical phase in the negative trend affecting height of Upper Palaeolithic European populations.

Interpretation of the phenomenon of stature decrease has mainly focused on relaxed selective pressures for large body size as a consequence of technological improvements and reduction in dimensions of the prey (Frayer 1981, 1984). Additional factors taken into account include climatic adaptations and nutritional status. Relationships between body size and climate explain a few morphological differences among human populations. The decline in temperature occurring during the Last Glacial Maximum may have brought a shift towards a shorter, cold adapted, body size (Holliday 1997). However, Ruff's (1991) cylindrical model stresses that body breadth rather than height is the critical factor in variations of surface area and body mass ratio. Thus, climatic factors cannot account for the marked negative trend affecting Late Upper Palaeolithic populations. On the contrary, it is well known that nutritional conditions are very important in the growth process (Malina 1987; Eveleth and Tanner 1990), and the mean stature of a population is taken as a parameter indicative of its nutritional status (Prince 1995). High nutritional standards probably played an important role in the attainment and maintenance of the large body dimensions characterizing pre-Glacial Maximum Upper Palaeolithic samples. These populations had wide access to animal proteins, mostly derived from megafauna, and it is likely that tubers, fruits and wild vegetables in general contributed to varying and improving the quality of diet (Mason *et al.* 1994). After the Last Glacial Maximum gregarious megafauna was replaced by smaller more solitary games, and archaeological data indicate a shift toward a broader spectrum of subsistence activities. Moreover, number and size of the sites suggest an increased population density affecting the positive relationship with the available biomass enjoyed by earlier groups.

The synergistic effect of lower protein intake and possibly of relaxed selective forces may account for the observed marked decrease in stature. However, an additional, generally less considered factor, could have played an important role in determining the phenomenon.

One of main difference between Pre- and Post-Glacial Maximum is represented by the gradual disintegration of the cultural homogeneity characterizing the Early and Mid Upper Palaeolithic. This homogeneity, apparent in technological, artistic, and funerary aspects of the archaeological record, probably reflects high mobility, linked to subsistence strategies, and to the need to keep intergroup contacts over vast territories (Gamble 1986). That is a condition resulting in outbreeding and high levels of gene flow. Gene flow is one of the mechanisms of evolution, and outbreeding has been suggested as one of the factors responsible for today's positive secular trend (Malina, 1979). Improved health and nutritional conditions are easily demonstrable environmental factors affecting growth and development, but it is apparent that socio-economic improvements have, as a side effect, increased mobility, breakdown of the isolates, and consequently higher genetic admixture. Thus, because of the concomitance of the changes, the relative importance of genetic versus environmental factors remains an unresolved matter. However, relationships between height and level of inbreeding have been observed in different European countries (Hulse 1957; Schreider 1967; Wolansky *et al.* 1970; Billy 1971), and a negative correlation between levels of inbreeding and stature has been found in Meso-American populations, in the absence of improved health and nutritional conditions (Little and Malina 1986). In that perspective, it is important to note that Late Upper Palaeolithic archaeological information points to the beginning of a process of regional diversification of the cultures, probably an effect of the increased territorialism of groups broadening their ability to exploit natural resources. This phenomenon, coupled with increased population density, prospects of decreased mobility, development of more localised breeding networks, and in particular decreased gene flow, an additional factor to take into account in interpreting the marked negative trend subsequent to the Last Glacial Maximum.

5. Upper limb: a functional interpretation (S.E.C.)

Geometric analysis of long bone cross-sections provides a method of inferring levels and patterns of activity in prehistoric peoples (see Ruff 1992 for a review and justification for this type of research). Application of this method to the bones of the upper limb gives information about habitual subsistence and technological behaviour (Churchill 1994). Humeral mid-distal shaft cross-sections were thus taken on 17 Mid and 23 Late Upper Palaeolithic modern human specimens (Table 9). The Mid Upper Palaeolithic sample is composed primarily of specimens deriving from gravettian or proto-magdalenian contexts, but also includes a small number of specimens from aurignacian levels. These include three individuals most likely derived from late aurignacian levels at Cro-Magnon and probably chronologically best placed at about 30,000 years ago (Movius 1969; Gambier 1989a), and a single individual from Stetten (Vogelherd) associated with a basal Aurignacian, possibly 35,000 years old (Czarnetzki 1980). Thus with one exception, the sample is best seen as comprising fossils falling between 30,000 to 20,000 years bp. Since a sexual division of labour as seen in recent hunter-gatherers may also have characterised Pleistocene groups, males and females were analysed separately. Thus the samples analysed were limited to specimens for which sex could be reasonably determined from associated pelvic and cranial remains. Two specimens, Vogelherd (Stetten) 3 and Le Placard 16, were represented by isolated humeri, and are here considered male based on size, muscularity and robusticity. For comparative purposes, data were also collected on the skeletons of recent foragers, agriculturalists and industrialised peoples. The foragers include Georgia Coast Woodland-period Amerindians (data from Fresia *et al.* 1990), Aleutian Islanders, and Jomon-period Japanese. Agriculturalists were represented by samples of Georgia Coast Mississippian-period (data from Fresia *et al.* 1990) and New Mexican late Pueblo- period Amerindians. Autopsy samples of 20th century European- and African-Americans were used to represent industrialised peoples. Details about the samples can be found in Churchill (1994).

External diaphyseal contour moulds and compact bone diameters taken from anteroposterior and mediolateral radiographs (see Churchill 1994) were used to non-invasively estimate humeral mid-distal diaphyseal cross-sectional anatomy. Cross-sectional properties were estimated from the x-rays alone, using formulae found in Fresia *et al.* (1990), in cases where moulding of the fossils was not possible. Sections were estimated for the mid-distal humeral shaft, at 35% of humeral articular length (HAL) measured from the distal end. Diaphyseal cross-sectional geometric properties are determined by modelling the bone as an irregular, tubular cylinder and using principles of engineering beam theory (see Ruff 1992). These measures reflect the contribution of bone geometry to mechanical strength at the level at which the section was taken (in this case, the mid-distal shaft). The relationship of cross-sectional geometric properties to diaphyseal strength under various biomechanical loads is discussed in more detail elsewhere (Jungers and Minns 1979; Ruff and Hayes 1983a; Ruff 1992). Cortical area (CA) was taken as a measure of the resistance of the bone to pure axial loads (compression and tension), while second moments of inertia and the polar moment of inertia were used as measures of the strength of the bone to bending and torsional loads. I_x, the second moment of inertia about the mediolateral axis crossing through the centroid of the section, measures the strength of the bone to bending in the anteroposterior direction, while the second moment about the anteroposterior axis (I_y) measures strength to bending in the mediolateral plane. The polar moment of inertia (J, calculated as $I_x + I_y$) is a reflection of the strength of the bone to generalised bending and torsional loads. Since the amount of bone tissue in a shaft cross-section is related to the size of the individual, and since size varies in these samples, strength measures were standardised to body size following arguments in Churchill (1994). Specifically, CA

Table 9. The sample composition.

MID UPPER PALAEOLITHIC		LATE UPPER PALAEOLITHIC	
SPECIMEN	SEX	SPECIMEN	SEX
Arene Candide 1	male	Arene Candide 2	male
Barma Grande 2	male	Arene Candide 4	male
Barma Grande 5	male	Arene Candide 5	male
Baousso da Torre 2	male	Arene Candide 10	male
Grotte des Enfants 4	male	Arene Candide 12	male
Grotte des Enfants 5	female	Arene Candide 13	female
Paglicci 25	female	Arene Candide 14	female
Pavlov 1	male	Grotte des Enfants 3	female
Dolní Věstonice 14	male	Romito 3	male
Dolní Věstonice 16	male	Romito 4	female
Cro Magnon 1	male	Romanelli 1	male
Cro Magnon 2	female	Bruniquel 24	female
Cro Magnon 3	male	Cap Blanc 1	female
Abri Pataud 4	male	Chancelade 1	male
Abri Pataud 5	female	St. Germain la Rivière 4	female
Paviland 1	male	Farincourt	female
Stetten 3	male	Le Placard 16	male
		Laugerie Basse 4	male
		Veyrier 1	male
		Veyrier 7	male
		Neuessing 2	male
		Oberkassel 1	male
		Oberkassel 2	female

was standardized by HAL^2, while second and polar moments were standardized by HAL^4. Humeral articular length (M-2: Martin 1928) was estimated for incomplete specimens (Churchill 1994). Mean values of these size-standardised robusticity measures are provided in tables 10 and 11.

Humeral strength measures in both limbs of Mid Upper Palaeolithic (MUP) males are generally below those of recent foragers, and are more consistent with values obtained from agricultural and industrial populations (Table 10). Values for Aleutian Islanders and Jomon-period Japanese (both coastal hunter-gatherers making use of marine resources) are generally higher than those obtained for the Pleistocene fossil groups, undoubtedly a reflection of high biomechanical loads in the upper limb related to frequent paddling of boats and kayaks on the open ocean (see Berget and Churchill 1994).

The Late Upper Palaeolithic (LUP) males have generally greater strength measures, comparable with the values for the Georgia Coast foragers. Although sample sizes are small, analysis of variance followed by Fisher's least significant difference test indicate that the LUP sample is significantly stronger in all measures and in both limbs than males from the MUP ($\alpha = 0.05$).

For females, the fossil sample sizes are inadequate for statistical testing. The two Upper Palaeolithic groups do not appear to differ substantially in size-corrected CA in either limb, or in standardised second moments or polar moments of inertia in the right humerus (Table 11). Late Upper Palaeolithic females are stronger in all measures, but especially in measures of resistance to bending and torsional stresses, in the left humerus than are their MUP counterparts. However, given the high variances associated with humeral strength measures within samples (Table 11) – likely a reflection of interindividual variability in behaviour and resultant upper limb loading intensities – and the small fossil samples, it is impossible to determine whether or not the increase in left humeral strength in LUP females is behaviourally significant. Females in both periods are more robust than the Georgia Coast hunter-gatherers, but comparable to or slightly more gracile than the Aleut and Jomon females.

It is interesting that the Late Upper Palaeolithic, associated with rapidly developing technological innovations such as refined lithic reduction methods (with increased frequencies of backed bladelets and micropoints: see Straus 1993), more

Table 10. Size-standardized[1] humeral mid-distal diaphyseal cross-sectional robusticity measures - males (Mean, SD).

	CA		I_x		I_y	
	Right	Left	Right	Left	Right	Left
Mid Up. Pal. (n = 9 r, 11 l)	222.9	174.5	827.8	510.6	638.3	411.4
	34.9	28.4	191.5	161.3	148.7	137.6
Late Up. Pal. (n =13 r, 10 l)	275.6	227.9	978.8	697.6	832.8	613.5
	40.5	52.0	279.5	229.5	239.5	280.9
FORAGERS						
Georgia Coast[2] (n = 6 r, 6 l)	260.9	222.6	804.7	811.3	751.6	756.2
Aleuts (n = 25 r, 24 l)	266.0	253.6	983.8	915.6	1101.9	980.6
	40.5	33.0	178.8	174.2	251.0	218.1
Jomon (n = 10 r, 10 l)	244.5	248.8	999.9	959.1	1108.5	1087.9
	45.8	47.6	306.9	250.1	282.1	279.9
AGRICULTURAL						
Georgia Coast[2] (n = 11 r, 11 l)	231.6	213.8	677.1	652.5	601.7	621.9
Pueblo AmerInd(n= 18 r, 16 l)	171.4	156.3	568.6	455.2	520.5	481.4
	26.3	14.4	128.5	83.5	113.9	52.6
INDUSTRIAL						
EuroAmerican (n = 23 r, 19 l)	204.8	197.1	680.9	626.3	593.8	554.5
	38.3	39.4	222.2	187.6	214.8	213.8
AfroAmerican (n = 12 r, 12 l)	210.5	200.4	864.6	719.1	800.3	689.5
	30.3	32.2	181.2	139.9	242.0	223.3

1. CA standardized to HAL^2 (* 10^5), I_x, I_y and J standardized to HAL^4 (*10^9)
2. Mean cross-sectional values standardized by mean humeral length (as above); data from Fresia *et al.* (1990)

diverse and efficient foraging technology (including nets, weirs, harpoons, spearthrowers, weapon armatures and possibly bows and arrows: Julien 1982; Tyldesley and Bahn 1983; Straus 1990, 1993; Bergman 1993), is associated with generally stronger humeri in the affiliated fossil hominids. Models that propose a link between developing technology and postcranial gracilization in human evolution (see review in Churchill *et al.* 1996) clearly do not apply here. Both enhanced skeletal robusticity and acceleration of technological development are likely related responses to resource stress – either due to population packing or climatic deterioration, or both – during the later Pleistocene (Churchill *et al.* 1996). From this perspective, foragers of the Mid Upper Palaeolithic likely enjoyed a greater ecological stability, in terms of the balance between resource demand and availability, than did later populations.

Robusticity measures tend to be highly bilaterally asymmetrical in the upper limbs of Upper Palaeolithic males (Table 12), even relative to that seen in recent marine-based foraging groups (data for the more terrestrial foragers from the Georgia Coast were not available). Asymmetry in these measures is pronounced in Upper Palaeolithic females as well, but not to the extent seen in the males (Table 14). In both sexes, the asymmetry reflects a pattern of right hand dominance (greater activity and hence bone tissue deposition in the right side limb relative to the left: Churchill *et al.* 1996). The greater asymmetry in males than females has been attributed to the regular use of hand launched weapons – either hand thrust, hand thrown, or spear-thrower (*propulseur*) projected – in hunting by males (Churchill *et al.* 1996). Examination of ratios of second moments of area in the anteroposterior (I_x) and mediolateral (I_y) planes (Table 13) reveals humeral sections that are, on average, less rounded in the Mid than the Late Upper Palaeolithic males (an I_x/I_y of one denotes a roughly circular section equally resistant to bending in both planes, a value greater than one denotes an anteroposteriorly strong section, while a value less than one denotes a relatively mediolaterally strengthened section). This pattern is slightly more marked for the right than for the left limb. The Mid Upper Palaeolithic males are,

Table 11. Size-standardized[1] humeral mid-distal diaphyseal cross-sectional robusticity measures - females (Mean, SD, n).

	CA		I_x		I_y		J	
	Right	Left	Right	Left	Right	Left	Right	Left
	213.2	183.2	616.4	528.4	511.7	424.7	1128.1	953.2
Mid Up. Pal. (n = 2 r, 4 l)	19.1	28.3	58.8	91.3	36.3	126.2	95.1	213.3
	214.2	196.3	670.1	677.5	504.8	502.7	1171.9	1178.6
Late Up. Pal. (n = 6 r, 7 l)	43.8	29.7	214.8	110.8	172.4	91.0	388.1	196.2
FORAGERS								
Georgia Coast[2] (n = 6 r, 6 l)	204.7	154.3	447.9	377.3	481.0	425.3	928.9	802.6
	205.0	203.9	713.4	708.9	690.8	700.0	1404.2	1408.9
Aleuts (n = 19 r, 16 l)	38.0	34.9	188.4	159.3	171.9	158.6	350.1	313.6
	204.8	199.6	764.6	728.3	851.0	794.0	1615.6	1522.3
Jomon (n = 13 r, 14 l)	33.8	32.9	165.1	129.4	133.2	152.3	287.1	258.1
AGRICULTURAL								
Georgia Coast[2] (n = 11 r, 11 l)	210.5	181.1	494.4	495.7	531.4	564.8	1025.8	1060.4
	164.4	203.9	475.4	479.0	541.0	552.0	1016.4	1031.0
Pueblo AmerInd[2](n = 16 r, 19 l)	26.9	34.9	96.9	115.2	86.9	115.0	161.6	219.9
INDUSTRIAL								
	142.2	136.4	443.5	411.3	370.6	354.7	814.1	766.0
EuroAmerican (n = 18 r, 19 l)	25.2	25.5	110.6	113.4	98.6	115.4	206.1	223.0
	160.8	157.6	567.9	507.6	502.0	446.7	1069.8	954.3
AfroAmerican (n = 14 r, 11 l)	41.9	30.6	182.3	122.9	177.4	125.1	350.7	238.8

1. CA standardized to HAL^2 ($* 10^5$), I_x, I_y and J standardized to HAL^4 ($*10^9$)
2. Mean cross-sectional values standardized by mean humeral length (as above); data from Fresia *et al.* (1990)

in fact, extreme among the comparative samples in the degree of anteroposterior elongation of the cross-sections (relative to the mediolateral strength). This difference in humeral shaft shape has been interpreted (Churchill *et al.* 1996) as reflecting a shift in habitual hunting technology, from a greater dependence on hand-held thrusting spears (producing anteroposterior bending stresses on the humerus) in the Mid Upper Palaeolithic to a greater reliance on thrown spears (producing torsional stress in the humerus) in the later period. In females, the asymmetry in humeral cross-sectional cortical area is only slightly above (MUP) or within (LUP) the range of recent peoples (Table 13). For the polar moment of inertia (J), again a reflection of resistance to bending and torsional loads, both MUP and LUP females show asymmetry levels well above those of more recent females. This suggests that palaeolithic females, like their male counterparts, were also regularly engaging in activities (such as throwing) that engendered higher bending or twisting stresses in one limb than the other. While the nature of the activities that produced these loads is presently unclear, it does raise the possibility that the sexual division of labour that is a near-universal among modern hunter-gatherers had not fully emerged by the later Pleistocene, and that females were engaging (albeit to a lesser degree based on the magnitude of asymmetry) in regular weapon-use behaviours.

6. Lower limb: biomechanical analysis (B.M.H.)

Archaeological and palaeoecological evidence suggests that major changes took place during the Later Pleistocene of Europe, with important effects on human subsistence. Upper Palaeolithic human postcranial remains provide a unique opportunity to understand the major trends and shifts that characterised this time period.

It has been hypothesized that subsistence changes that followed the Last Glacial Maximum in Europe resulted in decreased stature, skeletal robusticity, and sexual dimorphism (Frayer 1980; 1981). According to this hypothesis, the 'gracilization' process was a consequence of a reduction in the level of musculoskeletal stress as a result of better hunting technology and reduction of prey size.

Table 12. Median percent asymmetry[1] in cortical area (CA) and polar moment of inertia (J) in males (Median, Quartile Range, Range).

	% ASYMM - CA	% ASYMM -J
	29.0	58.7
Mid Up. Palaeo. (n = 7)	13.1 - 40.8	39.9 - 96.4
	11.4 - 68.4	21.7 -170.5
	33.8	51.2
Late Up. Palaeo. (n = 9)	28.9 - 48.0	45.7 - 97.4
	20.1 - 56.8	34.3 -132.2
	9.5	16.4
Aleut (n = 24)	2.6 - 15.3	6.3 - 21.8
	0.2 - 23.9	1.1 - 40.1
	6.7	6.4
Jomon (n = 10)	5.1 - 7.6	3.2 - 10.7
	0.4 - 15.0	1.6 - 16.7
	6.8	16.8
Pueblo AmerIndian (n = 14)	4.0 - 9.1	8.8 - 23.6
	0.4 - 33.4	5.5 - 37.8
	5.9	7.5
EuroAmerican (n = 19)	3.2 - 11.6	3.1 - 21.8
	0.7 - 26.5	1.6 - 41.6

1. Percent asymmetry calculated as [(max-min)/min]*100

Table 13. Mean I_x/I_y ratios (*100) for male samples - (Mean, SD, n).

	RIGHT	LEFT
Mid Up. Palaeo.	130.8	126.4
	16.5 (9)	16.5 (11)
Late Up. Palaeo.	118.6	121.1
	15.6 (13)	25.0 (10)
Georgia Coast H&G[1]	100.1 (6)	100.3 (6)
Aleut	103.7	101.6
	13.5 (19)	7.8 (16)
Jomon	89.7	89.1
	12.7 (10)	13.2 (10)
Georgia Coast Agricult.[1]	112.5 (11)	104.9 (11)
Pueblo AmerIndian	88.5	87.1
	15.2 (16)	13.5 (19)
EuroAmerican	120.9	118.9
	10.5 (19)	17.1 (20)
AfroAmerican	115.6	115.1
	15.0 (14)	15.7 (11)

1. ratio calculated using mean I_x and I_y values: data from Fresia *et al.* 1990

However, contrary to the 'technological efficiency' model, biomechanical analysis of upper limb bones (Churchill 1994; this chapter) point to a marked increase in activity levels during the Late Upper Palaeolithic. These contrasting lines of evidence suggest that both postcranial variability in Upper Palaeolithic Europeans and factors underlying that variability are poorly understood. Size alone, whether of the whole body or of long bones, is an imprecise indicator of biological adaptation (Ruff 1987). Changes in bone geometry, or shape, provide more precise information about adaptation to mechanical forces that are indicative of functional use and, thus, behavioural differences (Lovejoy *et al.* 1976; Ruff and Hayes 1983a, b; Ruff 1987). Distribution of bone viewed in cross-section reflects loads placed upon that bone because, during life, bones respond to changes in forces by adding or redistributing osseous material (Wolff 1870; Ruff and Hayes 1983a; Bridges 1991). Therefore, cross-sectional properties of lower limb bones directly reflect activity levels.

Interpreting differences in long bone structure in terms of mechanical forces results in a better understanding of biobehavioural changes that accompany a change in subsistence strategy (Benfer 1990; Ruff and Larsen 1990).

Cross-sectional geometric dimensions reflect the ability of the bone to resist internal loads and bending stresses. Several indicators of femoral and tibial diaphyseal strength are used in this study to assess variability and/or changes throughout the Upper Palaeolithic. The principal axes, I_{max} and I_{min}, indicate the directions of greatest and least bending rigidity at a particular section; I_x and I_y measure the strength of the bone in an antero-posterior (A-P) and medio-lateral (M-L) direction, respectively; J, the polar moment of inertia, measures the ability of the bone to resist torsional loads. In addition, ratios of bending moments are used (I_{max}/I_{min} and I_x/I_y) as a direct way of comparing relative bone area distribution within cross sections (cross-sectional shape).

Table 14. Median percent asymmetry[1] in cortical area (CA) and polar moment of inertia (J) in females (Median, Quartile Range, Range).

	% ASYMM - CA	% ASYMM -J
Mid Up. Palaeo. (n = 2)	14.0	27.3
	0.8 - 14.0	2.4 - 27.3
	8.2	22.3
Late Up. Palaeo. (n = 5)	1.5 - 10.5	14.5 - 23.6
	0.8 - 28.7	10.7 - 58.8
	7.6	16.7
Aleut (n = 14)	1.8 - 17.0	5.3 - 26.1
	0.2 - 49.4	0.7 - 52.9
	4.3	9.8
Jomon (n = 13)	3.7 - 7.0	2.0 - 14.0
	0.6 - 27.3	0.3 - 22.5
	10.2	6.9
Pueblo AmerIndian (n = 15)	2.0 - 16.4	4.2 - 17.3
	0.0 - 20.1	0.1 - 32.8
	11.1	11.7
EuroAmerican (n = 19)	2.3 - 13.6	3.0 - 19.4
	0.1 - 27.2	0.3 - 30.4

[1] Percent asymmetry calculated as [(max-min)/min]*100

Table 15. The samples.

SPECIMENS USED FOR FEMORAL ANALYSIS	SPECIMENS USED FOR TIBIAL ANALYSIS
MUP	MUP
Parabita 1	Parabita 1
Cro-Magnon 1	Barma Grande 5
Grotte des Enfants 4	Arene Candide 1
Barma Grande 2	Paviland 1
Paviland 1	Cro-Magnon 5
Cro-Magnon 2	Parabita 2
Paglicci 25	
Arene Candide 1	
La Rochette	
LUP	LUP
Veyrier 1	Romanelli 1
Chancelade	Romito 3
Neuessing	Oberkassel 1
Riparo Tagliente	Arene Candide 10
Romanelli 1	Arene Candide 5
Arene Candide 4	Arene Candide 4
Arene Candide10	Riparo Continenza
Arene Candide 5	Riparo Tagliente
Arene Candide 12	Romito 4
Riparo Continenza	Neuessing
San Teodoro 4	Veyrier 1
St. Germain	Romito 5
Bruniquel	Cap Blanc
Grotte des Enfants 3	St. Germain

These ratios have been shown to be very useful in documenting changes in shape, reflecting changes in activity levels and patterns (Ruff 1987). Numerous studies demonstrate the sensitivity of cross-sectional geometric properties to changes in specific activity levels that are related to subsistence (see for example Ruff *et al*. 1984; Brock and Ruff 1988; Benfer 1990; Ruff and Larsen 1990; Churchill 1994). Specifically, walking, climbing, and running generate bending loads in the knee region, resulting in A-P elongation of the cross-section at the distal femur and proximal tibia. Thus, the shape of the femur and tibia in the knee region reflects patterns imposed on the bone during locomotion.

The femora and tibia of 12 Mid (MUP) and 19 Late (LUP) Upper Palaeolithic humans (Table 15) were examined to evaluate the variability and changes in lower limb biomechanical strength between these two time periods. With the exception of a few specimens (Cro-Magnon, La Rochette) that could be older, the bulk of the material is dated between 30 and 20 kyr bp.

Expectations of the 'gracilization' model imply that measures of biomechanical strength should decrease by the LUP. Two sections were chosen for this study: midshaft (50%) femur and proximal (80%) tibia. The method used to reconstruct the cross-sections is identical to that described by Churchill (this chapter). Following Ruff *et al*. (1993), second and polar moments were scaled by estimates of femoral and tibial biomechanical lengths raised to a power of 5.33, and areas by length raised to a power of 3 (see Ruff and Hayes 1983a for definitions of the length measurements, and table 16 for list of abbreviations). Although there is little significant bilateral asymmetry in the lower limbs (Ruff and Jones 1981), when possible, the right femur and tibia were used. Because of small sample sizes, females and males were pooled.

Results of the analysis are given in table 16, and illustrated in figures 6 and 7. All measures of midshaft femoral robusticity increase between the MUP and LUP, although the increase in A-P bending strength (I_{max}) is not significant. Increases in TA and CA, as well as the fact that

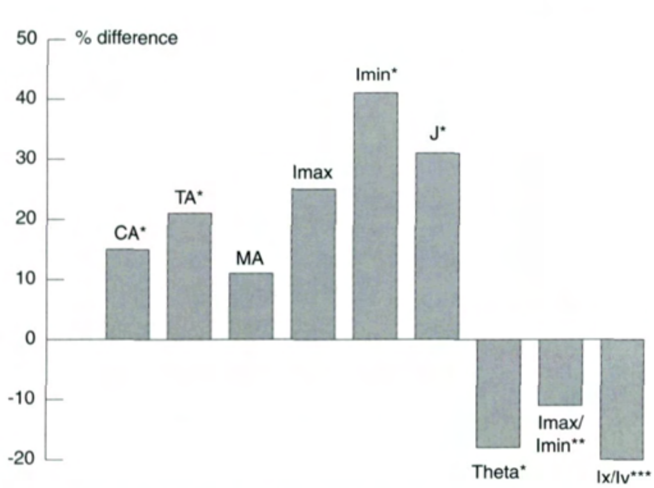

Fig. 6. Percent difference in femoral geometric properties between Mid and Late Upper Palaeolithic.

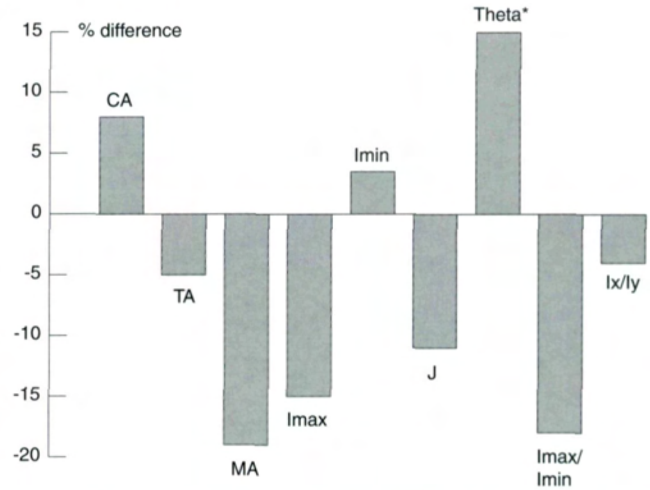

Fig. 7. Percent difference in tibial geometric properties between Mid and Late Upper Palaeolithic.

MA only increases slightly, result in a stronger and larger cross-section, with relatively more bone. The consequent larger J value points to an increase in torsional strength in the LUP group. Lower shape indices (I_{max}/I_{min} and I_x/I_y) show that LUP femora also became rounder in cross-section. This shape change is often associated with a reduction in A-P bending strength (I_{max}), relative to M-L bending strength, reflecting a reduction in activity levels (Ruff and Hayes 1983a, b; Ruff *et al.* 1984; Brock 1985). Here, however, the slight increase in I_{max} is offset by a significant increase in I_{min}, resulting in a decrease in I_{max}/I_{min}. The same is true of I_x/I_y. Thus, while rounder femoral and tibial cross-sections are usually interpreted as reflecting a reduction in levels of activities that involve A-P bending strength, here the change is primarily due to an increase in M-L bending strength. This reorientation of maximum bending strength is reflected in the decrease in theta. Thus, it appears that, while the distribution of bone within an area became more even, the size of the area increased, resulting in femora with larger, but more circular cross-sections. While it is clear that the magnitude of the bending loads increased, the unexpected strong increase in midshaft M-L bending strength also suggests a change in types of mechanical loadings.

In the proximal tibia, all measures of robusticity but two decrease, although none significantly. CA and I_{min} show a slight increase (not significant). Thus, while the femur got stronger and more circular over time, the tibia changed very little, although slight decreases in both shape indices indicate more circular cross-sections as well. Lastly, a significant increase in theta suggests a more A-P oriented-greatest bending rigidity.

The diachronic increase in lower limb robusticity requires a few words of comment. It is important to note that the results are influenced by the method used to standardise cross-sectional dimensions for body size. This apparent increase in robusticity disappears when a more sophisticated approach is used (see Holt 1999). It should be stressed, however, that the method used does not affect dimensions reflecting cross-sectional shape (I_x/I_y; I_{max}/I_{min}) since ratios do not need to be standardised. The significant increase seen in femoral cross-sectional circularity in the LUP sample suggests a reduction in activity level involving the lower limb, i.e. decreased mobility. This conclusion is consistent with archaeological evidence of increased territoriality and decreased residential mobility after the Last Glacial Maximum (Rozoy 1989).

7. Final considerations

The analyses reviewed here of temporal and geographic variance in cranial morphology, body shape and stature, and upper and lower limb skeletal robusticity in Upper Palaeolithic samples provide important information on the origins, microevolutionary trends, and biocultural adaptations of these populations. A number of issues raised in these summaries deserve comment.

Work carried out by Schumann on craniofacial form in the later Pleistocene, while detecting a small degree of morphological change (especially when the earliest modern humans of Europe are compared with the samples post-dating the Last Glacial Maximum), produces an overall picture of morphological stability during this time period. While the assumption that the Upper Palaeolithic was an insignificant or uninteresting period for human

Table 16. Differences in femoral and tibial geometric properties between Mid Upper Palaeolithic and Late Upper Palaeolithic.

Property[1]	MUP Mean	SD	LUP Mean	SD	% Difference[2]
Femur-50% (n=9 and n=14)					
CA	553.7	103.3	691.6	143.2	24.91*[3]
TA	709.3	102.3	866.4	164.1	22.15*
MA	155.6	72.5	174.8	54.7	12.34
Imax	298.9	80.0	373.4	119.1	24.92
Imin	187.8	56.2	267.3	80.5	42.33*
J	486.8	131.6	640.8	194.0	31.64*
Theta	84.2	10.4	69.9	16.2	-16.98*
Imax/Imin	1.6	0.2	1.4	0.2	-12.5**
Ix/Iy	1.6	0.2	1.3	0.2	-20.25***
Tibia-80% (n=6 and n=14)					
CA	1017.6	268.3	1101.2	200.1	8.22
TA	1980.6	347.6	1883.6	318.5	-4.90
MA	962.7	165.1	782.3	225.9	-18.74
Imax	2313.4	966.0	1966.8	636.1	-14.98
Imin	722.7	302.0	749.0	264.8	3.64
J	3036.1	1221.2	2715.7	850.1	-10.55
Theta	74.5	10.9	85.5	10.2	14.77*
Imax/Imin	3.4	0.9	2.7	0.7	-20.59
Ix/Iy	2.6	0.7	2.5	0.7	-3.85

[1] See below for abbreviations
All areas are standardized by L^3, multiplied by 10^8, all second moments of area are standardized by $L^{5.33}$, multiplied by 10^{12}

[2] [(MUP-LUP)/MUP]x100; a positive value indicates LUP>MUP

[3] * P<0.05; ** P<0.01; *** P<0.001

CA	cortical area
TA	total area
MA	medullary area
Imax	maximum second moment of inertia
Imin	minimum second moment of inertia
J	polar second moment of intertia
Theta	angle between M-L axis and direction of maximum bending rigidity

morphological evolution was clearly unfounded (Frayer 1984), it does appear that this period was characterised by a greater degree of stasis than change in craniofacial morphology. The lack of regional differentiation reported by Schumann is especially interesting, and may provide support for the idea of large-scale patterns of gene flow and cultural exchange across Europe during the Upper Palaeolithic (Gamble 1986). Regional differentiation during this period is low relative to living Europeans, raising the question of when (or over what period) the differences that characterise geographic populations of extant Europeans came into being. Schumann's work points to the major significance of the Last Glacial Maximum as a very dynamic phase during the Upper Palaeolithic, and it may be with the populations of post-glacial Europe, challenged by the climatic oscillations and large-scale environmental fluctuations of a warming world, that we should begin the search.

Relative morphological stability across regions, and support for the idea of 'open systems' (Gamble 1986), during the Mid Upper Palaeolithic is also suggested by analysis of stature. Formicola's work shows that both Ligurian (Grimaldi) and Moravian gravettian samples are characterised by very tall stature, considerably higher than that in later samples. Apparently, the most dramatical effects on height occurred at the end of the Last Glacial Maximum, rather than at the transition from the Palaeolithic to the Mesolithic. Factors generally invoked to explain the negative trend from Mid to Late Upper Palaeolithic include changes in functional requirements (a reduction in activity levels) and/or dietary sufficiency (a reduction in protein intake) related to changed subsistence strategies or increased populational demand on resources. A less often considered but potentially important factor could be decreased gene flow (and attendant inbreeding effects) in the Late Upper Palaeolithic in a context of decreased residential mobility and development of more restricted mating networks. Almost everyone who has viewed the Mid Upper Palaeolithic from a European (rather than more narrow regional) perspective has been struck by the cultural and morphological similarities of geographically separate populations. Formicola points to these broad geographic patterns as indicating a social and economic framework based on high levels of mobility and intergroup contact over vast areas – leading to the maintenance of networks of gene flow and cultural exchange. The Last Glacial Maximum may represent a watershed in the evolution of European social systems, in which increased territorialism and reduced intergroup exchanges (of perhaps both genes and material goods) resulted from the broadening of resource exploitation and greater control over the environment (thus obviating the need for extended social 'safety nets').

The biomechanical analyses of the upper and lower limb produce a somewhat contrasting picture. Holt's results point to a decrease in mobility and, thus, are in agreement with the model developed by Formicola. Churchill's analysis, however, reveals a significant increase in strength and robusticity in LUP upper limb. The wide-spread ecological changes that accompanied the post-Glacial Maximum created a complex situation, requiring broad ranges of biological and cultural adaptations. Trends exhibited by biomechanical data may be reflections of this complexity. The increase in body-size standardised upper limb bone strength, reflecting changes in labour intensity (most likely but not necessarily related to subsistence economy), occur in the context of a flourishing material culture. The emergence of solutrean, magdalenian and epigravettian cultures includes a rapid development of foraging tools, as well as objects of art and personal adornment possibly denoting increasing complexity in social organization. The traditional paradigm (traditional in American anthropology, at least) of a direct connection between technological evolution and reduction in bone and muscle strength is not borne out by these analyses. Instead, it appears that both technology and somatic strength may be reflecting a period of increased resource stress (and hence greater foraging intensity) in the Late relative to the Mid Upper Palaeolithic. This stress may have been driven by demographic (exponential population increase and increased population density) or ecological (deteriorating conditions associated with the onset of the Last Glacial Maximum) factors. This contrasts with Formicola's view of social and demographic factors responding to increased diversification in extracting resources from the environment. These differing viewpoints should stand as a focal point for further research. It is also noteworthy that the changes documented by Holt and Churchill in the postcranial skeleton are not reflected by changes in the presence or expression of features of cranial 'robusticity' (e.g., cranial vault superstructures). Taken together, the cranial and postcranial data paint a picture of mosaic evolutionary trends in skeletal morphology.

As concerns body shape, Mid Upper Palaeolithic remains tend to possess a long, linear physique more closely approximating the Sub-Saharan African condition than that of recent Europeans. The results of Holliday's analysis fit more easily within a Replacement (or Intermediate model) framework than within a model of Regional Continuity. This work also points to the absence of strong evidence for cold adaptation in the European modern human populations of the pre-Glacial Maximum. Interestingly, it is only after the Last Glacial Maximum that changes towards a more cold-adapted body shape (one that characterises living Europeans) can be detected. Thus, as with the work of Schumann, this points to the Last Glacial Maximum and the subsequent period as being key in the evolution of modern patterns of morphological variation in Europe. The absence of clear evidence for increased cold adaptation during the Mesolithic could be due to the rise of temperatures with the onset of the Holocene, or perhaps to improved cultural means (through clothing, shelter and pyrotechnology) of environmental buffering.

The results summarized in this paper point once more to the complex and dynamic nature of human adaptive, social and economic systems in the Upper Palaeolithic. If we are to arrive at a fuller and more accurate picture of the ecological, cultural, and biological aspects of late Pleistocene European populations, we must endeavour to integrate and synthesize the various approaches outlined here, and work towards a greater degree of interactive work with those investigating the dynamics of cultural evolution (through the archaeological rather than the fossil record) of this time period. We hope that this paper will serve to stimulate work of this nature in the future.

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Steven E. Churchill
Department of Biological Anthropology and Anatomy
Duke University
Durham NC 27710
U.S.A.

Vincenzo Formicola (to whom correspondence should be addressed)
Dipartimento di Etologia, Ecologia ed Evoluzione
Università di Pisa
via A. Volta 6
56126 Pisa
Italy

Trenton W. Holliday
Department of Anthropology
Tulane University
New Orleans, LA 70118
U.S.A.

Brigitte M. Holt
Department of Anthropology
University of Missouri
Columbia MO 65211
U.S.A.

Betsy A. Schumann
Department of Anthropology
Florida Atlantic University
Boca Raton, FL 33431
U.S.A.

Olga Soffer

5 Gravettian technologies in social contexts

After different lines of evidence, the gravettian sites of Moravia are held as aggregation locations where sizable groups of people gathered between early autumn and the spring months. An unprecedented variety of perishable and non-perishable items has been unearthed at such sites, reflecting the mastering of an array of different technologies used to make both utilitarian and non-utilitarian items. Amongst others, the use of plant fibres to manufacture basketry, textiles and netting is noteworthy. In this paper, it is argued that technological innovations signal the increased consumption demands of the co-residential groups, requiring a guaranteed food supply. Intensified ritual activity, as well as feasting, probably also characterised such gatherings of people. Seasonal aggregation was required to counteract the strain due to isolation of small, distant groups, living over vast depopulated territories during most of the year. Net hunting, which requires the co-operation of a whole co-resident unit, including women and children, would have allowed the production of the required surplus food, which otherwise would not have been made available by more restricted hunting parties, endowed with spears and lances only. The processing of plant food is also documented, further highlighting the importance of food procurement techniques usually associated with the feminine sphere of activity.

1. Introduction

Hunter-gatherers who occupied Central and Eastern Europe between some 30,000 and 20,000 years ago left behind a material record rich in technological diversity. These technologies have informed our reconstructions of gravettian lifeways, but have done so using insights only gained from the study of durable materials: stone, ivory, antler, and bone. Ethnographic and archaeological evidence, however, indicate that the overwhelming majority of material culture of all hunter-gatherer groups, both in the present and in the near and distant past, was made of perishable materials – with the documented ratios of durables to perishables hovering around 5%: 95% (e.g. Collins 1937; Taylor 1966; Helm 1981; Damas 1984; Croes 1997). Thus, given the wealth and diversity of perishables that were likely used in the Palaeolithic, our past failure to recover them not only strongly biases our understanding of those economies and technologies, but also makes invisible the inventories made and used by the majority of palaeolithic people – women and children (Kehoe 1990; Conkey 1991; Owen 1996). This occurs because technologies used by females, and by extension children, are far more perishable than those used by males – an observation confirmed by cross-cultural ethnographic data on the division of labour by sex and the concomitant implements associated with the different tasks (Mason 1910; Murdock 1937; Watanabe 1968; Murdock and Provost 1973).

In this chapter I begin redressing these past omissions by examining the technological repertoire of a subset of gravettian groups – those whose sites and inventories are assigned to the Pavlov culture and its immediate successors (Svoboda *et al.* 1996). I focus on data from the Moravian sites not only because they reveal a number of important technological innovations, but because the fortuitous preservation and recovery of perishable technologies here sheds light on the production and use of cordage and such cordage by-products as nets, baskets, and loomed textiles.

2. The sites

The data I examine come from the sites of Dolní Věstonice I and II, Pavlov I and II, Petřkovice, and Předmostí. Since these sites are treated in detail in the Svoboda *et al.* chapter in this volume, I will not dwell on them in detail. For the purposes of this discussion it is important to note first, that they were all occupied prior to the last glacial maximum dated to 20-18,000 bp, and thus fall into the Early Upper Palaeolithic period in those classificatory schemes which divide the Upper Palaeolithic into Early and Late (e.g. Lindly and Clark 1990). Second, as Svoboda and his colleagues note in this volume, the Moravian sites were occupied during a milder period of the last glaciation when the region was covered by a mix of park forest and grassland-steppe vegetation.

Although many of the sites are large and have yielded huge inventories (e.g. over 1,000,000 pieces at Pavlov I – Svoboda 1994, 1997), they do not represent single occupations, but rather resulted from repeated residential stays of groups along the slopes of the Pavlov hills (Klíma 1963, 1995; Svoboda 1991, 1994, 1996, 1997; Svoboda *et al.* 1996). The third important point about these sites is that the overwhelming majority of their large lithic inventories are made on exotic raw materials originating from different cardinal directions at distances between some 60 and 300 km from the sites. This, together with the wealth and diversity of their features and utilitarian and non-utilitarian inventories, suggests that such sites as Dolní Věstonice I and Pavlov I served as aggregation locations where sizable numbers of people gathered. Finally, although incomplete, extant information obtained from faunal and botanical remains, as well as from edgewear studies, suggest that these aggregations took place between the early autumn and the spring months (Svoboda 1991, 1994, 1996, 1997; Opravil 1994; Svoboda *et al.* 1996).

3. The technologies

The inventories from these sites are very diverse and show masterful use of both hard and soft media in production. For the purposes of this discussion, I subdivide them into the durable and perishable categories.

3.1 Durables

As at all other palaeolithic sites, the vast majority of the Moravian implements are made of inorganic materials as well as of more durable organic ones such as ivory, antler, and bone. This category can be sub-divided as follows:

3.1.1 Inorganic

Inorganic materials used by gravettian groups include stone, coal, clay, mineral pigments, and fossil shells.

lithics. Stone – most specifically chert, flint, limestone, metamorphite, quartz, quartzite, radiolarite, rock crystal, sandstone, slate, and obsidian – was used for the production of a variety of tools, especially such diagnostic tool types as burins, backed implements, endscrapers, and microliths and backed microliths (Klíma 1963; Absolon and Klíma 1977; Svoboda 1996; Svoboda *et al.* 1996). Because these inventories have received a great deal of attention in the literature, as well as the fact that they are discussed in the Svoboda *et al.* chapter in this volume, I will not discuss them other than to underscore that these inventories contain sizable percentages of microliths, including geometric shapes. Although these inventories have not been studied in detail for signs of diagnostic wear damage, cursory examinations of some of these backed blades and microgravettes has led Kozlowski (personal communication, 1997) to suggest that some may have been used as points in projectile weapons. The high percentages of geometric or para-geometric microliths at these sites, representing one of the oldest microlithic inventories on record, points to the production of complex composite propulsion weaponry (Svoboda 1996; Škrdla 1997). Stone was also used to produce rare non-utilitarian pieces such as the female figurine made of haematite found at Petřkovice (Klíma 1955b, c).

In addition to these knapped inventories, the Moravian sites also contain small but ubiquitous inventories of stone implements shaped by grinding and polishing (Škrdla 1997). These inventories include slate pendants or wetstones, grinding stones or slabs and grinders, as well as ground and polished pebbles likely used as retouchers. Škrdla (1997) notes that while some of these implements became ground and polished through use, others were purposefully shaped in this manner to produce desired forms – thus constituting the oldest evidence to date for ground stone technology.

coal. Klíma's (1953, 1955b, c) excavations at Petřkovice document yet another gravettian innovation – the burning of coal in hearths. The use of coal for fuel at this point in time has, to date, been only documented at this one site, a fact which, together with the local abundance of this fossil fuel in the area, suggests opportunistic rather than habitual use. At the same time it also indicates a sophisticated control of pyrotechnology, which is also attested to in the production of ceramics discussed below.

boiling stones. A number of hearths at the sites, especially at Dolní Věstonice II, were covered by fire cracked limestone rocks. These were likely used in cooking, and the presence of small pits surrounding the hearths implies that cooking was likely done by stone boiling (Svoboda 1991, 1996; Svoboda *et al.* 1996).

ceramics. Large inventories of ceramic fragments recovered from Dolní Věstonice I and II, Pavlov I and II, and Předmostí, together with two kilns used to fire the ceramics, bear witness to the ubiquitous production of ceramics in gravettian Moravia (Vandiver *et al.* 1990 with references). Research on these fragments indicates that local loess was mixed with water to fashion both animal and human figurines which were then fired in temperatures ranging between 600-800 degrees.

In addition to making these figurines, the residents of the sites also used local loess to produce a number of other implements which we are currently studying (Soffer and Vandiver 1994, 1997). Preliminary findings suggest that this category of ceramic fragments, which we have identified as 'structural ceramics', may represent clay linings of baskets, daub used in the construction of dwellings and, possibly, of house furnishings and containers. Loess was also used to construct two kilns at Dolní Věstonice I, as well as to cement a construction of mammoth bones at Pavlov I (Klíma 1957).

pigments. Vandiver's (1997) study of pigments at Pavlov I documents the use of both pure red iron oxides, mixtures of red iron oxides with local loess, and yellow clay-based pigments. Hard red iron oxides were ground into coloured powder which was then often mixed with local loess. These minerals were pulverised and mixed by grinding with pebbles on stone slabs. A similar range of pigments and of grinding slabs/palettes and grinding stones has been recovered from other Moravian sites as well (Klíma 1963; Absolon and Klíma 1977).

fossil shells. Numerous perforated fossil marine shells were also recovered from the sites (Klíma 1963, 1995; Absolon and Klíma 1977; Svoboda 1991, 1994, 1997; Svoboda *et al.* 1996). These, most likely, originated from local Tertiary deposits (Jarašová, personal communication, 1999).

3.1.2 Organic

The extensive ivory, antler, and bone artefacts recovered from the sites have been extensively published in the literature and, like the lithic inventories, will not be discussed in detail here. Klíma's (1963, 1987, 1994; Absolon and Klíma 1977) numerous publications on this topic document the fashioning of a wide range of utilitarian implements as well as of items of personal adornment and portable art. It is important to underscore that the utilitarian inventories contain both likely hunting weaponry (e.g. spears and lances) as well as a large suite of processing implements used as digging tools (hoes and mattocks), shovels, hammers, clubs, tent pegs, polishers, handles, piercers and awls. They were fashioned both by knapping and by grinding and polishing. Finally, the site of Předmostí has yielded the broken remains of a large antler needle, measuring 8.9 cm in length, with remnants of a cut-through eye (Klíma 1990a, fig. 28). Dating to some 26,000 bp, this item represents the oldest needle recovered to date and confirms the hypothesis expressed by a number of scholars on the basis of indirect evidence, that the use of needles dates well before the last glacial maximum (e.g. White 1992; de Beaune 1993). Their rarity in Eurasian sites prior to some 20,000 bp, together with the indirect evidence for tailored clothing at Sungir' (Bader 1978), dated to some 25,000 bp, as well as at Mal'ta and Buret' in Siberia at possibly 22,000 bp (Derevianko 1998), raise the question if other plastic materials, such as wood, were more commonly used to fashion them.

Finally, the inventories also contain numerous perforated animal teeth, usually arctic fox canines, used as items of personal adornment.

3.1.3 Range of items produced

The range of items produced from durable materials is very wide. The utilitarian inventory contains a diversity of hunting weaponry and processing equipment associated with a wide range of activities from the killing of prey to meat and hide processing, the making of tools and weapons from stone, ivory, antler and bone, and the digging of soil to daubing, the construction of kilns, the stone boiling of food, the grinding of pigments and the likely processing of tubers, fruit, and seeds for food (Mason *et al.* 1994), to sewing or looping.

The non-utilitarian inventories indicate the production of beads and pendants made of stone, shell, ivory, and animal teeth, ivory pectorals and rings, the engraving of curvilinear and geometric designs, and the production of realistic and stylised animal, anthropomorphic, and human figurines depicting both men and women.

3.1.4 Production techniques

The range of techniques used to produce these items is equally impressive. The reduction techniques include knapping, grinding, polishing, cutting, and drilling. While the use of all of these techniques to work ivory, antler and bone is documented from the Aurignacian onward (Knecht *et al.* 1993), Klíma (1994) and Škrdla (1997) note that it is the Gravettians who expand the use of abrasion, grinding, and polishing to working stone as well.

The additive techniques, seen in the production of ceramic inventories and in the fashioning of composite weaponry, include the conjoining of separate pre-fabricated pieces to form complete objects.

3.2 PERISHABLES

The recovery of diverse perishables from Moravian gravettian sites – including worked wood, cordage, textiles, baskets, nets, and plant foods – resulted from fortuitous Pleistocene behaviour, from recovery techniques and methods used as well as from expectations that evidence for these technologies should be there. The widespread use of fire by Pavlov groups to warm themselves, cook their food, and light their dwellings, as well as their use of pyrotechnology to produce their ceramic inventories, from time to time likely led to both intentional and unintentional conflagrations. These, in some cases, inadvertently preserved charred remains of structures, as in the case of a wood construction above the triple burial at Dolní Věstonice II (Klíma 1990b, 1995). In other cases, the fires destroyed the dwellings but in doing so preserved impressions of cordage, textiles, basketry and nets – as at Pavlov I, Dolní Věstonice I and II (Adovasio *et al.* 1999; Soffer and Vandiver 1997; Soffer *et al.* in press). In yet another case, as at Dolní Věstonice II, the preparation of tuber, fruit, and seed gruels is documented by charred macro-botanical remains recovered through flotation from a hearth (Mason *et al.* 1994).

3.2.1 Wood

Klíma's (1990b, 1995) excavations of the triple burial at Dolní Věstonice II recovered a charred inventory of worked

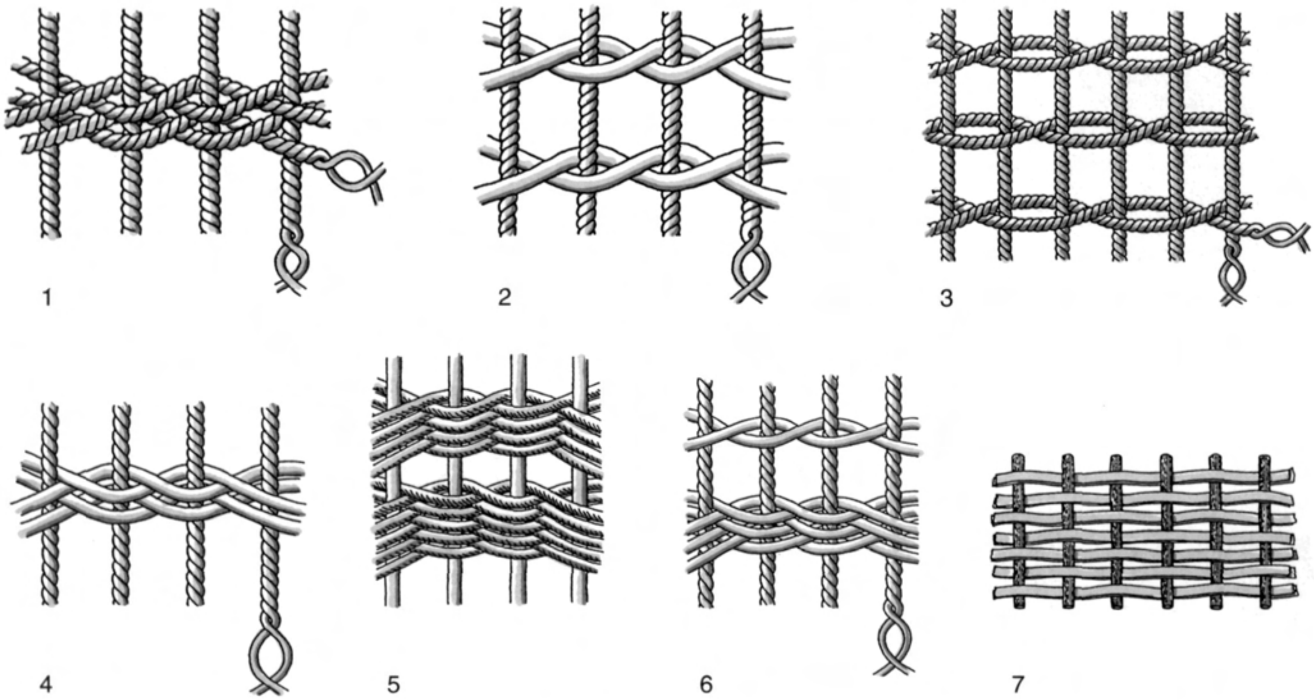

Fig. 1. Schematic diagram of twining and plaiting types represented in the Moravian textile and basketry impressions (after Adovasio *et al.* 1999, fig. 3. Soffer *et al.* in press, fig. 7)
1. Close simple twining, S twist weft, 2. Open simple twining, S twist weft, 3. Open diagonal twining, S twist weft, 4. Close simple twining, Z twist wefts, 5. Close simple twining, Z and S twist wefts, 6. Open and Close simple twining, Z and S twist wefts, 7. Wickerware-style plaiting, 1/1 interval

wood fragments made of coniferous taxa. He argues that these cut and shaped fragments once formed a super structure over the burial which was incinerated as the final part of the burial ritual. He has also documented the shaping of wood to make a number of other implements at Pavlov I, including likely anthropomorphic figurines (Klíma 1955a, 1990b). All of these objects are highly fragmentary and preclude exact identification to specific implements.

3.2.2 Plant fibers

Our research on the Pavlov I, and Dolní Věstonice I and II inventories has documented the use of plant fibers to manufacture cordage, basketry, textiles, and netting (Adovasio *et al.* 1999; Soffer *et al.* in press- both with references). The evidence for this technology comes from negative impressions of fiber-based constructions on fragments of fired clay and represent the oldest indications of fiber-based technology in the world to date.

textiles/basketry. The impressions show that textiles were produced by twining and exhibit seven of the eight commonly produced twining types, including open simple twining as well as open and closed diagonal twining. They also document simple plaiting to produce both loom-woven cloth as well as more rigid basketry and/or mats. Some specimens show conjoining of two pieces of fabric by whipping stitch to produce a seam (Adovasio *et al.* 1999 with references). This evidence for the conjoining of two pieces of textiles via a whipping stitch reflects sewing – a production technique indirectly attested to by rare needles and the use of tailored clothing hypothesized on the basis of funeral inventories and human depictions.

The impressed textiles were clearly made of plant rather than animal fibers. Pollen and macrobotanical data indicate a forest-steppe environment with the presence of both bast-bearing and other plants at the sites (Mason *et al.* 1994; Opravil 1994; Svoboda 1994; Svoboda *et al.* 1996). The impressions are sufficiently distinct to suggest that the textiles

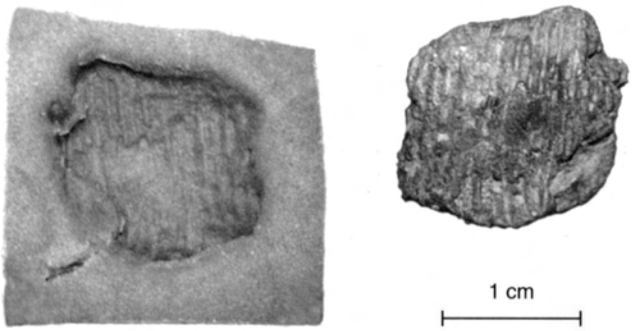

Fig. 2. Pavlov I- 54 no. 1 ceramic fragment (right) and its impression (left) – open simple twining, Z twist weft (photo O. Soffer)

were likely made of such bast-bearing fibers as milkweed (*Asclepias* sp.) and nettle (*Urtica* sp.). Fibrous bark of both alder (*Alnus* sp.) and yew (*Taxus* sp.) may have served for the production of basketry. All of these species have well-documented ethnographic and prehistoric uses as perishable production media (Barber 1991; Andrews and Adovasio 1996).

The impressions represent well-made items. The typological heterogeneity coupled with the general regularity and narrow gauge of the warp and weft elements used in the textile/basketry types identified to date, suggest a high level of standardisation and antecedent development. The same observations may be extended to the cordage specimens which are not portions of textiles.

cordage. Impressions of cordage in the assemblages document the production of a minimum of five different structural types including single, multiple, and braided specimens.

netting. The assemblage also contains several impressions of knotted cordage produced through the weaver's knot or one of its variants such as fishnet knot (Adovasio *et al.* 1999 with references). Depending on its precise configuration, ethnographically and archaeologically known knotted cordage often represents fragments of netting.

plant foods. Although the use of plant foods has been postulated for Eurasian hunter-gatherers by a number of scholars on both theoretical and associated empirical grounds (e.g. the presence of grinding stones and grinders), unequivocal evidence for them has been surprisingly sparse. Mason and her colleagues have identified in the macrobotanical remains from a hearth at Dolní Věstonice II as remains of cooked plant food residue used to make mush or gruel – possibly baby foods (Mason *et al.* 1994). It remains unclear if these remains represent refuse thrown into the hearth or resulted from spillage in cooking over open fires.

3.2.3 Range of items produced

The fragmentary nature of all perishable remains precludes clear identification of the range of items made from plant remains. We are most secure in identifying macrobotanical remains from hearths as food residue and on less firm ground postulating the uses that worked wood was put to. As noted previously, Klíma (1995) has suggested that some cut wood was used as structural elements in a funerary construction. Shaped wood may equally represent a range of items from fuel to burned discarded wood implements of unknown type, including figurines. Given the antiquity of shaping wood for hunting weaponry (e.g. at Swanscombe, Lehringen, and Schöningen), we can anticipate that Moravian groups fashioned a large suite of like implements as well. The hypothetical identification of some geometric microliths as arrow heads may hint at the existence of bows and arrow shafts as well.

Because the Moravian ceramic assemblage is highly fragmentary and the impressions very small in size, Adovasio and his colleagues note that it is also not possible to specify whether the identified textile structural types represent bags, mats, or cloth fabrics (Adovasio *et al.* 1999). If they are portions of bags or mats, they may have been used on floors or sitting/sleeping platforms in the case of mats, and as storage/transportation devices in the case of bags. They may also represent wall hangings and/or blankets. If they are portions of cloth fabrics, and the fineness of some suggest they were, they could represent a wide diversity of forms ranging from shawls to skirts, shirts, sashes or belts etc. Some scholars have, in fact, interpreted the decorations on some of the Upper Palaeolithic female figurines as depicting string skirts and textile belts (Barber 1991).

Ethnographic analogy suggests that some of the impressions could represent the intentional application of clay to the 'outside' of some flexible containers to provide a simple form of mould. They may also represent clay lining of baskets to make them watertight and suitable as containers for stone boiling. Another possibility are items that were simply impressed into moist floors as a consequence of use as well as the practice of transporting clay in bags. Intentional use of such items to pack or 'tamp' down prepared clay floors is possible, as is the use of wall hangings applied over and impressed into still wet clay which was subsequently accidentally fired after the structure was destroyed.

The presumed function of cordage is easier to stipulate – these items, likely, served the same function that cordage fills in all societies where it is produced – meeting a wide range of lashing, binding, and tying needs, as well as serving as the production medium for other compound constructions such as items of clothing, bags, and nets (Adovasio *et al.* 1999). The identification of a sheet bend or weaver's knot on four of the impressions supports this hypothesis and suggests the production of knotted netting likely used for hunting.

3.2.4 Range of production techniques

The Moravian perishable inventories reflect the use of a wide range of production techniques. The preparation of plant foods pre-supposes the digging up of tubers and the gathering of fruits and pulses as well as the grinding of wild seeds. The presence of processed plant food residue in hearths hints that, in addition to stone boiling in cooking pits next to the hearths, cooking may also have been done in watertight containers directly over the hearths.

Remains of worked wood suggest the production of implements by reduction – through cutting and polishing.

The impressions of textiles, basketry and cordage reveal a slew of additional reduction techniques. The production of cordage resulted from plant harvesting, processing (retting and hacking), and twisting and/or spinning lengths of fibrous material. These items were then used in an additive fashion via twining and plaiting to produce artefacts created through repetitive conjoining of like segments. This involved both looping (in the case of nets) and weaving (textiles and basketry). The fineness of some of the weavings indicates, almost certainly, the use of non-heddle loom or weaving frame (Adovasio *et al.* 1999 with references). It is important to underscore that this inventory is characterised by a very high level of typological diversity. Adovasio and his colleagues note that younger Mesolithic/Archaic and Neolithic/Formative perishable assemblages usually exhibit a far more restricted array of types with a clear preference for certain warp and weft manipulations as well as preferred initial spin and especially final twist directions (Adovasio *et al.* 1998). It may well be that this later homogeneity reflects a stabilised technology practiced over millennia.

Finally, given the highly fragmentary nature of these remains and their association with dwelling structures (Soffer and Vandiver 1997; Adovasio *et al.* 1998), it is not possible to hypothesize whether they all represent utilitarian inventories. Depictions of possible woven belts and string skirts or aprons on some of the Upper Palaeolithic figurines (Barber 1991), as well as Klíma's (1990b) identification of one wood fragment as a remnant of an anthropomorphic figurine, suggest that perishable media, like their durable equivalents, were likely used to make both objects of utilitarian and non-utilitarian value.

4. Why these innovations at this point in time?

The gravettian record clearly documents a number of significant innovations some of which, like complex insert technology, show continuous development through Upper Palaeolithic times, while others, like polished stone technologies and, possibly, ceramic technologies, may not. This necessarily raises questions both about why these innovations arose as well as why some of them did not see widespread adoption and elaboration. To address these questions I next turn to some current theories of technology.

4.1 Understanding innovation

Technological change through time has been of prime interest to archaeologists and a focus of much research (e.g. Childe 1951; White 1959). This research, however, did not problematise change but assumed that the evolution of technology was a natural process not needing an explanation. This effectively separated technology from society and led to unsatisfactory explanations for change that focused on such prime movers as human 'genius' or invention, climatic change, diffusion, etc. (Dobres and Hoffman 1994). Today scholars see technological change as a historical process which takes place within particular economic, political, and cultural contexts (Parayil 1993). In considering these contexts, it is important to remember the following 'laws' formulated by Kranzberg (1989) for technology in general:

1. Technology is neither good, bad, nor neutral – meaning that technology interacts with society in ways that technological developments have impact beyond immediate purposes and can have quite different results when introduced into different contexts.
2. Invention is the mother of necessity – meaning that technology solves perceived problems.
3. Technology comes in packages, big and small – meaning that when one component of the social, political, economic, and cultural environment changes, others are affected.
4. Although technology might be the prime element in many public issues, non-technical factors take precedence in technological decisions – which highlights the social component of technological stability or change.
5. Technology is a very human activity and so is the history of technology.

Furthermore, it is necessary to view technological innovation as a process and to separate it into its constituent components: invention or discovery and its development. Spratt (1982, 1989) points out that in dealing with innovation process, it is necessary to understand what impels it to take place and then to delimit the course that the process takes: accepted and developed or not, if accepted is the development slow or rapid, etc.

These theoretical insights direct us to embed technology within human decision making from which it emanates (Lemonnier 1986, 1992, 1993; Nelson 1991; Van der Leeuw

1993; Dobres and Hoffman 1994). Since, as Torrence (1989), among others, points out, technology is developed in order to solve problems – it follows that seeing technology as a solution to problems – calls for specifying the types of problems which it addressed (Torrence 1989; Stiner and Kuhn 1996).

Our past studies of prehistoric technologies have followed adaptationist paradigms which favour seeing ecological/economic concerns as primary in human decision making (e.g. Torrence 1989; Nelson 1991). More recent research, however, points to the importance of economic, social and political, as well as ideological (something Lemonnier (1992) has termed "cultural logic") concerns of the decision makers.

Although a number of these important variables, such as ideology or strategic decision making by particular individuals may not be accessible in the study of palaeolithic innovations, because the record we have to work with is too coarse for such questions, nonetheless there are a number of insights that are applicable to Upper Palaeolithic Moravia. For the purposes of this discussion I wish to stress Basala's (1988: 11) point that technology is cultivated to meet perceived needs and that these needs are defined by individuals in a particular social matrix. The social matrix, in turn, is constrained by a number of variables which may be discernible in the archaeological record. Specifically, if we combine economic insights that it is consumption that stimulates production in pre-market societies (Gregory 1982; Minnegal 1997) with the understanding that technology is a seminal component of production – we see, first, that Moravian technological innovations likely signal changed – more specifically – increased consumption demands.

We can expand on this by making a few other predictions about the relationship between Moravian technological innovations and the social organisation of the groups who produced them. Since technology is associated with production, it follows that technological innovations represent an intensification of production. Second, since production needs are determined by consumption needs, we can anticipate that technological innovations were designed to meet some new socially determined needs. Furthermore, since, as Torrence and Van der Leeuw (1989: 10) have pointed out, innovations are more likely to be accepted in stress times when traditional ways of doing things are more likely to be seen as wanting, we need to look for possible causes of stress in Moravian times. Finally, in the absence of unique environmental conditions in Moravia 30,000-20,000 years ago which were unprecedented before or after this time slice, we clearly should seek such evidence for stress in the social rather than in the natural environment – more specifically – in changed group size of the co-residential units.

4.2 Studying technology – measuring innovation

A number of technological innovations at the Moravian sites relates to more efficient food procurement. To understand them I next turn to Oswalt (1976) who has systematised the study of ethnographic food production technologies by, first, identifying the technological units (technounits) employed to produce the implements and, second, by delimiting the methods of conjoining these units into the finished product. He sees the evolution of technology reflected in the increasing number of technounits used and in the more complex ways of conjoining them. Oswalt (1976: 199-208) identifies four specific principles universally used in artefact production, which appear sequentially through time:

1. reduction
2. conjunctions – the combining of different technounits to make composite artefacts (e.g. hafting)
3. replication – the combination of two or more like structural elements to function as parts of a complex form (e.g. complex insert weaponry, house construction)
4. linkage – the making and use of co-dependent artefacts (e.g. bow and arrow, spear thrower and spear).

In considering the facilities used in food procurement, Oswalt (1976: 129) points out, first, that it is technologically simpler to gain a hold on wild species than it is to kill them by other means, and second, that facilities designed to do so have fewer technounits than hunting weaponry. Using facilities in food procurement is not only technologically simpler, but also a practice which greatly increases the effectiveness of hunting weaponry. Furthermore, although tended facilities (those dependent on close monitoring by people – e.g. hunting nets, drive lines), are technologically simpler than untended ones, they require greater co-operation and collaboration than does the use of untended facilities. Untended facilities, on the other hand, consist of more technounits – which is the price paid for substituting technounits for people. Finally, Oswalt (1976) also demonstrates that facilities used to capture prey on land have fewer technounits than those used in water. This observation leads him to conclude that such harvesting techniques as net hunting likely originated on land for capturing terrestrial resources and that their use to harvest aquatic taxa developed later in time (Oswalt 1976: 129).

This perspective on food procurement technologies allows us, first, to see that all four principles of artefact production are in evidence in the Moravian inventories: reduction – stone and bone tools; conjunction – hafted implement; replication – composite insert technology, the making of nets and baskets; and linkage – grinding stones and slabs, possible bows and arrows. Second, it also sheds light on the possible use of nets as tended facilities for hunting terrestrial game and the absence of evidence for their use for procuring either fish or birds. Furthermore, it also explains why, in spite of many suggestions that snares and traps were used by palaeolithic hunters (Pidoplichko 1976; Straus 1987; Pike-Tay 1993; Musil 1994, 1997), to date we have no firm evidence for these untended facilities, which may not have been in use before the Holocene.

5. Implications of theory and data for gravettian Moravia

In this concluding section I examine the Moravian technological innovations through the lens of theory and tentatively outline some proximate and ultimate causes – all social in nature – which may account for these inventories. I stress that in doing so I do not assume that all of them necessarily arose in Moravia some 27,000 years ago. Data on gravettian textiles and basketry, for example, clearly suggest antecedents. Regardless of when each was invented, my primary concern here is with their co-occurrence at this point in time. I begin with what we firmly know and progress to more hypothetical insights.

5.1 Types of sites

As noted previously, most of the sites assigned to the Pavlov culture are aggregation sites where sizable numbers of people co-resided together during the autumn to spring seasons. Given the recovery of food remains identified as likely weaning foods, we can assume that these co-residential groups included women and children. It is important to underscore that this is the earliest unequivocal evidence we have for aggregation sites in the Upper Palaeolithic. Preceding aurignacian sites in both Central and Western Europe are considerably smaller in size with smaller inventories and more limited numbers of less diverse faunal remains (Enloe 1993; Pike-Tay 1993; Pike-Tay and Bricker 1993; Svoboda *et al.* 1996) – suggesting that they were occupied by small groups. Furthermore, Hahn (1987) has noted that gravettian groups in Germany were either more mobile or had more attenuated exploitation territories than did their aurignacian predecessors, an observation which Svoboda *et al.* (1996) confirm for Moravia as well. I suggest that it is precisely this increase in seasonal mobility of small groups, and the concomitant attenuation of exploitation territories, which put a strain on mating, information exchange and risk sharing networks of gravettian hunters and gatherers, and that cold weather aggregations were their social solution for this strain.

Aggregations, however, while solving problems caused by group dispersal, create their own problems for both subsistence practices and for day to day social interactions (see Johnson 1982 on social consequences of aggregations). Large groups require more food and aggregations can only be viable if there is a guaranteed food supply. Large groups require more food than small ones – and this demand, in turn, calls for the intensification of food procurement efforts. These efforts can take a number of forms, some of which – such as more complex weaponry, communal net hunting (Adovasio *et al.* 1999), the broadening of the resource base to include medium and small sized prey (Musil 1994, 1997) – are evident in gravettian Moravia and constitute a form of intensification of subsistence pursuits.

5.2 Hunting implements

The presence of microliths and geometric microliths in the Moravian inventories in sizable numbers herald the presence of complex multi-component weaponry – most likely lethal barbed throwing and thrusting spears and lances. These short-range weapons, while likely improving hunting success, still limited prey choice to large-sized animals and the hunting methods to ambush. Churchill (1993), on the basis of cross-cultural ethnographic data, has recently demonstrated that long-distance hunting weaponry (i.e. spear throwers and bows and arrows) not only considerably increases the effective range of hunting implements but also makes possible effective hunting of medium and small sized animals. He has also demonstrated that the absence of long-distance hunting weaponry favours co-operative hunting (Churchill 1993). The gravettian record contains no spear throwers, and while some scholars have argued that some of the microliths may have served as arrows – and thus suggested that hunting with bows and arrows came into practice some 26,000 years ago – evidence for this is equivocal and in need of empirical demonstration. Finally, the abundant and varied faunal remains at the Moravian sites has led a number of scholars to argue for collaborative hunting (e.g. Klíma 1963; Musil 1994, 1997; Svoboda *et al.* 1996).

5.3 Hunting facilities

The inventories also contain evidence for the production of nets which were likely used for hunting. To date the mesh size of the hypothesized Pavlov nets is quite small, which would have made them suitable for the hunting of only small-sized prey. This observation is in good accord with the high numbers of such taxa as hares and foxes recovered from the sites (Musil 1994, 1997). It is also in good accord with cross-cultural ethnographic data which indicate the use of nets to capture small terrestrial fauna, including fur-bearers, throughout the world (Steward 1938; Satterthwait 1986, 1987; Roscoe 1990, 1993; Andrews and Adovasio 1996). While the ethnographic literature also documents the widespread use of nets for fowling and fishing, the lack of fish remains and the paucity of avian elements at Moravian sites (Musil 1994, 1997), suggests that fish and birds were not an important component of the Upper Palaeolithic diet at these sites. This observation corroborates Oswalt's (1976) hypothesis that net hunting of terrestrial game likely preceded fishing and fowling with nets.

The fine gauge of virtually all of the gravettian weaving suggests that, perhaps, the larger gauge fraction of the perishable industry has not been preserved or recovered to date. Ethnographic data show that nets, in addition to capturing small-sized mammals in the 3-20 kg weight range, were successfully used to capture a wide range of larger-sized herbivores from kangaroos and even horses in post-contact times in Australia (Satterthwait 1986, 1987) to antelope, deer, and mountain sheep in North America (Frison *et al.* 1986; Andrews and Adovasio 1996). This implies that, if practiced, net hunting may have been used to procure larger-sized taxa in Upper Palaeolithic Moravia as well.

The possibility of net hunting carries important implications. Cross-cultural research indicates that net hunting is a communal effort, which, because of the relative lack of expertise necessary for success, as well as the minimal danger involved in such a non-confrontational harvesting technique, requires fewer skilled hunters and can and does utilise the labour of the entire co-residential social unit (Steward 1938; Anell 1969; Satterthwait 1986, 1987; Frison 1987; Wilkie and Curran 1991). It is, thus, the one hunting method strongly associated with the labour of women and children (Murdock 1937; Murdock and Provost 1973). It is likely that net hunting may have been more frequent in the past than documented in the ethnographic record, where it is rare but widespread (Manhire *et al.* 1985; Satterthwait 1986, 1987).

Finally, net hunting is also associated with large harvests in short periods of time and, thus, with the production of a surplus (Satterthwait 1986, 1987). Although such a surplus in some ethnographic cases is associated with participation in a market economy (e.g., the Ituri forest [Wilkie and Curran 1991]), in other cases, such as in Aboriginal Australia (Satterthwait 1986, 1987) or in New Guinea (Roscoe 1990, 1993), it is associated with large gatherings, feasting, and ceremonialism.

If, as I have argued above, the Moravian record does show the advent of group hunting and mass harvesting, then the use of particular tended facilities to do so – specifically nets – suggests increased demands on the labour of women, children, and of older individuals. Wilkie and Curran (1991) have argued that the Mbuti of the Ituri Forest took up hunting with nets to incorporate female labour into meat procurement pursuits. In the Ituri this was done to increase surpluses for trade. In Upper Palaeolithic Moravia it may have been done to support aggregations.

5.4 Food storage and preparation

The storage of food is clearly another method for insuring food surpluses – but it is a method for which we have no documented evidence until after the last glacial maximum (Soffer 1985, 1989). The Moravian sites contain no storage pits and the one potential candidate as such, uncovered at Pavlov I in 1951, Klíma (1977) interpreted as a pit house. The faunal remains at such sites as Dolní Věstonice I, however, do contain an abundance of filleting marks suggesting that meat was reduced to small strips (Soffer 1989). This, together with the presence of small boiling pits around many of the hearths at the sites, which suggests that meat was processed and cooked in small parcels, may possibly hint that meat strips may have also been preserved by drying. If this was the case, then Moravian groups may have practiced a form of portable storage – but this, while it can be hypothesized – remains to be empirically demonstrated.

The Moravian inventories also contain many implements, such as shovels, grinding equipment, and microlithic inserts possibly used in knives, which are associated with plant harvesting and thus with the labour of women (Klíma 1963; Zvelebil 1994). Direct evidence for plant foods, as noted, comes from the one hearth at Dolní Věstonice II whose contents were floated.

Little evidence exists for food preparation – but that on hand clearly reflects the labour of women who are universally responsible for food preparation and serving in the ethnographic record (Murdock 1937; Murdock and Provost 1973). The presence of grinders and grinding stones may indicate that some foods were ground before cooking. The fillet cut marks on animal bones suggest that meat was reduced into small packages. The boiling pits, in turn, suggest that the meat and plants were cooked in liquids producing something like gruels, soups, or stews.

Mason (*et al.* 1994) and her colleagues' recovery of foods at Dolní Věstonice II, if they represent food spilled in the process of cooking as opposed to food residue disposal, may indicate direct cooking over open fires. If this was the case, then some textiles/basketry impressed fragments of fired clay, some of which we have preliminarily termed 'structural ceramics', may represent fragments of cooking vessels such as clay lined baskets.

5.5 Maintenance implements

As noted before, the Moravian textiles and basketry are quite diverse. It is tempting to hypothesize that such diversity may reflect idiosyncratic production on the level of the household (Adovasio *et al.* 1999). It may also reflect the nature of Moravian occupations. Adovasio (*et al.* 1999) and his colleagues suggest that if sites such as Pavlov I and Dolní Věstonice I served as seasonal aggregation loci for a number of independent social units who spent the remainder of the year elsewhere, then these sites should present evidence of greater technological variability than locales where multiple social units co-resided with each other on a more permanent basis.

The presence of the textile/basketry impressions at these sites carries other social implications also. Cross-cultural research shows that in pre-market societies the production of textiles and basketry is associated with the labour of women (Murdock 1937; Murdock and Provost 1973; Schneider and Weiner 1989; King 1991). Given such patterns of production and use, the Moravian impressions thus directly reveal female labour. The fineness of the gauge of some of the textiles, in turn, suggests that this labour was quite intensive.

5.6 SURPLUS – SEDENTISM – TIME BUDGETS – INNOVATIONS

I next briefly examine some mechanisms which made the invention and/or extensive use of some new technologies possible. In this I follow Brown (1989) who has argued that in order to understand the adoption of technological inventions we need to consider not only consumer demand but also factors acting to constrain such demand.

5.6.1 Time budgets and technologies

The Moravian sites reflect both group aggregation and residential stability over a number of autumn through early spring months. This residential stability was made possible through food surpluses, in part likely obtained through communal net hunting. This, in turn, brought about the re-deployment of labour from direct procurement pursuits to the production of weaponry for future use as well as the production of a myriad of implements for maintenance activities (e.g. clothes, containers, jewelry, etc.). Such an intensification in the production of diverse inventories during periods of greater residential sedentism is amply documented for hunter-gatherer groups, especially those in northern latitudes who require greater amounts of tools and implements for survival (Kelly 1995 with references).

Different technologies require different time budgets, however. As Brown (1989) points out, some technologies widely used by hunter-gatherers, are congruent with "stop and go" production sequences. The making of spear heads, the carving of figurines, the looping of nets, or weaving with simple looms can be interrupted and resumed at a later time without detriment to the final product. These technologies are thus congruent with mobile lifeways. Other technologies, such as the harvesting and processing of bast-bearing plants to make plant fibers for weaving, require continuous work over a number of days and weeks and, thus, require greater residential stability. Ground stone technology to make large grinding slabs and grinders – items which are not easily carried from place to place – is another example of a energetically expensive technology associated with residential stability.

Furthermore, the seasonal availability or accessibility of the suitable raw materials for some technologies requires that residential stability occurs during those months when the suitable raw materials can be obtained. In Pleistocene Moravia, for example, loess for ceramic production was likely far more easily accessible from spring to autumn when the ground was not frozen. Ethnographic data on the harvesting of such bast-bearing plants as nettle and milkweed indicate that these plants are harvested and processed in the autumn months after the plants reach their maximal growth and dry out (Barber 1991). We can presume that they were harvested during the autumn in gravettian Moravia as well.

These brief observations indicate that for some technologies there is an association not only with residential stability but with such stability during specific seasons and the Moravian evidence shows that there was the congruence of the two at the sites.

5.6.2 Food sources and types of cooking

Brown (1989) also points out that some types of foods – specifically cereals – require long cooking at relatively high temperatures to make them digestible. We can add root crops to this as well. Such direct cooking stresses the cooking vessels much more than does indirect cooking by stone boiling. The Moravian data do indicate stone boiling in pits. At the same time, Mason's (Mason *et al.* 1994) data on plant foods at Dolní Věstonice II, although more tenuous, hint that other foods may have been cooked directly over hearths. If this was the case, we can anticipate the need for watertight containers – possibly met by tightly woven and/or clay-lined baskets. Furthermore, such direct cooking would have placed greater stress on containers, their more frequent replacement, and thus increased consumer need for more baskets. More frequent production, use, and discard would create more visible archaeological remains – which may account for their presence at the sites.

Finally, since hunter-gatherer aggregations are also associated with feasting requiring intensified preparation of food (Satterthwait 1986, 1987; Ames 1991; Hayden 1995), it is possible that if such feasting took place in Upper Palaeolithic Moravia, it too would have created increased need for the the use and production of containers.

6. Aggregations and rituals

Finally, I turn to a brief examination of the association of rituals, aggregation, and their material manifestations. Johnson (1982) has convincingly demonstrated that there is a strong structural connection between temporary aggregations of large numbers of people and ritual performances. Since ceremonies and rituals usually involve the manipulation of some non-utilitarian materials, we can anticipate finding larger numbers of such items at archaeological sites which served as aggregation locales.

Although it is nearly impossible to unequivocally demonstrate that specific archaeological artefacts were non-utilitarian ritual paraphernalia, some remains from the Moravian sites are likely candidates. Specifically, Vandiver's (*et al.* 1990 with references) study of the production and firing of the ceramic animal and anthropomorphic figurine fragments from the sites led her and her colleagues to conclude that these figurines were not produced to be durable objects – or "permanent art". They have argued, instead, that this inventory represents the residue of "performance art" – images that were important during the production and firing moments only, and that such production performances were likely ritual in nature. Finding such 'art' at Moravian aggregation sites is thus not unusual, but, rather, to be expected.

7. Final lessons

The above discussion reminds us, once again, of the fact which we all know well, but tend to forget in examining change in artefacts through time – namely, that technology has no evolutionary trajectory of its own but is embedded in the social context which both brings it into existence and brings about its abandonment. Some of the technologies we see in use in Moravia, such as the production of ceramics, is only faintly echoed at other Eurasian Upper Palaeolithic sites somewhat younger in time – e.g. Kostenki I-1 (Praslov 1991) or at Maina (Vasil'ev and Ermolova 1983)(for an extensive discussion of palaeolithic ceramic technology see Vandiver *et al.* 1990 with references). These faint echoes suggest either its abandonment for a time or its decrease in importance through time, until it resurfaces once again around 13,500 bp in the Russian Far East (Zhushchikhovskaya 1994; Derevianko and Medvedev 1995) and at the Jomon sites in Japan, where it includes the production of pottery. Complex insert technology, on the other hand, appears to undergo continuous use and elaboration through palaeolithic time.

Similar patterns in the use of technology are in evidence for hunter-gatherers who lived in more recent time periods as well. Manhire *et al.* (1985), for example, use rock art imagery to persuasively argue that net hunting was practiced in the past by the San – something not documented in the ethnographic record. Another example is the simplification of Tasmanian technology documented through time by Jones (1984).

Theoretical insights and these examples clearly show that technologies are adopted or abandoned in the social realms of solving problems. Because of this, to understand changes in technologies we must look not at the global but at the purely local social impetus and constraints. These, as Dobres and Hoffman (1994) note, are felt and reacted to by individual social actors for some of whom innovation is more advantageous while the *status quo* suits others better. In light of the near impossibility of identifying individual actors in the remote past, we need to identify the actions of as many different social groups as possible – including those of women, children, and the elderly, as well as any other groups we can detect. This chapter has shown that this means looking far beyond lithics and realising just how finite, biased, and woefully incomplete a picture of past lifeways these durables offer.

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Olga Soffer
Department of Anthropology
109 Davenport Hall
Urbana, Illinois 61801
USA

Wil Roebroeks
Raymond Corbey

6 Periodisations and double standards in the study of the Palaeolithic

Periodisations of the Palaeolithic, while in fact mere working hypotheses, tend to be taken too seriously by many researchers. Using various archaeological case studies we show how differentially phenomena are treated depending upon their position in relation to the 'Archaic-Modern' boundary. The background to these scientifically unhealthy practices is analysed, and it is concluded that the essentialist thinking at the root of this double standard constitutes a major problem for a discipline which tries to chart and explain cultural developments in terms of evolutionary trends rather than in typological modes.

1. Introduction

The terms Lower, Middle, and Upper Palaeolithic are more than just neutral and straightforward divisions of 2.5 million years of human cultural development. They are essential building blocks for our understanding of the prehistoric past (cf. Gamble and Roebroeks 1999). Periodisations are, in fact, never neutral or 'objective'. In historical disciplines they are, in the first instance, working hypotheses that order the confusingly large amount of historical data and developments into more or less digestable time slices, while at the same time expressing specific views on how best to segment time sequences, preferring specific characteristics to delineate periods rather than alternative ones. As such, they express a certain viewpoint on how best to approach a study of the past and on the chronology of key events and transitional periods.

As working hypotheses, periodisations should ideally be subjected to continuous testing and reassessment. This is rarely done in archaeology, and when it is, it is mostly done in an implicit and unsystematic way. It is striking to see that our divisions of the prehistoric past have survived all kinds of major changes on both theoretical and empirical levels since the emergence of the basic framework in the second half of the 19th century. Periodisations can become dangerous instruments when long periods of uncritical usage have incised them too deeply in the sedimentary bedrock of scientific practice, when their longevity seduces scholars to treat these working hypotheses, these abstractions, as realities and to take them too seriously. In the case of palaeolithic archaeology, there is the extra danger of thinking in teleological sequences. As Gamble and Roebroeks (1999) have noted, archaeologists' preference to think in threes (ages of stone, bronze and iron; Gordon Childe's three revolutions: Neolithic, urban, and industrial, etc.) has led to a type of reasoning in which the period in the Middle is compared favourably with the Lower and unfavourably with the Upper, with Upper Palaeolithic humans often treated as the ultimate goal of all preceding evolutionary processes.

Periodisations are also 'fossilised expectations', and expectation is a powerful guide to action and interpretation. Conkey (1985) has given a clear example of how such expectations steer our activities to what she calls "spatio-temporal collapse" approaches. This term indicates the lumping of sociocultural phenomena which are distributed both in space and time into sets of attributes considered characteristic for one specific period. For instance, the whole Middle Palaeolithic, roughly 250,000 years, is thus contrasted with "the" Upper Palaeolithic for its absence of art, despite the fact that there were many regions and periods within the latter that had no archaeologically visible art production at all (Conkey 1985: 301). In the same vein, the Lower and Middle Palaeolithic are often portrayed as periods of stable, unchanging and monotonous adaptations, in contrast to 'the' Upper Palaeolithic cultural bonanza. In such a scientific climate, the position on either side of the Middle/Upper Palaeolithic boundary greatly determines the scientific treatment that finds receive: the inferred level of 'humanity' of the hominid involved forms the basis of behavioural reconstruction. Similar finds are interpreted differently. The fact that many researchers tend to focus on specific time periods also triggers a social and institutional clustering of researchers around the time blocks and hence a continuous reinforcement of such periodisations.

One of the explicit aims of the *European Science Foundation* Network on the Palaeolithic – which organised the meeting from which this volume resulted – was to break through this state of affairs and to treat the three periods under discussion during the meetings as periods *an sich* according to their own, however heterogeneous structure, not as a part of the ascendence of modern humans. This, however, proved to be difficult at the Pavlov workshop that dealt with the period from 30,000 to 20,000 years bp. Despite these explicit goals and an awareness of the problems just mentioned, various participants commented upon the striking differences in the approach to the archaeology of that period as compared with the workshops on earlier periods. In dealing with the Lower and Middle Palaeolithic, a highly critical approach prevailed in which, for instance, hearths and dwelling structures were concepts to be applied only after a careful scrutiny of the data. Similarly, there was also a kind of 'double standard' with regard to the association of faunal remains and stone artefacts: at earlier sites, the actual degree and type of interaction between humans and animals had to be convincingly demonstrated time and time again, whereas in the context of modern humans, such critical examinations seemed less important and interpretations of stones and bones flowed more freely in terms of hunters and their prey (Mussi and Roebroeks 1996).

We will now give a few more examples of double-standard operations, then move to a general discussion and a tentative explanation of what may be at stake here. We will end with some suggestions on how to deal with such double-standard approaches.

2. Double standards at work

Most readers are aware of examples of double standards in their own field of expertise. We shall present four cases here: four very specific ones, and a more general one, which perhaps touches most clearly on what might be the core issue here.

2.1 Grave shortcomings

In a paper entitled "Grave Shortcomings", Robert Gargett (1989) gave a critical review of the evidence for intentional burial by Neanderthals. The criteria he developed to recognise purposeful interment – a new stratum, i.e., a well-defined grave fill and grave walls with visible contact between the fill and the overlying sediments – removed intentional burying entirely from the Neanderthal behavioural repertoire. But as Paola Villa (1989) pointed out, if this criterion was applied as strictly to the Upper Palaeolithic evidence, 22 out of 28 Upper Palaeolithic burials in France and Italy would not classify as burials, including the double burial at the Grotte des Enfants and the Grotte Paglicci burial of a boy covered with ochre. That did not bother Gargett too much ("so be it"); from the beginning he argued that in contrast to the Middle Palaeolithic evidence, in the majority of Upper Palaeolithic cases the inference of deliberate mortuary interment is probably well founded. In the same vein, Antonio Gilman pointed out in his comments on the paper that it is apparent that the critical procedures Gargett used to rightly cast doubt on textbook burials such as Shanidar and La Chapelle-aux-Saints would sweep away the evidence from virtually all pre-1960 excavations for periods prior to the Neolithic.

In an examination of the attitudes to the problem of Middle Palaeolithic burials found in current research, Belfer-Cohen and Hovers (1992) compared interpretations of Natufian burials with interpretations of the controversial Levantine mousterian interments. The description of the common Natufian burial is identical to that of many of the mousterian inhumations, but nevertheless Natufian burials are generally seen as intentional, while Middle Palaeolithic burials are given differential treatment and are hotly debated. Within the group of Levantine Middle Palaeolithic burials, the anatomically modern Qafzeh/Skhul hominids have been credited with some symbolic behaviour, e.g., intentional burial, whereas Neanderthal skeletons in comparable settings are not seen as reflecting mortuary practices. Belfer-Cohen and Hovers conclude that there is a clear bias against Middle Palaeolithic hominids other than *H. sapiens sapiens*. They are treated as poor relations who did not survive and "must therefore have been inferior to their *H. sapiens sapiens* contemporaries" (1992: 470).

2.2 Repetitive behaviour

In the discussion on behavioural differences between 'ancients' and 'moderns', a part of the debate has focused on differences in the way both 'groups' operated in their respective landscapes, among other things, the distances over which raw materials were transported (Roebroeks *et al.* 1988; Stringer and Gamble 1993), the spatial organisation on the site-level (Gamble 1986; Pettitt 1997; Kolen 1999), and differences in the geographical expansion of ancients and moderns. In general, these inferred differences have been summarised and explained in terms of Binford's (1987) distinction between a niche and a cultural geography: "We can imagine two very different types of organized land use. One articulates a cultural geography with an environmental geography; the other simply creates an archaeological landscape in direct response to the structure of the natural geography as it differentially offers "need servicing" and conditions the behavior of an animal species" (1987: 18). Whereas modern human populations construct environments (residences, settlements, etc.) and operate out of "camps" into an environment, pre-modern archaeological landscapes were probably generated episodically, in the same way many animals "move within their natural environments among the places where they may obtain the resources essential to their biological success. We commonly say that, although animal behavior is not organized culturally, nevertheless it is not random in an environment. It produces a pattern of differential placement, differentiation of behavior, and intensity of use within a habitat, resulting in a "niche geography"" (1987: 18). While this is certainly a valuable distinction, its application to concrete archaeological material is not unproblematic and, in some cases, very obviously steered by expectations. A good example is furnished by two recent papers, one on intrasite spatial data from Middle

Palaeolithic sites (Pettitt 1997) and the other on the archaeology of Paviland Cave, Wales, and, more specifically, on the 'Red Lady' burial there (Aldhouse-Green and Pettitt 1998).

In his review of Middle Palaeolithic intra-site spatial data, which includes the Kebara (Israel) Middle Palaeolithic burial, Pettitt stresses that most Middle Palaeolithic occupation horizons are palimpsests and that repetition is a striking character of the pre-modern archaeological record: "...it would seem that the repetition observable in other areas of Neanderthal behaviour, e.g. lithic technology, which has been described as archaic and repetitive... is equally observable in their use of space. Where such repetition is observable within the discrete geological horizon, I interpret this as reflecting behaviour that was both limited in variability and *habitual in nature*... The Neanderthal organization of space, where observable, seems to have been along very simple lines, which cannot be distinguished from that of non-human carnivores" (Pettitt 1997: 219).

In 1823, Paviland Cave (Wales) yielded fossil human remains stained in red ochre, which became known as the 'Red Lady of Paviland'. Nowadays we know that the bones belonged to a young adult male, who has a radiocarbon age of *c.* 26,000 bp (Aldhouse-Green and Pettitt 1998). The new AMS dates for Paviland Cave also show that after the burial of the 'Red Lady', brief visits to the cave occurred between 25,000-21,000 bp. Apart from the gravettian presence, there is evidence of an aurignacian phase of settlement *c.* 29,500-28,000 bp. Before these dates became available, typology was the only tool to interpret the Paviland sequence, as the 19th and early 20th century excavations yielded only poor documentation. Yet, despite the absence of solid stratigraphical and spatial data on the skeleton, the ceremonial burial character of the human remains is simply taken for granted. It is from that point of departure that a 'cultural geography' speculation starts which is strongly at odds with the critical treatment of the Middle Palaeolithic record by Pettitt, one of the authors of the Paviland Cave article. Now the numinosity of the site "- a sensation experienced by many at the present day who are able – at low tide – to view the cave as its prehistoric occupants did, from below on the plain" (1998: 767) is brought into the debate. Next the observation that natural landmarks, including mountains or hills, were often perceived as sacred or imbued with mythical importance in the ancient and pre-industrial world (1998: 767) takes us to the coincidence of hill and cave at Paviland and to the idea of the *mons sacra* (sic) as a ladder between Earth and Heaven in Asiatic shamanism: "The concept of the site as a sacred hill and/or cave implies that it was a well-established landmark, perhaps reflecting folk memory of an earlier phase of ancestral, probably aurignacian settlement. It may be, indeed, that Paviland was simply a *locus consecratus* whose mythical significance did not depend upon its topographical situation or features. In either case, this model may explain the evidence for repeated visits, perhaps episodes of pilgrimage, to the site which seem to have continued until a time when the British isles were otherwise virtually depopulated..." (Aldhouse-Green and Pettitt 1998: 768).

Who would seriously think of invoking folk memory and ceremonial pilgrimage in interpreting multi-level Middle Palaeolithic sites, even such spectacular 'landmark' sites as La Cotte de St. Brélade (Jersey) or Kebara (Israel) with its well-documented burial? Poorly documented modern human remains can become the relics of gravettian pilgrimages to a *mons sacra*, while repetition in a Middle Palaeolithic context is interpreted as habitual, and animal-like in nature.

2.3 Palaeolithic 'dwelling structures'

Despite the large number of fanciful reconstruction drawings of palaeolithic huts we encounter in archaeology textbooks – e.g., the ones on the southern French beach of Terra Amata – most scholars would argue that structural features such as constructed hearths or the remains of 'dwellings' are very rare or even completely absent in the Lower and Middle Palaeolithic record. Well-known exceptions such as the mammoth bone piles uncovered at Molodova are all relatively late, dating from the last glacial, and even these later ones are in no way convincing as remains of former dwellings (cf. Stringer and Gamble 1993; Kolen 1999). Many archaeologists hold that, in contrast to the Lower and Middle Palaeolithic, the situation in 'the' Upper Palaeolithic was significantly different, as exemplified by Paul Mellars' (1996) treatment of the subject: "There can be no doubt that many Upper Palaeolithic sites show far clearer and more sharply defined evidence for deliberate living structures than anything so far documented from Middle Palaeolithic sites". Furthermore, there is "evidence for some kind of clearly structured, preconceived form in the design and construction of many Upper Palaeolithic living structures" and "one of the most striking features of many documented Upper Palaeolithic settlements is the way in which the principal areas of occupation can usually be seen to be centred around one major and centrally located hearth" (Mellars 1996: 313). Richard Klein (1989: 315) is even more pertinent: "Well-excavated Upper Palaeolithic sites almost always contain unambiguous and often spectacular evidence of structures, in the form of artificially excavated depressions and pits, patterned arrangements of large bones or stones, postholes, or some combination of these."

These quotes give, we believe, a fair representation of the common view of Upper Palaeolithic on-site patterns as compared to earlier ones. It is significant that various authors, including Mellars, have suggested that even the appearance of châtelperronian structures in the Grotte du Renne at Arcy, occurring "long after the Moderns arrived in central Europe and the Iberian peninsula", was an "archaic" behavioural novelty "influenced by the Moderns...not developed independently by the Neanderthals" (Stringer and Gamble 1993: 200-201; for a discussion of other inferred copying of 'modern' material culture by the Châtelperronians, see D'Errico *et al.* 1998). However, in an important reappraisal of Middle Palaeolithic 'dwelling structures' and other features, Jan Kolen (1999) has recently shown that those who adhere to such an imitation scenario tend to forget that there are no known contemporary prototypes whatsoever from which the Neanderthals could have copied. In fact, with regard to the spatio-temporal collapse image of Upper Palaeolithic use of space formulated by Mellars, Kolen argues that the European Aurignacian is remarkably devoid of on-site structures, all the more so if we evaluate the few claims according to the same critical standards he applied to Lower and Middle Palaeolithic 'habitation structures'. Not only are supposed dwellings from early 'modern' sites as ambiguous as the ones from the Middle Palaeolithic, even constructed hearths are quite rare until later in the Upper Palaeolithic, and in fact, while unquestionable Upper Palaeolithic dwellings and hut constructions are known from gravettian contexts, as shown in this volume, most date from after the Last Glacial Maximum (Kolen 1999).

2.4 Ancient technologies

Another clear example of a double standard can be found in the way lithic assemblages from the Lower and Middle Palaeolithic are often treated as opposed to those from the Upper Palaeolithic. While the uniformity of pre-modern assemblages with little variation is usually treated as a reflection of a 'tool-assisted' rather primitive behaviour (cf. Binford 1989; Mithen 1996), comparable patterns in the Upper Palaeolithic can be interpreted in a diametrically opposed way. "Despite its remoteness and ecological difference with other Aurignacian sites," Chilardi *et al.* (1996: 562) write on the aurignacian site of Fontana Nuova in Sicily, "the lithic assemblage shows no fundamental variance from sites many kilometres away. This suggests that Aurignacian assemblages reflect the ability of human groups to adapt to a variety of ecological situations, without substantially altering the technological, typological and, probably, functional characteristics of stone tools". In the case of earlier hominids, uniformity through various ecological zones is usually seen as a manifestation of a lack of flexibility, as an expression of "cognitive constraints" (Mithen 1996: 131-132), and in terms of an almost biological role of stone tools.

2.5 'Anatomically modern humans'

The last two decades have witnessed the rise of a concept (and a key actor) in palaeoanthropology whose impact is matched only by its vagueness: the anatomically modern human. As various scholars have argued, the phrase 'anatomically modern' has no clear or established meaning, and is basically "a scientific sounding way of evading the fact that there is no agreement on the list and distribution of the defining autapomorphies of the human species" (Cartmill 1999). Anatomically modern humans, 'people like us', are supposed to possess all the characteristics essential to our species, with the capacity for a complex symbolic language being a major attribute. What makes the Gravettians different from westerners at the end of the 20th century is not a matter of innate capacities, that is, biological endowment, but simply some 25,000 years of history and cultural development. The differences between *Australopithecus*, *Homo erectus*, and the Neanderthals, however, concern manipulative abilities, structure of the brain, etc. In short, they fall in the domain of biological evolution. In Tim Ingold's view, "from the moment when "modern human" capacities were established, technology "took off", following a historical trajectory of its own, thenceforth effectively decoupled from the process of evolution" (Ingold 1995: 243). But in what sense, Ingold asks, did the (presumed) failure of Neanderthals or earlier hominids to speak differ from the Upper Palaeolithics' failure to read and write as we do? Why is biology invoked in the first case and unfulfilled historical conditions in the second? "If Cro-Magnon Man, had he been brought up in the twentieth century, could have mastered the skills of literacy, why should not *Homo erectus*, had he been brought up in the Upper Palaeolithic, have mastered language?" (Ingold 1995: 245-246).

3. What's at stake?

The latter case, that of the anatomically modern humans, gives an indication of why such double standards are applied. The implicit starting assumption often seems to be that there is a kind of 'in-group' of 'anatomically modern' actors, who possess all the 'essentially human' capacities considered characteristic of 'people like us', even when the archaeological record shows no traces of these competences, i.e., when these inferred competences are not manifested. The older 'out-group' is defined in a negative way, as not yet being capable of doing what the 'in-group' is supposed to be capable of. To paraphrase in juridical terms, one could say that the 'moderns' are capable until proven incapable, whereas the attitude of many scholars towards the 'ancients' can be summarised as incapable, until proven capable. These implicit but germane assumptions keep the building blocks of our interpretive frameworks and our archaeological scenarios nice and tidy, and fit very well in a discipline which has always predominantly been focused on the emergence of modern humans.

Matt Cartmill (1990; in press) has dealt extensively with the focus on (modern) human uniqueness in the field of palaeoanthropology. His basic thesis in the 1990 article is that palaeoanthropology (and one has to include palaeolithic archaeology here) has suffered from its persistent anthropocentric approach and its constant efforts to police the human-animal boundary. For this policing, human essentials are defined – such as upright posture, large brains, technology, and language – which are thought to be characteristic of humans and which separate them from animals. The history of palaeoanthropology shows that these characteristics are redefined every time they do not manage to keep animals out, to such a degree that, for example in the case of the 'uniquely human' capacity for language, "...what we mean by "language" is whatever substantiates the judgment that nonhuman animals are unable to talk" (1990: 184).

Following Cartmill (in press), one could say that palaeolithic archaeologists tend to approach the past in terms of a mixture of descriptive (focused on essentials, as mentioned above) and historical (genealogy, evolutionary descent) classification, where from a certain point in time onwards, all historical descendants are supposed to possess all the autapomorphies (descriptive essentials) characteristic of 'people like us'. The *Grave Shortcomings* case mentioned above again illustrates this nicely, when Gargett (1989: 188) states that burial, "clearly, is a derived characteristic and one which, on the evidence, is manifested only by Upper Palaeolithic, morphologically modern *H. sapiens*."

To keep the in- and out groups clear, and our theoretical building blocks nice and tidy, it is usually sufficient to reformulate the defining essentials, as shown for palaeoanthropology by Cartmill (1990), who reports a number of historical cases of redefinition of human essentials such as brain size and organisation, toolmaking and language. In all these cases, the autapomorphies, the unique essential characteristics that distinguish a descendant taxon from its more primitive ancestor, have a history of redefinitions that serve to keep humans in and animals out. In the case of language, the goal posts were moved from semantics to syntax. But there is an alternative to redefining the essentials: if necessary, even the genealogical groups, the 'bearers' of the essentials, can simply be changed. This is illustrated by the history of the acceptance of Upper Palaeolithic art, where the set of defining essentials stays the same, while the historical 'owners' of these characteristics have changed in such a way that today's 'moderns' are in fact yesterday's 'ancients'. Nathalie Richard (1993) has given a detailed description of this important period in palaeolithic archaeology and the shift in interpretation of Upper Palaeolithic art from the simplicity of "art ludique" to the complexity of "art magique."

The case is the following. In the second half of the 19th century, *art mobilier* was seen as an expression of an 'archaic', 'primitive' style of cognitive functioning (Richard 1993). Early interpreters of small figurative objects from the Upper Palaeolithic like Édouard Piette (1874, 1875) and Gabriel De Mortillet (1879, 1883) postulated that these artefacts mechanically reproduced nature as perceived with the senses – a naive realism, without composition, perspective, or indeed any traces of symbolism or abstract thought. A few typical quotes from that period illustrate the basic attitude: the Upper Palaeolithics were supposed to have an "esprit léger", an "absence de symbolisme", they lacked "réflexion et prévoyance", were only capable of imitation, and their art was one "né de l'instant, non d'une réflexion esthétique". This kind of thinking initially stood in the way of the acceptance of the 'high art' from the caves, e.g., Altamira. In fact, Upper Palaeolithic foragers were interpreted in very much the same way as Middle Palaeolithic Neanderthal foragers are now interpreted by many, mostly Anglo-Saxon, authors. They were assumed, to put it in modern scientific idiom, not to have entered the domain of 'cognitive and behavioural modernity', and to be unable to perform the complex actions we see later on, which presuppose the ability to abstract and organise mentally.

We have, of course, to situate this attitude within what Herbert Kühn (1976) has called the dominant framework of materialistic philosophy and the concomitant complete rejection of religiosity[1] and metaphysics in general by virtually all 19th century archaeologists. Even the large number of skeletons found in the second half of the 19th century (Aurignac, Cro-Magnon, Solutré, the Grimaldi caves, Předmostí, Brno) only very gradually convinced the wider scientific community that there was more in the Upper Palaeolithic than Gabriel De Mortillet thought. To him, *art mobilier* was decoration, and "Les gravures et les sculptures, dans leur ensemble aussi bien dans leur détails, conduisent à la même conclusion, l'absence complète de religiosité. Ce ne sont que de simples motifs d'ornamentation des plus élémentaires ou des reproductions plus ou moins réussis d'objets naturels" (1900: 335). "Il n'y a pas de trace de pratiques funéraires dans tous les temps quaternaires. L'homme quaternaire était donc complètement dépourvu du sentiment de la religiosité" (1883: 476)[2]. Piette's remarkable (and exceptional) suggestion that female figurines might have been a kind of amulet, was fiercely rejected by De Mortillet (Kühn 1976: 120).

These interpretations of the Upper Palaeolithic started to change around the turn of the century (cf. Richard 1993). Archaeologists like Émile Cartailhac, who showed real amazement over the burials and was impressed by the ritual character of the Grimaldi burials (Cartailhac 1896, 1902), Gustave Chauvet (1903) and Salomon Reinach (1903) now started to stress the considerable complexity of newly discovered Upper Palaeolithic graves and cave paintings, which they compared to similar practices among contemporary 'primitives'. Verneau (1906) has given a good review of the history of the interpretation of the Grimaldi burials (intentional burials or not, Palaeolithic or Neolithic, etc.), and reading his *Résumé historique* on the age of the burials makes one fully aware of the fact that the acceptance of the skeletons as Upper Palaeolithic burials had a long history, filled with quite intense debate. Although the final acceptance did not automatically imply that Upper Palaeolithic humans and the 'contemporary ancestors' were as fully modern as contemporary Europeans, they now came to be seen as being on the modern side of the boundary, while older hominids like the Neanderthals were assigned a place on the other side of the fence.

We agree with Richard that this shift was an important one, but at the same time we are convinced that this did not represent "the collapse of the insights of 19th-century prehistorians" (Richard 1993: 60), for the basic conceptual structure of those insights did survive the shift in interpretations; the difference was that the scheme now came to be applied to the forerunners of the Cro-Magnons, the Neanderthals[3]. Hence, the set of defining essentials stayed the same, but was transferred to another genealogical group. The character of the boundary between 'modern' and earlier humans stayed intact; only the group qualifying for the sign 'modern' changed.

4. Discussion

A persistent focus on inferred essentials of 'modern humanity' seems to be the heart of the issue. However, that having been said, how should we deal with this problem? Two basic answers to this question are possible: a pragmatic one, which takes double-standard operations for granted and one which takes them to be methodologically unsound and redundant.

Pragmatically, one could say that double-standard approaches have the advantage of provoking reactions against such one-sided studies of the past, and that ultimately the most reasonable perspective will probably emerge from the struggle. Kolen's (1999) study of palaeolithic dwelling structures was in fact triggered by scientific unease with teleological approaches to the earlier palaeolithic record, which interpreted palaeolithic data in a retrospect perspective centred on the emergence of modern humans without trying to study the various periods on their own terms. Likewise, boundary policing tends to generate sharper definitions and concepts, for instance, in the case of 'planning', 'curation', etc. Double standards can thus have an important heuristic function.

However, on another level, double standards are quite revealing with respect to the character of our discipline, with its tendency towards dichotomies, essentials, boundaries, and discontinuities. The way out of a double-standard archaeology might be to get rid of the top-down approach with modern humans as a starting point for analysis and to opt for a continuity approach which works from the bottom up, observing and documenting what palaeolithic hominids actually did and how their behaviour changed over time, not just whether or not they could do what modern humans did (cf. King 1994: 138). A more 'historical' approach is called for in palaeolithic archaeology, a discipline which has traditionally had only a limited interest in regional developments and a very strong focus on universal principles of adaptation and evolutionary changes, probably as a result of the domination of functionalist approaches. The last decade has, however, seen a shift towards the documentation of regional diversity and Pleistocene "polyphony" (cf. Soffer and Gamble 1990). The present volume testifies to this development, which to some extent is analogous to developments in cultural anthropology, e.g., the (now almost extinct) 'revisionist' debate in hunter-gatherer studies. Contrary to the evolutionary-ecological school in hunter-gatherer studies, the 'revisionists' were not so much interested in the modelling of human behaviour as in situating each foraging group in its own history, where varying degrees of contacts and interrelationships with neighbours for centuries or millennia played a significant role (Stiles 1992). Instead of an archetypical and timeless, unchanging and pristine 'essential' hunter-gatherer – which archaeologists liked to project into the past – now a historic-particularistic approach has obtained an important place in hunter-gatherer studies. Eric Wolf's (1982) criticism of anthropologists' treatment of non-Westerners as "people without history" contributed much to the historisation of this field (cf. Myers 1988; Lee 1992).

To varying degrees, archaeologists have always been aware of the problems discussed here[4]. Some of the recent proposals for more fine-grained divisions of the Upper Palaeolithic into two or more phases (e.g. Lindly and Clark 1990, and the threefold division used in this volume) are probably partially rooted in analogous lines of reasoning. However, such divisions, again, run the risk of caricaturisation of the Pleistocene past into periods with 'those who have' and preceding periods with 'those who have not'. Whether the Last Glacial Maximum is a crucial Rubicon in a division or the Middle to Upper Palaeolithic transition is irrelevant in the sense discussed here, as long as such divisions run the risk of throwing large blankets over the past and hiding more variation than they uncover. Variation is the key word here because "...if culture is subject to evolutionary conditioning, then surely the early days of populations possessing a cultural capacity must have been importantly different from later times. For example, while the early Aurignacian remains from Germany have a very 'modern' feel (Hahn and Owen 1985), the contemporary and even more recent 'Aurignacian' of central France, which sometimes alternates in a 'Mousterian' fashion with the Châtelperronian (Roc de Combe [Bordes 1967]), does not" (Binford 1989: 36-37). It is not important here whether Binford's assessment of aurignacian and châtelperronian chronology (see D'Errico *et al.* 1998 versus Mellars 1999) is right; what counts is the underlying view of archaeology as a discipline which tries to chart and explain cultural developments in evolutionary terms rather than in typological modes. In order to do so, we have to get rid of double-standard approaches and remain open to mosaical and non-linear developments, in short, to 'history'. And like our colleagues in history, we should use our old and worn periodisations as loose and flexible ways of organising our primary data, not as the typological straightjackets they gradually have become.

notes

1. "Die vollständige Ablehnung des Religiösen... bei jedem Verfasser in dieser Zeit zwischen 1870 und 1900" (1976: 122). And: "So stark wirkt die materialistische Philosophie, die Abneigung gegen das Metaphysische überhaupt" (121).

2. Within such 'materialistic' settings, claims for intentional burial by Neanderthals were regarded with quite some scientific suspicion, a factor which needs to be taken into consideration when evaluating Gargett's (1989) assessment of earlier workers' interpretations.

3. According to Wiktor Stoczkowski (pers. comm. 1997), the terminology used in the debate on *art ludique* as quoted above (lack of foresight, reflection etc.) was used in the 18th century to differentiate westerners from 'Hottentots' and other 'non-whites'.

4. For example Lewis Binford (1989: 22): "Consideration of the transition from earlier forms to fully modern man often takes the form of citing the earliest evidence for certain categorical forms of behavior recognized as characteristic of the latter – the earliest evidence for symbolism, for an aesthetic sense, for a "human" form of social organization. There is, I think, a kind of chauvinism, ethnocentrism, or even racism associated with this approach. It is not uncommon to hear that the properties we consider most admirable in our behavior are those to be differentially investigated".

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Wil Roebroeks and Raymond Corbey
Faculty of Archaeology
Leiden University
P.O. Box 9515
2300 RA Leiden
The Netherlands

Jean Clottes

7 Art between 30,000 and 20,000 bp

Recent discoveries and analyses – e.g. at Grotte Chauvet – have falsified traditionally held notions about a gradual and linear development of parietal art. This paper evaluates the chronological value of current notions on art and stylistic conventions. The evidence from Grotte Chauvet and other sites shows that around 30,000 bp art must already have had a long history, largely unknown because of taphonomic processes. The implications of new research are that the notion of a crude aurignacian beginning of parietal art is no longer tenable: from the Aurignacian onward, all artistic techniques were mastered and used to depict themes which saw a gradual shift from a focus on 'dangerous' animals such as rhinoceros, felines and bears in the Aurignacian, to a focus on commonly hunted animals in later periods. The chronology of the thematic changes indicates that in Central and Eastern Europe this shift occurred later than in southwestern France.

1. Introduction

In a recent paper on this subject, Brigitte and Gilles Delluc (1996: 87) envisaged "the birth of drawing, at the very beginning of the Aurignacian, in two separate centres (the region of Les Eyzies in the Périgord and the high Danube in Baden-Württemberg); a considerable expansion, especially northeastwards, of these graphic arts during the Gravettian (from Spain to the Don Valley in Russia); their subsequent retreat towards some regions of southwestern Europe during the Solutrean (in a very cold period, namely that of the Last Glacial Maximum at 20,000 years when Central Europe was emptied of its inhabitants), and then one sees the technology improving and specialising, and becoming richer with new contributions, mostly related to the mastering of perspective, before blossoming at Lascaux at the beginning of the Magdalenian".

These few lines summarize well the notion, classic since A. Leroi-Gourhan, of a linear evolution of art, with aurignacian beginnings in the Périgord and the Swabian Jura and with technical improvements – amongst which the invention of the perspective – in the Solutrean, before the apogee of Lascaux, dating to the beginning of the Magdalenian.

Yet, in the last few years analyses, discoveries, and re-evaluations have substantially changed this relatively simple scene. Very early dates have been obtained for Grotte Chauvet (Clottes *et al.* 1995; Clottes 1996b), Grotte Cosquer (Clottes and Courtin 1994; Clottes *et al.* 1996) and the Grande Grotte of Arcy-sur-Cure (Girard *et al.* 1995). Others, older than expected, have been obtained for Pech-Merle (Lorblanchet *et al.* 1995) and Cougnac (Lorblanchet 1994, 1995). The homogeneity of Lascaux is contested (Bahn 1994) and the themes used both in parietal art and in portable art are believed to have undergone considerable changes in the period under consideration (Clottes 1995, 1996a).

Rather than examining the current state of our understanding of art between 30,000 and 20,000 years bp region by region or culture by culture, we would like to discuss here some of the major problems that are presented by the latest developments in research and the changes that they bring about in our notions of palaeolithic art.

2. Before 30,000 bp

Around 30,000 bp, art had already a long history. Art results from the projection on the world that surrounds humans of a strong mental image that colours reality before taking shape and transfiguring it (Clottes 1993). Consequently, by using this definition, we qualify only those activities as art which aim to reproduce a physical or a symbolic reality in two or three dimensions.

The first artistic evidence is always subject to debate. It seems, however, that two facts emerge very clearly: on the one hand, more and more numerous material traces, for periods that go further and further back – including the Lower Palaeolithic – betray an awakening that goes beyond the contingencies of everyday life, beyond the simple quest for food and survival, and which casts an inquisitive look around; on the other hand, the 'symbolic representation', "conclusive evidence of access to abstract values" (Leroi-Gourhan 1980: 132) coincides with the diffusion of *Homo sapiens sapiens*, the real creators of art. Before them we may, at least so far, speak of pre-art.

The humans that preceded *Homo sapiens sapiens*, whether we are dealing with the Neanderthals or *Homo erectus*, have left behind several categories of remains that are generally classified under the heading of 'art', but which must be discussed separately. The *cupules* are among them. A stone

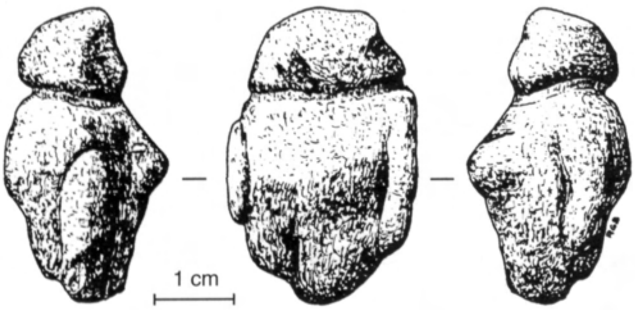

Fig. 1. Acheulean 'Figurine' (?) from Berekhat Ram (Israel). The natural form could have been partially modified (after Bednarik 1994b, fig. 1, p. 353).

slab with 18 *cupules* covered a burial of a mousterian child at La Ferrassie. A *cupule* and a dotted wavy line have been indicated under an acheulean layer in India, in the Bhimbetka (Bednarik 1994b). These *cupules*, are they really art in the sense defined above?

The same question can be asked for the series of parallel lines with sometimes very early dates, such as the lines on bone from Bilzingsleben, in Germany, undoubtedly the most famous ones because of their inferred age of 220,000 to 250,000 years, or those engraved on a cortex from Quneitra in Israel (around 54,000). Also in Israel, in Berekhat Ram, a stone, the natural shape of which evokes a human silhouette (Fig. 1), would have been partially engraved in order to accentuate this resemblance: it would date from an extremely early period since a lava flow that overlies the layer in which it was found, is dated to 230,000 bp, while the one underneath dates to 800,000 years ago (Goren-Inbar 1986; Bednarik 1994c).

And finally, the use of ochre has been demonstrated in very early periods in Europe, Africa, Asia, and Australia. Even if this was mainly for the tanning of hides or other practical uses, those who used it must surely have noticed its colouring effect. Consequently arguments were drawn from its presence in support of hypotheses, not proven but plausible, of the use for body painting or on perishable objects (Kozlowski 1992).

If the evidence of an art dating back to tens, even hundreds of thousands of years remains scarce then this would be for taphonomic reasons, as quite obviously it would have been less susceptible to preservation than art of the Upper Palaeolithic (Bednarik 1994a; Bahn 1995). Yet, if in Europe the last Neanderthals of the Châtelperronian engraved lines on bones or stones and if they indisputably possessed jewelry, they did not produce a real portable art – or parietal one – contrary to the Aurignacians. Given their contemporaneity with the latter, the taphonomic argument does not seem to work in this case.

The first Aurignacians arrived in Western Europe around at least 38,000 bp. Between this date and the beginning of the period that interests us here, all crucial progress had been made as far as art is concerned. We now have evidence that proves the existence of very varied techniques and themes that are subsequently encountered again in Franco-Cantabrian art.

With the portable art of the rock shelters of the Swabian Jura, in southwestern Germany, and the 17 ivory statuettes found in the aurignacian layers of the rock shelters of Hohlenstein-Stadel, Geissenklösterle and Vogelherd, as with the stone female statuette of Galgenberg in Austria, the Aurignacians have shown their mastery of three-dimensional sculpture, where naturalism and stylization often combine with subtlety (Fig. 2). The engravings complement them and they are sometimes coloured red. The three main techniques, sculpture, engraving and painting are thus jointly used in portable art from this period, before 30,000 years ago.

The same applies to parietal art. Until the discovery of Grotte Chauvet, aurignacian parietal art was hardly known, except from the rock shelters in the Dordogne and it was considered as an art of the exterior (Leroi-Gourhan 1965). However, those that studied it have occasionally noticed a preliminary preparation of the wall surface (Les Bernous) or the application of a red background on which the aurignacian drawings were traced in black (Blanchard, La Ferrassie), or also the fact that many walls of aurignacian rock shelters were colourwashed with red (Delluc and Delluc 1991: 340). Painting – sometimes dichromic – was therefore commonly used at the same time as the engravings on blocks. The engravings could be fine (La Croze à Gontran), or more often dotted (Belcayre, Blanchard, Cellier), or both. When deep, they occasionally go over in bas-relief (vulvas).

The discovery of Grotte Chauvet and the dates in excess of 30,000 years for several of its black drawings (Clottes *et al.* 1995) had, nevertheless, a stunning effect. How was it possible that at such an early date, supposedly only at the very beginnings of art, this cave in the Ardèche already contained real masterpieces of line drawings instead of the expected clumsy and crude sketches? The certainty that such a mastery of the art could not be but 'developed', i.e. relatively late, was such that before these dates were known, the art of Grotte Chauvet was placed in the Magdalenian on the chronological scale intended for a permanent exhibition at Vallon-Pont-d'Arc, an error that was only rectified several years later.

Several other authors could not accept the very early dates for Chauvet. Thus, Brigitte and Gilles Delluc (1996: 90) content themselves to note, without the slightest discussion, that "these dates are clearly much older than the stylistic

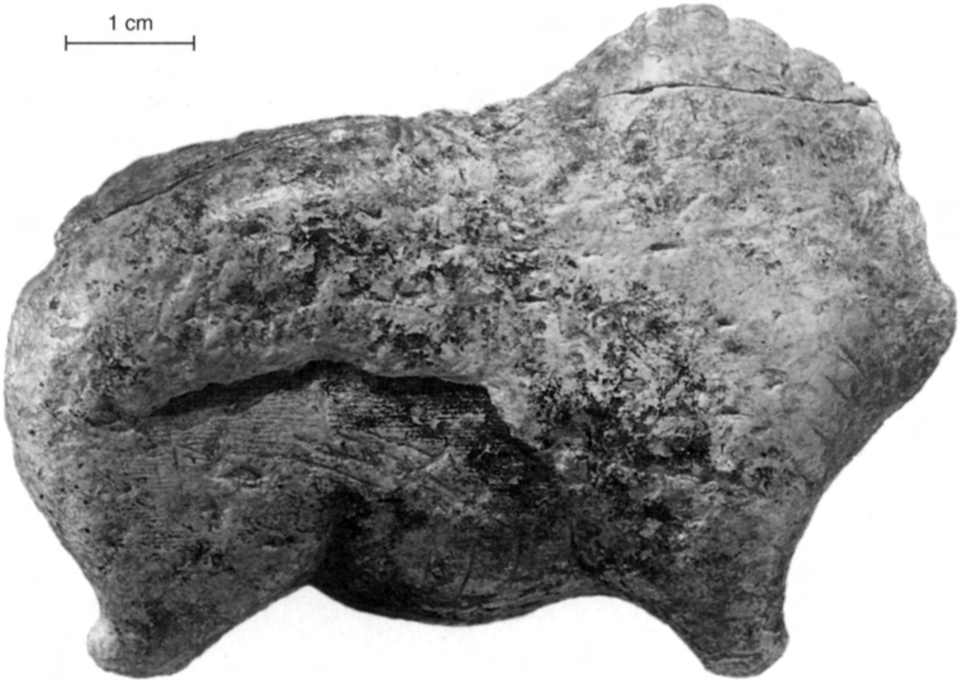

Fig. 2. Bison no. 9, sculpted in ivory and carrying various signs, found in an aurignacian layer in the Vogelherd (Germany) rock shelter (photo University of Tübingen).

analysis of the work indicates". Nevertheless, there is a major problem: either the dates of Grotte Chauvet are believed to be erroneous, in which case they should at least be discussed and reasons should be put forward for them not being credible, or else they should be accepted, and in that case the stylistic analyses need to be revised, or at least the assumptions that underlie them. That clearly raises the question of the chronological value of the current notions on art and on the stylistic conventions, which are even less certain the older the art is, especially with regard to parietal art.

3. Grotte Chauvet and the chronological problems of palaeolithic parietal art prior to 20,000 bp

So far only one specialist, Christian Züchner, has explicitly contested the dates for Grotte Chauvet and has argued his point of view (Züchner 1994-95, 1996). He attributes the red paintings of the Ardèche cave to the Gravettian and lower Solutrean, and the black paintings to the final Solutrean and the early Magdalenian (contemporary with Lascaux and Gabillou). In doing so he uses three arguments: the techniques (red and black), the themes (signs, different animal species), and the conventions followed in the representation of the animals.

These arguments are based on a fundamental postulate, which is an implicit acceptance of the value of our current knowledge. For example, in order to refute the direct radiocarbon dates, Züchner writes that "the reindeer is a theme of magdalenian art. It is not represented earlier" (Züchner 1996: 26), and that "the manner in which the anatomical details, the volumes, the perspective, and the movement are present in Chauvet is unknown before the final Solutrean and early Magdalenian" (*op. cit.*). The implicit assumption behind these assertions is that we know enough of the development of palaeolithic art, both about the use and duration of its themes and its conventions and techniques, that the broad outlines are definitely fixed, and that new discoveries should of necessity fit within established frameworks.

It is true that the study of themes, techniques, superpositions and conventions can allow an approach that, in a number of cases, proves to be on the whole correct as ^{14}C datings become available. This was the case, for instance, with the attribution to the Gravettian of part of Pech-Merle (Lorblanchet *et al.* 1995), as in this cave the possibility of the Panel of the spotted Horses belonging to the Gravettian had already been envisaged (Clottes *et al.* 1992: 273-4; Clottes and Courtin 1994: 167).

However, experience proves that every time a major discovery is made, it brings with it amazing novelties and

Fig. 3. Grotte Chauvet (Vallon-Pont-d'Arc, France). Clashing rhinoceroses, which have been given three ^{14}C dates: the rhinoceros on the right: 32,410 ± 720 bp (Gif A 95132) and 30,790 ± 600 bp (Gif A 95133); the rhinoceros on the left: 30,940 ± 610 bp (Gif A 95126) (photo J. Clottes).

provokes sometimes very important readjustments of our knowledge and our notions. For instance, during the last ten years an open air palaeolithic art of great magnitude has been discovered, against all expectations, in the Iberian peninsula (Foz Côa in Portugal, Siega Verde, Domingo Garcia and others in Spain).

In fact, these surprises were nothing out of the ordinary and their occurrence was foreseeable. Palaeolithic art has an established life of more than twenty thousand years. For this very long period a little over three hundred sites featuring parietal art are known in the whole of Europe, from the southern tip of Spain to the Urals. This is a very small number when we take into consideration the necessity of the transmission of knowledge and ritual practices. Thousands of sites must have disappeared or remain undiscovered (Bednarik 1994a). We have no means to know precisely whether those that we have found constitute a representative sample of the whole. We assume this to be the case because we cannot do otherwise. Under these conditions, we should expect modifications to, and even a shake-up of, our knowledge as discoveries are made. To judge the validity of dates obtained from such or such a cave, we should therefore consider each case individually on its own merits. What are the implications of this for Grotte Chauvet, given its importance, and more generally for sites dated between 20,000 and 30,000 bp?

If we had had only a single date for Grotte Chauvet, it would most probably have been dismissed as 'aberrant', following the old saying 'one date is no date'. In fact, there are five dates obtained from three samples, coming from three different animals (Fig. 3). These dates fall in the same range, between 30,000 and 32,000 bp. They are confirmed by the dating of charcoal on the floor, that gave a date of 29,000 ± 400 bp. Moreover, a non-calcited torch mark superimposed on a thin layer of calcite that covers the animals painted in black (Fig. 4) has been dated to 26,120 ± 400 bp, a date corroborated by the analysis of another *mouchage*, in a different chamber, that has given two

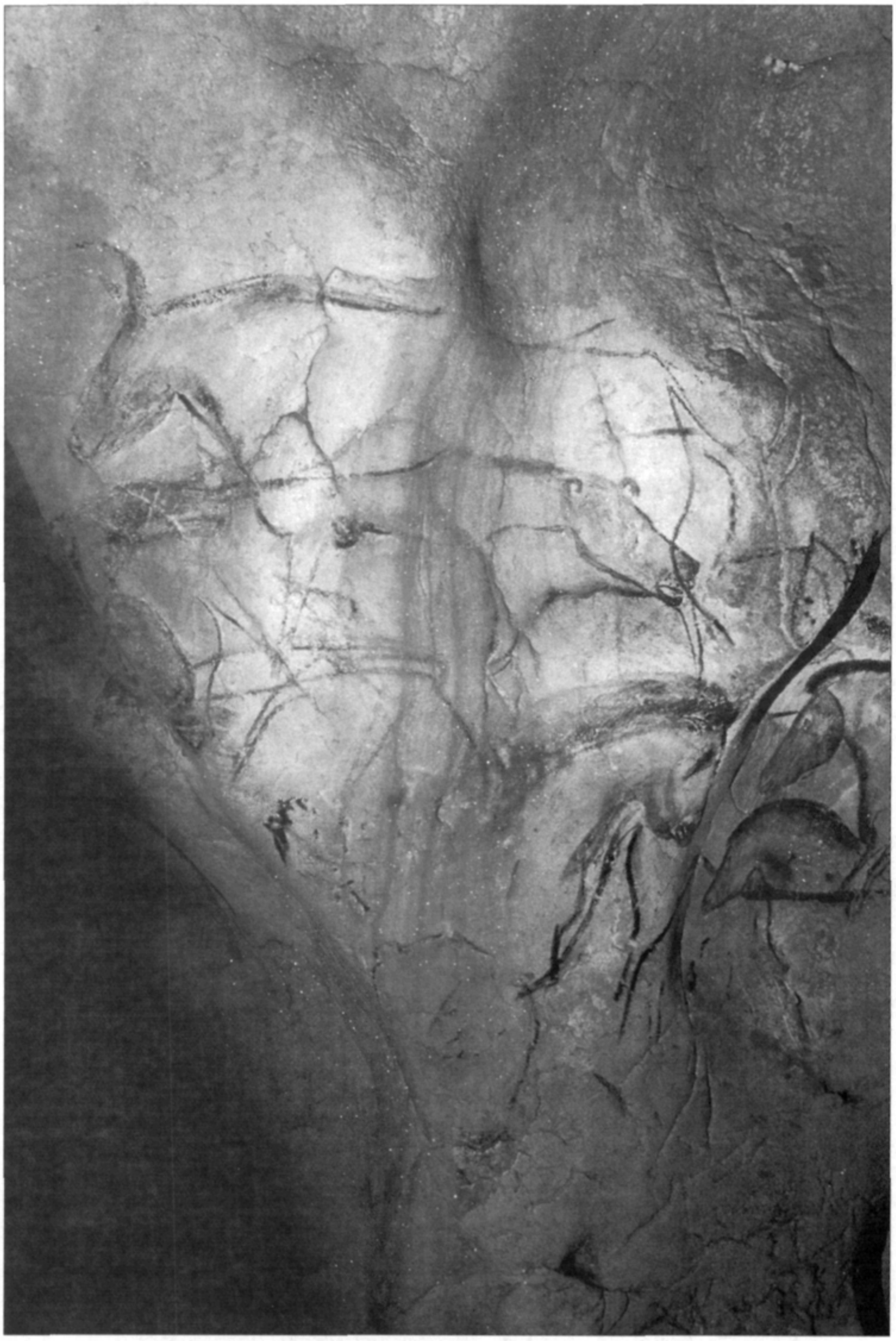

Fig. 4. Grotte Chauvet. On the very left of the panel, torch marks are superimposed on the calcite that covers the earlier paintings. They have been given a date of 26,120 ± 400 bp (Gif A 95127) (photo J. Clottes).

identical dates (26,980 ± 410 and 26,980 ± 420 bp; Clottes *et al.* 1995). It is a genuine parietal stratigraphy with a coherent sequence of dates that has thus been obtained. These observations eliminate one of Züchner's hypotheses: in order to explain the very early dates of the black animals of Chauvet, the artists could have used fossil wood, or picked up charcoal that was lying on the ground. It would have been necessary in that case that by exceptional coincidence the wood used for the torches was sufficiently old, but not too much so, to remain compatible with the observed parietal stratigraphy. Finally, the oldest dates of Chauvet tie in with the discoveries of portable art made in the Swabian Jura where ivory statuettes, found in aurignacian levels with similar dates, depict identical subjects to those of Grotte Chauvet: mammoth, felines, bisons, bear, horse, rhinoceros and composite beings. The dating of part of the parietal depiction of Chauvet, provisional as it may be until other ^{14}C dates have been obtained, does therefore not rest on a single date but on a series of dates and on a set of observations. That makes Chauvet one of the more certain sites on the chronological map. What about others?

In a recent work, M. Lorblanchet has drawn up the list of sites with "objectively dated Palaeolithic parietal art" (Lorblanchet 1995: 284). The period dealt with here (30,000-20,000 bp) covers the Aurignacian, the Gravettian and the very beginning of the Solutrean. For the Aurignacian, six sites are mentioned (the rock shelters of Blanchard, Castanet, Cellier, La Ferrassie and La Viña, and Grotte Chauvet); for the Perigordian these are Arcy-sur-Cure, Cosquer, Cougnac, Fuente del Salín, Gargas, Labattut, Laussel, Pair-non-Pair, La Viña, and Pech-Merle, that is to say ten sites; Cosquer, Cougnac, Le Fourneau du Diable, Le Placard, La Tête du Lion, and La Viña (six sites) represent the Solutrean sample. This list was established "using the most objective methods, that means mainly the integration of representations within a stratigraphic context, their relation to an archaeological level and for 27 parietal motifs age measurements directly on the pigments" (p. 279).

These criteria could be debated. Direct radiocarbon dates are no panaceas and should be placed into context, as we have just seen for Chauvet. As for the dates obtained on archaeological remains on the floor, there can be no question of extrapolating them to the painted walls of the caves (except in special cases, such as La Tête du Lion where the dated level contained drops of pigment). M. Lorblanchet knows this (p. 271) and yet he uses this criterion to classify certain ensembles amongst those that are 'dated objectively' (Arcy-sur-Cure, Fuente del Salín). In the case of Le Placard, he envisages the very theoretical possibility of "a decorated perigordian cave" (p. 268-9) of which the artists would not have left any traces. The same reasoning could be applied to many other sites where the parietal art is much less well dated than that of Le Placard, and it could be said with as much plausibility, for instance, that the art of the Grande Grotte of Arcy-sur-Cure or that of Pair-non-Pair could be Aurignacian. Whereas, "if as a rule the engravings of Pair-non-Pair are more often attributed to the Gravettian than to the Aurignacian then it is to the stylistic motifs that they owe this preference" (Delluc and Delluc 1991: 64). This shows how strong the influence of established ideas is, even on those that challenge them *a priori*.

Nevertheless, this list, imperfect as it may be, gives a base to which one can add several other caves and decorated rock shelters of which the attribution to the periods concerned is probable, either because of their archaeological context, or because of stylistic similarities with well-dated caves (cf. Delluc and Delluc 1991). For the Aurignacian these are El Conde, Les Bernous, Belcayre, La Croze-à-Gontran, Lartet, Le Poisson, La Souquette, and Brassempouy. That would therefore make 14 sites in total for the Aurignacian, twelve of which are in France and only two in Spain. For the Gravettian the list would come to 21 in total, of which two only are in Spain, with the addition of the following sites: Le Poisson, Jovelle, Roucadour, Pataud, Vignaud, Oreille d'Enfer, Laugerie-Haute, Le Facteur, La Cavaille, Fongal, and Les Trois-Frères (Galerie des Chouettes). As for the Solutrean, there would only be nine sites, two of which are in Spain, with amongst others Roc de Sers, Oullen, and Ambrosio. Taking into account that a certain number of these solutrean sites are undoubtedly younger than 20,000 years bp and that certain others have been mentioned under two different chronological headings, there would be in total about forty caves and decorated rock shelters that belong to the period with which we are concerned. Hereto added should most probably be caves for which we have not a single solid dating element, such as La Baume Latrone, La Grotte aux Points (Gard), maybe Mayenne-Sciences, and at least part of the surface art (Foz Côa).

We can see from the evidence that we are well behind what could have been expected, since these approximately 40 sites correspond to less than one seventh of the total ensemble of palaeolithic caves and decorated rock shelters, while the period concerned covers more than half the duration of the parietal art.

4. Development and specialisation of art

This shortage of information is due to one of the major unsolved problems, namely the dating and the duration of stylistic criteria which support convictions on the creation date of sites and on their use over time. I do not think that we have entered a "post-stylistic era", as has been predicted (Lorblanchet and Bahn 1993; Lorblanchet 1995: 282; see on this subject Clottes 1994). Strictly speaking, this would mean that 'style', that is the manner in which figures are represented, the details of their realisation, their techniques and even their themes, are hardly important. Nothing can support such a paradox. If the notion of a 'post-stylistic era' only applies to criteria of the chronological determination of figures, then the expression becomes more defensible but it still remains exaggerated. In fact, we will never manage to have enough radiocarbon dates and laboratory analyses to date *all* the parietal figures in a cave. At best, certain

Fig. 5. Grotte Chauvet. A large lion turned towards the right has deliberately been placed in a spatial perspective in relation to three earlier horses by interrupting the lines, to make him appear to be behind them (photo J. Clottes).

representations – as many as possible – will be dated but not the engravings nor the red figures, and only a small part of the black drawings: some of those made with charcoal that are sufficiently well preserved, but not those made with manganese dioxide (Lascaux or Rouffignac). These bases, always inadequate, having been reached, we will of necessity proceed as we have done since Breuil – even those against it – namely by stylistic comparison: if A, B, or C, which resemble each other because of the recurrence of the characteristics x, y or z, have been given dates between 20 and 23,000, it is assumed that D which shows the same traits x, y and z should roughly be attributed to the same period.

The difficulty is therefore to have fixed points in such numbers that the beginning and end of themes, conventions, and techniques can be determined. This means evaluating the relevance of the dates obtained and of the observations carried out, and to have a sufficient number of quasi-certainties to be in a position to extrapolate from them. At present we are a long way from such a situation.

Despite this fundamental reservation, a certain amount of knowledge appears almost assured. This concerns in the first place the mastery of techniques from the beginning of the Aurignacian. It is no longer possible, after the discoveries of these last few years, to envisage an archaic and crude Style I and a gradual development in the course of the ten or fifteen thousand years that followed. Right from the start the artists are capable of skilfully and accurately engraving, painting and sculpting the images of the animals that surround them. The Aurignacians of Grotte Chauvet have not only rendered the spatial perspective but they have done so by means of different techniques. In this we note a real meticulousness: the lion of the Panel of the Horses (Fig. 5) was deliberately placed in the background by stopping the line at the level of the animals that were drawn earlier (Chauvet *et al.* 1995, fig. 54), the horns of a group of rhinoceroses (Fig. 6) were sketched in a diminishing perspective from the horn in the foreground to those in the background (*op. cit.*, fig. 86); a bison was drawn on a dihedron, the face seen full face on

Fig. 6. Grotte Chauvet. The horns of the upper rhinoceroses that show the same conventions as the two dated rhinoceroses (cf. fig. 3), have been represented according to the laws of perspective (photo J. Clottes).

one level and the body seen in profile on another, at 90⁰, to accentuate the effect of the perspective (*op. cit.,* fig 88). The use of stump-drawing, in the same cave, is common. The animals are often represented in action, "animated" as A. Leroi-Gourhan called it, which contradicts his remarks on "the growing preoccupation with representing movement in the course of the development of Upper Palaeolithic art" (Leroi-Gourhan 1982: 42).

Fig. 7. In the Grotte Cosquer (Marseille, France) negative hands such as these are numerous (55). Some have been given very high dates: 27,740 ± 410 bp (Gif A 96073) for hand no. 19, 27,110 ± 390 bp (Gif A 92409) and 27,110 ± 350 bp for hand no. MR7 (photo National Navy).

These observations have very important implications. We can no longer consider that, during these ten thousand years, art slowly developed along a more or less constant linear scheme of progress. From that point of view, the parietal art of Chauvet corresponds with the portable art of the Swabian Jura and is closely akin to it: in certain periods very sophisticated art forms have come to light, but under which influences? Culturally? Individually? Have these major successes been further developed and continued? We have too few elements to say so. The fact remains that in the same periods and in other regions (Périgord, Pyrenees, Cantabria), we do not record the presence of such masterpieces. Undoubtedly we should believe, as Ucko and Rosenfeld have suggested from 1967 onwards (cf. also Ucko 1987) that there could have been many apogees and many declines, just as the coexistence, at the same time but in different places, of talented artists and less gifted practitioners. That relativises to a great extent the value accorded to the criteria that Leroi-Gourhan (1965), and subsequently the Dellucs (1991), have given for defining his Styles I and II. The image of a linear and progressive evolution of art in the course of these ten thousand years, with a slow acquisition of more and more complex techniques, is therefore substituted for the notion of a seesaw-like evolution.

Amongst the specifics of the period, the finger tracings have to be mentioned, as they are certainly more numerous and widespread at that time, even in the major caves (Cosquer, Chauvet, Gargas, Trois-Frères) than later (Tuc d'Audoubert). Negative hands, or positive ones, are attributable to the Gravettian (Fuente del Salín, Cosquer (Fig. 7), Gargas, Labattut) and it is possible that they go back to the Aurignacian (Grotte Chauvet, where they are closely associated with red figures that show the same characteristics as the dated black drawings; cf. Chauvet *et al.* 1995, fig. 25).

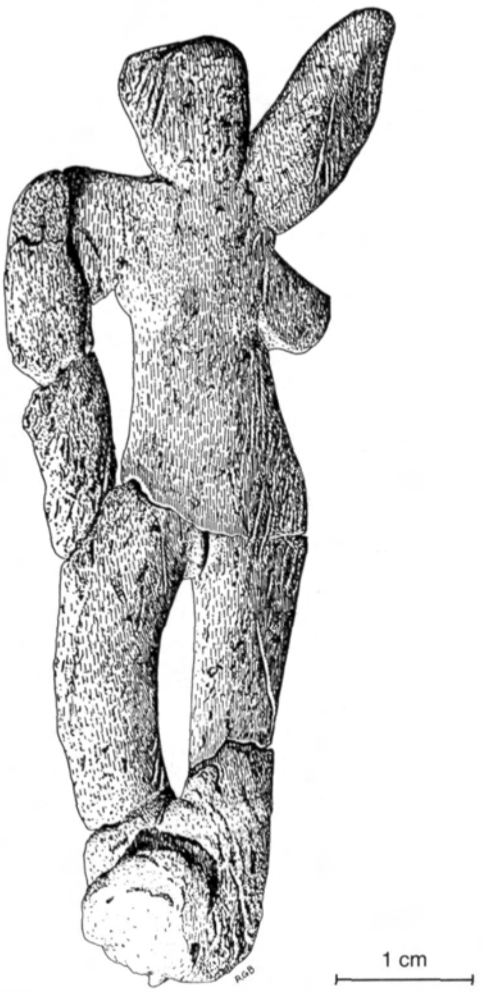

Fig. 8. Female sculpture (serpentine) from Galgenberg (Austria), dated to more than 31,000 bp (after Bednarik 1994b, fig. 2, p. 79).

In portable art, two series of typical objects have been known for a long time. Their diffusion is very specific. The gravettian-pavlovian-kostenkian female statuettes cover the whole of Europe and are found as far away as Siberia. But they were apparently not made south of the Pyrenees, which is very surprising. The pseudo-statuette reported from Setubal (Portugal) (Farinha dos Santos 1980-81) is a *lusus naturae* without the slightest human intervention. Since the discovery of the 'Venus' of Galgenberg (Fig. 8) it is known that this theme goes back to the Aurignacian. On the other hand, the recent discoveries in Canada, of a series of 7 figurines from the excavations by Jullien at Grimaldi (Bisson and Bolduc 1994) should not be questioned: their careful examination shows that we are really dealing with authentic palaeolithic statuettes, in spite of certain ill-founded doubts (Bahn 1995: 204). They are very probably attributable to the Gravettian, like their colleagues (Bolduc *et al.* 1996). In Central and Eastern Europe quite a small statuary, prior to 20,000, has been known for a long time (Kozlowski 1992).

The engraved *plaquettes* of El Parpalló, in Spain, have received much less attention. However, it is the only known case where a very important portable art on *plaquette* has survived locally for about ten thousand years, from the Gravettian up to and including the late Magdalenian. According to the dates obtained in southeastern Spain, the period concerned, besides the non-represented Aurignacian in El Parpalló, covered the Gravettian and the lower and early middle Solutrean. Decorated *plaquettes* are rare in the Gravettian of El Parpalló (7, with 13 decorated sides) and they become much more numerous in the Solutrean (lower: 154, with 193 sides; early middle: 326, with 402 sides) (Villaverde Bonilla 1994b: 146). It is therefore impossible to determine a development. It should be noted, however, that, according to the author who has made a very detailed analysis trying – often not without difficulties – to apply the criteria and principles of Leroi-Gourhan, the perspective and the shading for the interior of the bodies of the animals were already mastered (Villaverde Bonilla 1994a, 1994b).

Whether we are dealing with the aurignacian statuettes from the Swabian Jura, the absence of 'Venuses' in Spain and Portugal, the long tradition of engraved and painted *plaquettes* in El Parpalló, or even the pavlovian and kostenkian statuary, the counterpart of which is not found in Western Europe, a specialisation according to region and cultural group is noticeable prior to 20,000 bp. Certain techniques and subjects seem specific for particular regions at such or such times. What about the themes?

5. Animal themes and their development

According to Leroi-Gourhan, the figurative themes hardly change from the Aurignacian to the Magdalenian: "The themes of period I (…) are the same which dominate the entire Palaeolithic art" (1965: 148). Since those distant beginnings, we are, according to him, dealing with "a system of symbolic representation of the living world that persists with minor variations for the whole duration of Palaeolithic art" (p. 147). Leroi-Gourhan has lain great emphasis on the survival of the same content from beginning to end, to conclude that "the ideological unity therefore deprives parietal art of the reference points that would be provided by the changes in the fundamental figurative theme. Only the variations in the representation of this uniform content remain perceptible through stylistic study" (p. 137). As for the Dellucs, they compiled (Delluc and Delluc 1991: 328) an

Fig. 9. Grotte Chauvet. The representations of bears and other *a priori* non-hunted animals are numerous in this cave. Here a large red bear from a side gallery near the entrance (photo J. Clottes).

interesting enumeration of parietal animals to which we will return, and they note that rhinoceros and bear are only represented in the Aurignacian (p. 334) while the cervids are lacking, and that, as has been pointed out many times, the vulvas are then numerous (p. 347). However, they do not draw any conclusions from this enumeration which would be at odds with the theories developed by Leroi-Gourhan.

On the other hand, J. Hahn has stressed the originality of the themes of the German statuettes, which is no less great than the sophistication of their techniques. This originality was such that he even envisaged an aurignacian cultural isolation in southern Germany (Hahn, in Albrecht *et al.* 1989: 35). He remarked that the represented species were the largest, the most powerful and the most dangerous, an idea reinforced by the threatening posture of some animals and by their sexual characterisation as males: "According to the choice of animals, force and strength seem to be the components that they were trying to express" (Hahn 1986: 222). He also mentions the influence of the seasons of occupation and the functions of the sites on this choice (Hahn 1990: 181), as well as that of the environment on the greater or lesser abundance of mammoths, which are more numerous in the Pleniglacial than at the end of the Pleistocene (*op. cit.* p. 182; cf. also de Sonneville-Bordes, in Hahn 1990: 183); the intensive hunting of mammoths and rhinoceroses could have been the determining criterion for these choices (Hahn, in Albrecht *et al.* 1989: 35). However, he specifies that this remark could not apply to lions and bears and that these last ones by their presence exclude the hypothesis of hunting magic (Hahn 1986: 221).

J. Kozlowski also insists on the fact that these statuettes represent animals that were difficult to hunt, but he draws opposite conclusions from it as, according to him, they seem "as the expression of a magic destined to appropriate the qualities of the animals and, perhaps, to ensure the success of the hunt. (This art) does in no way correspond with a complex and structured religious system" (1992: 40). The beginnings of this religious thought in Western Europe were only

Fig. 10. Grotte Chauvet. Engraving of a vulva, a very frequent motif in aurignacian parietal art (photo J. Clottes).

perceptible through "the rather crude representations" (p. 42) in the Dordogne, whereas the aurignacian magic tradition would be carried on through gravettian zoomorphological statuettes in Central and Eastern Europe: "In fact, in Dolní Věstonice, for instance, the animals most frequently depicted are felines and bears, thus animals difficult to hunt, the ones that probably most impressed gravettian man" (Kozlowski 1992: 68). Despite this convergence, he thinks that the gravettian works of art, whether pavlovian or kostenkian, contrary to aurignacian ones, could be interpreted within the framework of a coherent religious system because of the more complex symbolic behaviour to which they testify (p. 66).

A first inventory of the animals represented in Grotte Chauvet has shown that species that were not hunted clearly dominate here (Clottes 1995, 1996a; Clottes *et al.* 1999). Of the 313 animal representations found, rhinoceros (Fig. 6) (61, that is 19%), mammoth (64, that is 20%), and lion (61, that is 19%) (Fig. 5) are by far the most numerous. The most common animals in the Franco-Cantabrian caves, horses, bovids, cervids and caprids, represent in all 115 units, i.e. 36% of the identifiable animals in Grotte Chauvet, whereas the dangerous and generally rarer animals in parietal and portable art, rhinoceros, felines, mammoths and bears (11, that is 4%) (Fig. 9) number 197, almost twice as much (62%).

This inversion of themes in relation to what we know from elsewhere poses a problem. Even if lions, rhinoceroses and mammoths were more abundant in the aurignacian fauna than they would be a few thousand years later, which remains to be proven, it has long been accepted that the animals represented were not necessarily representative of the biotope of the artists. Nor did they copy it closely, otherwise we would have to picture the Dordogne around Rouffignac covered with mammoths during the Magdalenian.

In the Périgord the rock art sites considered as archaeologically dated to the Aurignacian are not very numerous, as we have seen. The inventory of animals gives 6 ibexes, 3 horses, 2 bovids, 2 mammoths, 2 rhinoceroses, 2 bears, and 6 indeterminates (Delluc and Delluc 1991: 328). The total number (23) is not very high and any percentage can only be indicative with such a small total. Nevertheless, we can see that dangerous animals constitute an abnormally high proportion (26%, or 32% of the identifiable animals), especially if we compare it with the detailed account that the same authors give for the gravettian parietal animals: 9 ibexes, 9 cervids, 7 horses, 4 mammoths, 3 bovids, 1 megaceros, 1 salmon, and 10 indeterminates (*op. cit.*). The dangerous animals of the Gravettian therefore do not constitute more than 9% of the ensemble and slightly more than 11% of the determinable animals, which means that they are nearly three times less numerous than in the preceding period. They remain, nevertheless, at a higher frequency than later in the Solutrean and Magdalenian, when rhinoceroses, bears, and lions will be considered as rare animals, just as the mammoth will be in entire regions (Pyrenees, Cantabria).

The preferred themes of Grotte Chauvet thus find a definite echo in southwestern France during the Aurignacian. These parallels are further accentuated by the presence of three engraved and two painted vulvas in Chauvet (Fig. 10) which recall this theme, so abundant in the Aurignacian of the Dordogne.

A certain number of other undated caves show resemblances with Chauvet. Thus, the Grande Grotte of Arcy-sur-Cure, apart from 8 negative hands and a positive one, has several points in common with the cavern in the Ardèche, with the presence of rhinoceros (1, and 1 possible but not certain), feline (1), bear (4), and mammoth (27). Other species are: 6 cervids, 1 ibex, 2 bovids, 1 horse, 1 bird, and 9 indeterminates (Baffier and Girard 1995). Also in this case, the number of animals is slightly too low to have reliable percentages, except for information only. However, it is not uninteresting to note that the dangerous animals that made the researchers qualify this bestiary as 'original' represent more than 62% of the total number and 75% of the identifiable animals.

Amongst the other undated caves, the strangest by its style is La Baume Latrone (Gard), which was intuitively attributed to the Gravettian by H. Breuil, by A. Leroi-Gourhan, and next by Dr Drouot, who studied it. The list of represented species, according to this last author, consists of: 10 mammoths, 2 ibexes, 2 cervids, 1 horse, 1 bovid, 1 bear, 1 feline, and 1 rhinoceros (Drouot 1984b). All the dangerous animals of the Grotte Chauvet are here. They account for more than 56% of the ensemble and for more than 68% of the determinable subjects. In addition to these convergences there is the presence of finger tracings and of 5 positive hands in clay.

The same remarks apply to the Grotte Bayol, also in the Gard, where there are 3 ibexes, 1 mammoth, 1 bear, 1 feline, 1 cervid, and 1 horse, and 6 positive hands (Drouot 1984a). Positive hands are extremely rare in palaeolithic art. Their presence, in Bayol, as in La Baume Latrone and in Chauvet, is the more remarkable. This does not mean, of course, that we should automatically consider Bayol or La Baume Latrone as Aurignacian, as we never know for how long a certain theme could have persisted. Drouot has attributed certain figures of Bayol to the Solutrean by comparison with Oullins, but he reckons that the representations of hands and several other figures could be notably older (Drouot 1984a: 326).

These observations show that in the Aurignacian, in southeastern France and Germany and to a lesser degree in the Dordogne, the theme of non-hunted animals, the most fearsome or impressive ones, dominated in both parietal and portable art. These themes are also present in undated caves whether they be Aurignacian or of a later date, if they have persisted here and there.

In the French caves, the decorated ensembles attributed to the Gravettian, on the other hand, show a strong preponderance of hunted animals, with the horse very widely dominant. The animals itemised in Gargas (Barrière 1976) are 148, a respectable number that allows statistical comparison. In fact, this bestiary has neither feline, nor rhinoceros or bear, and the mammoths only amount to 4% here, whereas the rest of the fauna is more consistent with the usual scheme, with 36.5% bovids (bisons and aurochsen), 29% horses, 10% ibexes, 6% cervids, 8% indeterminates, apart from 2 birds and 1 wild boar. The thematic preferences of the Gravettians of Gargas therefore differed radically from those of their immediate predecessors.

The same applies to the Galerie des Chouettes of the Tréfonds des Trois-Frères whose stylistic and technical similarities with Gargas allow it to be definitely attributed to the Gravettian. Using the tracings made in this gallery by the Abbé Breuil (Bégouën and Breuil 1958), D. Vialou (1986: 124) has counted 2 birds (owls), 5 engraved bisons, 8 bovids, 8 horses, and 39 indeterminates.

It seems therefore that a thematic change has taken place in the French Midi from the beginning of the Gravettian (Gargas, Le Tréfonds des Trois-Frères, perhaps Cosquer) or at the end of the Aurignacian. It is not impossible that there could be chronological discrepancies, particularly in eastern France (La Grande Grotte) and that in some regions they have continued to use the same themes longer than in others. That could explain the multiplicity of mammoth representations in certain caves in more recent periods (Pech-Merle, Cougnac).

Persistencies such as these have been demonstrated in Central and Eastern Europe judging by the abundant portable art in those regions. In the Pavlovian and Kostenkian, corresponding *grosso modo* to the Gravettian, the percentages of dangerous animals are more or less the same and continue the aurignacian tradition. Among the 67 animal statuettes in the Pavlovian recorded a few years ago, there were 21 bears, 11 small carnivores, 9 felines, 8 mammoths, 6 birds, 6 horses, 4 rhinoceroses, 1 caprid and 1 cervid. Even without counting the small carnivores, the total of the dangerous animals comes to 42 (62.6%). For the kostenkian statuettes the respective proportions of these animals vary but their total remains constant, since 36 mammoths have been counted, 11 birds, 8 rhinoceroses, 6 felines, 5 bears, 3 horses, 2 bisons, 1 caprid, 1 cervid, 1 small carnivore, 1 other and 16 indeterminates (Hahn 1990: 178). For these 91 representations the overall percentage of the 55 dangerous animals reaches 60.4%; it goes up to 73% if only identifiable animals are considered. On the other hand, the difference with the Magdalenian of the same regions is striking, where animal sculpture is not less abundant than previously but with a spectacular inversion of themes. In fact, 139 animal statuettes have been recorded (Hahn 1990: 178) of which 56 horses, 44 bisons, 9 bears, 2 felines, 2 birds, 1 mammoth, 1 caprid, 1 cervid, 5 miscellaneous species and 18 indeterminates. One notes the absence of rhinoceros and the small number of other dangerous species: 12 in total, thus barely 8.6% of the ensemble and 10% of the determinable animals.

For reasons that we can only assume, perhaps partly linked to the nature of the biotope, we therefore notice a drastic change in the represented themes, that is to say in the beliefs and cultural practices of the cultures concerned (Clottes 1995, 1996a). This change occurred rather early, at the end of the Aurignacian or the beginning of the Gravettian, in Western Europe, much later in Eastern Europe. These observations run counter to Leroi-Gourhan's theories on the unicity of themes from the beginning to the end of the Upper Palaeolithic.

6. Conclusions

To conclude this brief overview, we would like to mention once more the noteworthy facts of this long period prior to 20,000 bp, as they appear to us after the shake-ups of the last years.

Still very few certain elements are at our disposal. In particular, the chronological attributions of numerous parietal sites must be clarified and surprises are possible and even probable. However, we now know that from the Aurignacian onwards the people mastered all artistic techniques, in all their aspects, and that occasionally they could show the most sophisticated qualities in the rendering of forms and postures of animals. Other discoveries, in the future, will surely confirm this observation. From now on it changes our notions of the appearance and especially the development of art. We do not know exactly what will be the duration of the conventions and what those are that could prove to be decisive for characterizing undated sites. In this respect, the situation is somewhat comparable to the one the prehistoric specialists of industries went through when they abandoned the concept of the type fossil.

As for the themes, certain classic ones have been confirmed: the representations of vulvas are always abundant in the Aurignacian, and the 'Venuses' in the Gravettian, but for the latter now with an ancestor in the Aurignacian (Galgenberg). The theme of the composite figure, half human/half animal, known above all from the middle Magdalenian (Trois-Frères) and perhaps from the early Magdalenian (Gabillou), as well as from the Gravettian and the Solutrean (Cougnac, Pech-Merle), is now recognised in both the portable aurignacian art (Hohlenstein-Stadel) and the parietal one (Chauvet). The belief in therianthropic beings, demonstrated worldwide in every period, forms without doubt part of the universals of the human mind. If, as one could think, a large part of the works of Chauvet belongs to the same period, then the beginning of the negative hands could moreover be older by several thousand years. This original aurignacian art, certain aspects of which are similar in portable and in parietal art, has known different continuations in different places. It seems to have lasted during the entire Gravettian in Eastern Europe, while in southwestern France the animals commonly hunted took over from the dangerous animals and became generally the majority from the beginning of the Gravettian.

Finally, contrary to what Leroi-Gourhan thought, the oldest art is not only an exterior art, present in rock shelters with daylight. The discoveries of Chauvet, Cosquer, and La Grande Grotte of Arcy-sur-Cure show this well. A recent inventory of the decorated caves and rock shelters in France has shown that in the 'early' periods, that is the Aurignacian and the Gravettian, rock shelters exposed to daylight and deep caves were used concurrently, in comparable proportions (Clottes 1997).

All these observations confirm the sense of unity in palaeolithic art. We can no longer speak of 'archaic' art or of the 'primitive period' for the period prior to 20,000 bp. Distinctions exist, certainly, but they are more due to local particularities – for which we should attempt to elucidate the reasons and methods – than to a development with the passing of thousands of years, and even less to a progress in techniques and concepts.

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Jean Clottes
11, rue du Fourcat
09000 Foix
France

Margherita Mussi
Jacques Cinq-Mars
Pierre Bolduc

8 Echoes from the mammoth steppe: the case of the Balzi Rossi

The 15 Balzi Rossi figurines were discovered in the late 19th century at the Barma Grande and Grotte du Prince, two closely associated cave sites located on the Italian Riviera. About half of them have long been on display in archaeological museums, while the others have remained hidden from the archaeological community. These have only recently resurfaced in Canada where L.A. Jullien, who had originally found the statuettes, had emigrated before the turn of the century. It is by far the largest collection of this type from Western Europe. A systematic analysis of the 15 specimens allows us to make comparisons on a much wider scale than before, and to make what we think is some progress toward the elucidation of their function in palaeolithic societies. We find close technological and typological similarities with statuettes discovered in often distant parts of Europe and even Siberia. We also note changes and adaptations, in space and most probably in time, which are evidence of a dynamic set of relationships that are rarely displayed in an archaeological record unfortunately characterised more by gaps than by solid evidence. Furthermore, some of the Balzi Rossi evidence can be used to suggest that a sophisticated set of beliefs existed in Mid Upper Palaeolithic Europe, which included the notion that certain individuals (notably women) had the ability or the power to shift from ordinary to a less or non-ordinary level of existence. These as well as other strong ideological ties probably contributed to the successful colonisation of the immense Eurasian mammoth steppe during the MUP.

1. Introduction

The Balzi Rossi or Grimaldi caves are a string of natural cavities located at the base of a cliff that faces the Mediterranean shore, at the frontier between Italy and France (Fig. 1). In the late 19th century, quarrying activities, the construction of a railway connecting the two countries, as well as amateur and, later, scientific excavations led to the

Fig. 1. The Balzi Rossi (after Rivière 1887).

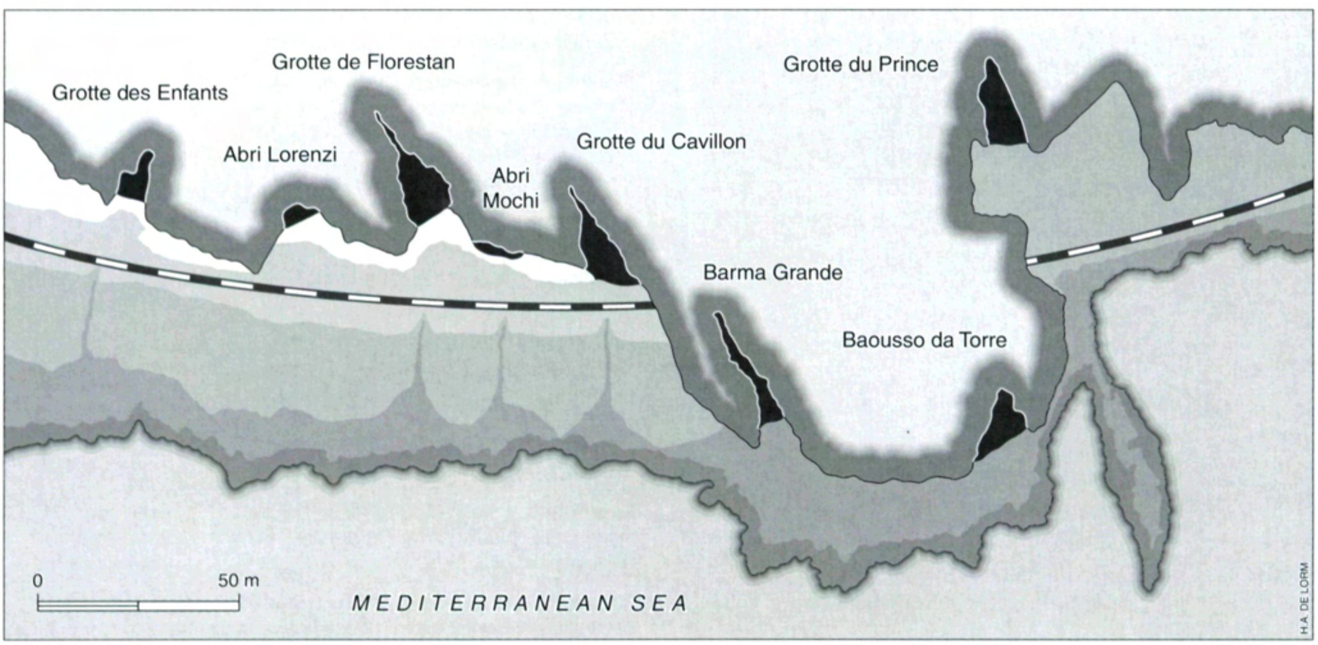


Fig. 2. The 15 Balzi Rossi figurines – a synoptic presentation.

THE DOUBLET OR 'THE BEAUTY AND THE BEAST'

Steatite. - Yellowish green (translucent). - 47x23x10 mm. - 11.4 g. - Complete. - Canada.

A non-human being with a triangular head and clepsydra-shaped body, back-to-back with a well-proportioned woman; they are joined at the head, shoulders, and lower extremities.

THE BICEPHALOUS

Steatite. - Yellowish green (translucent). - 27.5x12x18 mm. - 1.9 g. - Complete. Canada.

A woman with protruding abdomen and buttocks; a second, triangular, non-human head looking backward is connected to the first one by a bridge-shaped element resulting from a transverse perforation.

THE JANUS

Steatite. - Dark green. - 61.5x21x11 mm. - 16.9 g.- Incomplete: left side broken. - U.S.A.

Flattish figurine with a woman carved on each face; a perforation is located between the chin and the breasts.

THE HERMAPHRODITE

Steatite. - Dusky yellowish green. - 51x17x11 mm. - 11 g. - Incomplete: missing the head and the lower extremities. - France.

Flattish female figurine exhibiting a second head located between the thighs.

THE NUN

Chlorite. - Dusky green/dusky blue green. - 44x28x8.5 mm. - 14 g. - Incomplete: missing distal end. - Canada.

Two female representations located on opposite faces of a flat, ovoid pebble; one detailed, the other one barely suggested; a perforation is located just below the head.

THE GOITERED LADY

Antler. - Light reddish-brown/reddish brown. - 45x14x8 mm. - 3.6 g.- Incomplete: missing face, left breast, right hip, and lower limbs. - France.

Flattish female figurine with reversed pyriform breasts and abdomen; round appendage below the chin; the buttocks area also exhibits a second pubic triangle.

THE OCHRED LADY

Ivory. - Very dusky red/dark reddish brown. - 75x18x22 mm. - 20 g.- Incomplete: missing lower extremities; ivory surface extensively deteriorated. - Canada.

Female figurine characterized by a prominent coiffure and well-developed buttocks; a hole drilled between the breasts opens up in the back in a funnel-shaped fashion.

THE ABRACHIAL

Ivory. - Red/yellowish red. - 68x20x23 mm. - 19.4 g. - Incomplete: missing lower extremities.- Canada.

Woman with a faceless cylindrical head and prominent abdomen and buttocks; remnants of a possible perforation at the distal end.

THE LOZENGE

Steatite. - Dusky green. - 62x24x17 mm. - 17.5 g. - Incomplete: missing distal end. - France.

Wide-bodied female figurine characterized by pointed head and lower limbs, and exhibiting prominent abdomen and buttocks

THE PUNCHINELLO

Steatite. - Dusky yellowish green. - 61x11x20 mm. - 8.9 g. - Complete. - France.

Narrow-bodied female figurine characterized by pointed head and lower limbs, and exhibiting prominent abdomen and buttocks.

THE YELLOW VENUS

Steatite. - Dark yellowish brown. - 48x21x13 mm. - 15.4 g. - Incomplete: missing lower extremities. - France.

Heavy-set woman with prominent pendulous breasts; also exhibiting a pointed face and a nuchal appendage.

THE INNOMINATE

Steatite. - Greenish black. - 38x12x14 mm. - 7.7 g. - Incomplete: missing the frontal part of the abdomen as well as lower extremities. - France.

Woman with protruding breasts and buttocks; rounded head with faint facial features.

THE BUST

Chlorite. - Dusky green/dusky blue green. - 29x17x9 mm. - 8.1 g. - Incomplete: missing lower part of the body below the breasts. - Canada.

Flattish bust of a woman showing a clear delineation of the face and possible remnants of a perforation on the broken distal edge.

THE NEGROID HEAD

Steatite. - Dusky green. - 25x14x24 mm. - 12.9 g. - Incomplete: missing portions in the cranial area. - France.

Head showing checkered, engraved patterns; protruding flat face below a sloping forehead; facial area marked with eyes and mouth.

THE MASK

Steatite. - Yellowish red/yellowish green. - 19x23x5 mm. - 2.8 g. - Complete. - Canada.

Two non-human faces, one more detailed than the other, made by incisions and drilled holes on both sides of a flat, disk-shaped support.

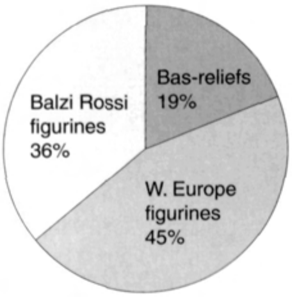


Fig. 3
MUP female imagery
(tot. = 42)

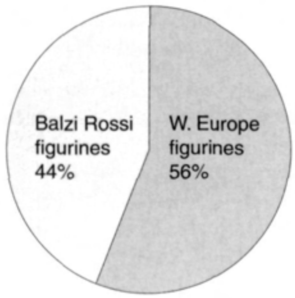


Fig. 4
MUP figurines
(tot. = 34)

near total eradication of what were undoubtedly very rich archaeological deposits. As one of the major palaeolithic locales of Western Europe, it notably included Mid Upper Palaeolithic (MUP) layers in a minimum of six caves and shelters. These yielded vast amounts of lithic artefacts and faunal remains, as well as several burials, and figurines commonly known as 'Venuses'. We shall describe here remains from Barma Grande and the Grotte du Prince. While the Barma Grande was intensely settled during the MUP, the Grotte du Prince was a secluded cave, by then almost completely filled with Middle Palaeolithic deposits. It seems to have been only occasionally used around the Last Glacial Maximum, and certainly not on a regular basis (Mussi *et al.* in press).

The Balzi Rossi figurines, totalling 15 (Fig. 2), were all discovered by a French amateur, Louis Alexandre Jullien, between 1883 and 1895 (Bolduc *et al.* 1996), in the course of scientifically uncontrolled excavations. Two or more were first found in the Barma Grande, and the other ones were later discovered in the Grotte du Prince. Part of the collection was sold by Jullien before the end of the century, and seven statuettes eventually ended up at the Musée des Antiquités Nationales of Saint-Germain-en-Laye, near Paris (France). For reasons that we shall never fully understand, the eight others were kept by Jullien, ending up in Canada when he emigrated to that country. After Jullien's death, one of his daughters sold a single figurine to the Peabody Museum at Cambridge (USA) in 1944 (Marshack 1986). The seven others, which were kept by the last descendants of Jullien, only resurfaced recently in Montreal (Canada). Thus, for the first time, it has become possible to undertake a general assessment of this rather unique collection, the largest in Western Europe, i.e. the part of Europe west of the Rhine-Adriatic divide.

According to Delporte's inventory (1993), this region has so far yielded 14 localities containing such sculptures, dating to the MUP. Whether or not one includes the bas-relief form of representation, one ends up with the Balzi Rossi having yielded more than one third (Fig. 3), or nearly half (Fig. 4) of the total sample. If one takes into account, however, the fact that several specimens are 'doubles' (see below), it becomes evident that the actual contribution of the Balzi Rossi series to the overall Western European sample is far more important than previously known, and this not only in terms of size but also significance. In this regard and as will be shown below, the 'reunited' collection demonstrates very clearly that the 'classic' (i.e., Saint-Germain-en-Laye) Balzi Rossi contingent of figurines, which played a major role in the construction and formulation of stereotyped models of female palaeolithic imagery, was a highly skewed and non-representative sample.

2. Method of analysis and overall description of the figurines

Our analysis begins with a methodical and systematic description of every statuette, currently taking into account more than 50 entries for each specimen. These range from measurements to raw material, from technical aspects of carving to the typology of every part of the body, from state of preservation to the evidence suggestive of use. We also stress the need for detailed and accurate anatomic descriptions. In our opinion, such an approach, involving careful and systematic examination and recording of all and every aspects of palaeolithic works of art, is the only scientifically valid means of avoiding the facile and unwarranted speculations that frequently mar the literature (see, for instance, White 1997, and his so-called 'interpretation' of female imagery). Thoughtful and systematic approaches, even if based on assumptions different from ours, have been presented elsewhere: for example, by M. Gvozdover (1989) for female figurines, and recently by Iakovleva and Pinçon (1997) for zoomorphic parietal art. There is no doubt in our mind that such attempts will lead to the development of the kinds of comprehensive databases that should, eventually, provide us with the means to arrive at a fuller appreciation of what is subsumed under the palaeolithic art label. In the meantime, and as a first step in the right, more objective direction, this process will allow for the cross-checking of observations.

A summary description of the collection is presented in figure 2. In our conventional list, we start with the double figurines, from the more explicit to the less explicit, and we end with the heads and masks. They have already been described in some detail, and well illustrated in pictures and drawings (Bolduc *et al.* 1996; Mussi *et al.* in press). A comprehensive study will be presented elsewhere when the analysis is completed and the data are fully processed. In the next few pages, we shall focus on some aspects of our

Fig. 5, perforations

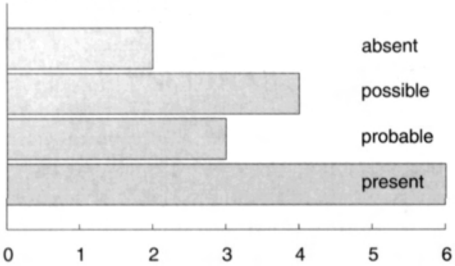


Fig. 6, fractures

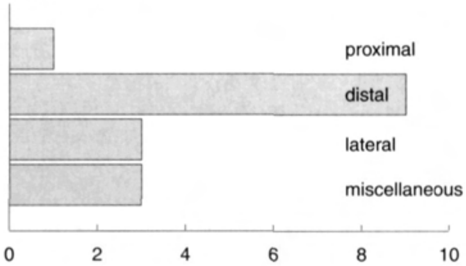


Fig. 7, resting position

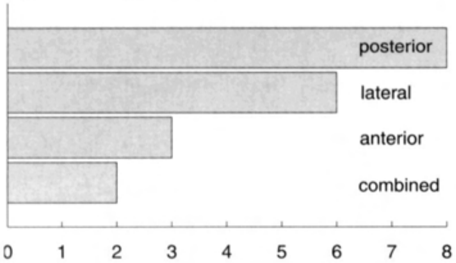
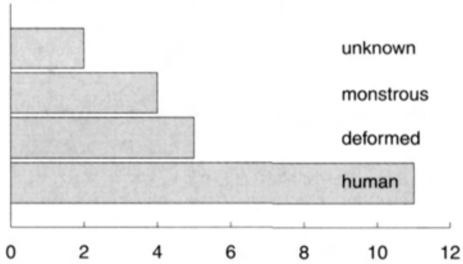


Fig. 8, shapes of head



analysis which, in our opinion, are relevant to both a better definition of the Balzi Rossi specimens, and an understanding of their place in the larger Eurasian context.

3. Pendants

The Balzi Rossi collection consists of a number of complete or nearly complete figurines, some of which are in pristine condition. We have already discussed elsewhere their state of preservation and, in our opinion, this strongly suggests that they were originally deposited in contexts that were conducive to preservation (Mussi *et al.* in press). Due to this excellent state of preservation, perforations are well documented. Clearly identifiable in six instances, they are also considered to occur in three additional cases (the Bust, the Abrachial, and the Lozenge) where various segments of perforations can be identified on broken edges (Fig. 5). In fact, there is ground to believe that accidental fractures are more likely to have occurred just where perforations were being made or had been completed. This conclusion is supported by the analytical study of fractures (Fig. 6). Even if pooled together, the distal fractures outnumber all the others. This shows that the distal parts of the Balzi Rossi figurines seem to have been much more fragile than the proximal ends and the heads. If we consider the 'elongated' statuettes (i.e., excluding the Negroid Head and the Mask), it is quite clear that, on the incomplete specimens, it is the distal end that is inevitably fractured. In our view, this pattern is best explained by the presence of a perforation at this broken end. There are only two exceptions to this pattern: the Punchinello which was clearly not perforated, and the Negroid Head whose particular configuration precludes any kind of statement in this regard.

The finding that most or all the statuettes were intended to be pinned, suspended or otherwise fixed, is in good accord with the general survey of both anthropomorphic and zoomorphic figurines made by J. Hahn (1990). According to him, the statuettes less than 100 mm in length, and less than 30 mm in width – the so-called 'small statuettes' – are better interpreted as pendants. The Balzi Rossi ones all fall within the limits proposed by Hahn (actually in the lower range of this class).

Drilled or otherwise perforated figurines are well known in Eurasia. The best examples are probably those from Mal'ta, with holes or slots at the distal end. At least a few of the statuettes discovered at Kostenki and Avdeevo also exhibit elongated holes or slots between the legs, (i.e., between knees and feet), which could possibly have had a functional purpose. In Western Europe, a hole between the conjoining feet has also been detected on the Sireuil specimen.

That the Balzi Rossi figurines are likely to have been worn and, perhaps, displayed in some fashion is suggested by more than just their size and the aforementioned perforations. A distinct polish that we interpret as use-wear can be seen notably around the hole between the two heads of the Doublet, and between the two heads of the Bicephalous. In addition, the latter specimen exhibits a similar polish on the thighs, below the buttocks, and on the side. It appears to have been tightly fixed or secured onto some kind of support. This is also shown by various facets (indicative of a prolonged contact with a smooth and somewhat rigid surface) that can be detected on one or more faces of each figurine and allow a stable resting position (Fig. 7). These various attributes suggest that the Bicephalous (as well as, perhaps, a few other figurines) were not necessarily pendants (*sensu stricto*) or elements of a string or necklace. This should come as no surprise since, as shown by the ethnographic record, there have been through time countless systems devised by human populations for securing small but rigid objects for public display or for private and more secretive uses.

4. Double beings, monsters and palaeo-morphing

The Balzi Rossi collection is also characterised by a number of double representations which, in addition, exhibit at least three basic types of relationships. There are those corresponding to actual 'couples', such as with the Doublet (two well-delineated bodies) or the Bicephalous (one body, but two well-delineated heads); others corresponding to figures found on the opposite faces of the same specimen, such as in the Janus and the Mask (complete) and the Nun and the Goitered Lady (incomplete); and yet others created by a distal/proximal opposition of figures (playing-card type of representation) found on the same face of a statuette (such as with the Hermaphrodite). By taking this dual or double composition into consideration it can be shown that the 15 Balzi Rossi statuettes represent 22 beings.

Also worth noting is that on these doubles, the representations are not simply mirror-like. What can be observed, instead, are shifts from one type of rendition to another. These can be very subtle, i.e., a slight variation of the same theme, such as with the Nun. Others are more obvious, such as with the Doublet and the Bicephalous (Fig. 9) on which different beings are clearly represented. There is, however, on all of them, a definite level of representational correspondence, even if expressed by different means: the two bodies of the Hermaphrodite are symmetrically opposed on each side of the round abdomen, which is common to both; the two faces of the Janus, the Mask, the Nun, the Goitered Lady, all correspond to beings which are of the same size, are positioned in the same direction, and exhibit the same general shape to suggest anatomical details, including the head. The equivalencies between the two arched bodies of the Doublet are less obvious, if only because they are nearly completely separated from each other (Fig. 9). However, the general symmetry of the object, the common position and orientation, the equivalent size of the gross anatomical parts, the deformed aspect of the woman's head when seen in profile, and then the three connections at the head, shoulders and lower end, all underline a subtle link between the opposed bodies. This is also true for the minute Bicephalous on which the proportions and orientations of both (human and non-human) heads provide a sense of balance and symmetry to what is clearly a complex representation.

Such double figures are not peculiar to the Balzi Rossi, and have been recognised elsewhere in Europe. For example, they have been found at Laussel, Lespugue, Savignano, Gagarino (Tarassov 1971; Coppens 1989; Mussi 1995, 1996), and at Mauern where the 'Venus' can be seen as both a feminine and a masculine representation (Zotz 1955; Mussi 1997).

In our view, most of these objects can be interpreted as indicative of attempts on the part of the MUP artists to illustrate much more than just different types of beings or entities but, perhaps more importantly, the complex set of relationships that these beings (human as well as non-human) had with one another and with the world(s) they lived in. Contrary to the simplistic, opportunistic and "accommodative arguments" (*sensu* Binford, *passim*) and explanations that tend to see these figurines as 'jokes', representations of sexual intercourse, women giving birth, hermaphrodites, or incompletely severed statuettes abandoned in the course of manufacture (see Delporte 1993 for a catalogue of such 'interpretations'), the doubles clearly bespeak of a rich and complex system of beliefs that, as early as the MUP, was addressing questions pertaining to duality and multiple levels of reality. In this respect, the most eloquent examples (the Doublet and the Bicephalous) do suggest that what was being illustrated was not so much different beings (i.e., human and non-human) but parts of, or manifestations of single entities undergoing or having achieved a process of transformation.

This transformation process is well illustrated by the head shapes and their relationships to one another. Upon detailed examination, they can be shown to represent more than just a 'human'/'monster' opposition (as in Leroi-Gourhan's 1983 definition of "figures humaines et animales présentant des caractères insolites"): there are also the not-fully-human ones, that we have labelled as 'deformed' (Fig. 8). When taken together, these show what appears to be a continuum ranging from truly human heads, to odd-shaped ones, to patently deformed heads, and then to fully monstrous ones (Fig. 10). That is, we can perceive in the entire sample more than the differences and changes that are so obvious in the paired beings of the doubles (e.g., the Doublet or the Bicephalous). In other words, both the internal and external variations observable in the whole series present us with an obviously complex and very subtle set of progressive physical and, likely, symbolic transformations and shifts. We propose that this dynamic mode of representation be called morphing or, better, palaeo-morphing.

Palaeo-morphing is certainly not unique to the Grimaldi series. Long ago, Leroi-Gourhan (1965) underlined a similar

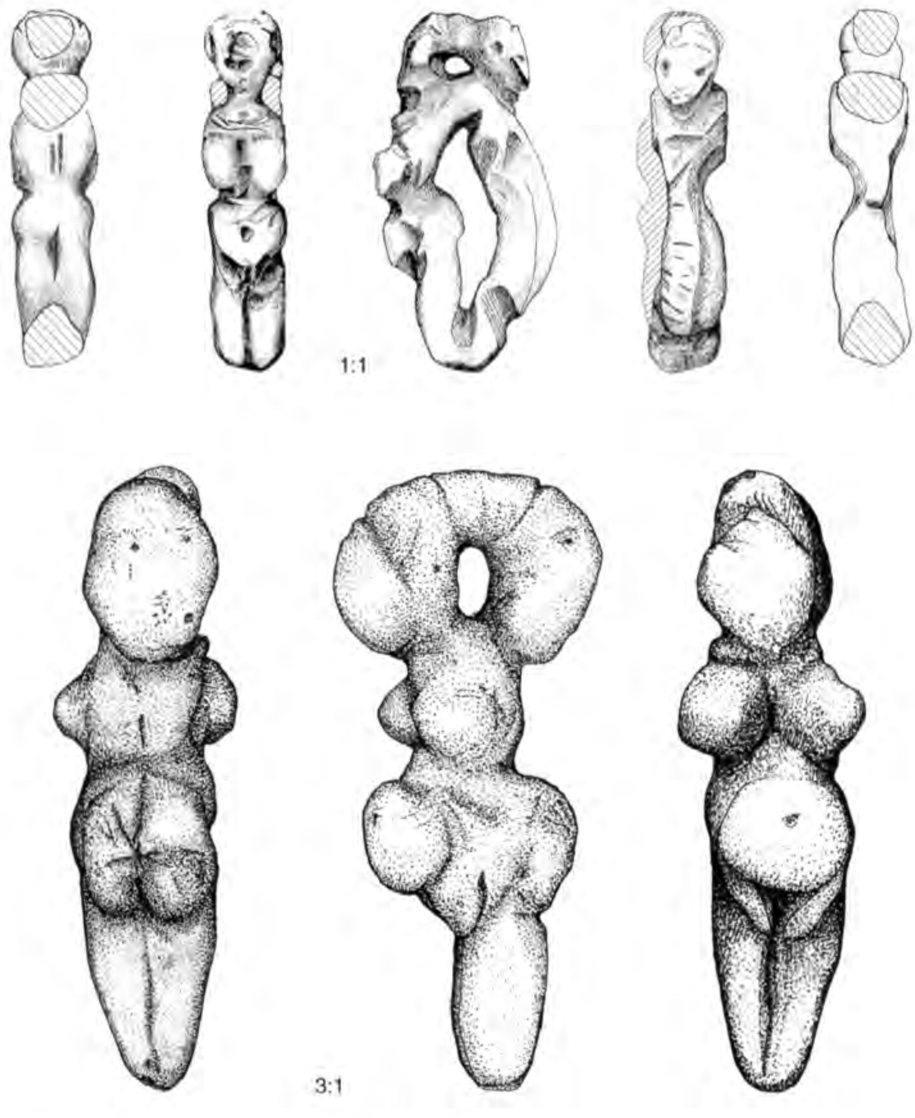


Fig. 9. The Doublet (above) and the Bicephalous (below).

process of deformation in the 'panneau des femmes-bison' of the Grotte du Pech-Merle, in France. We also suspect that something similar could be highlighted in the rich series of Kostenki I, as Abramova (1967, 1995) clearly describes, in her terminology, several "anthropo-zoomorphic" figurines (Fig. 11), and Gvozdover (1995) illustrates "polyiconic" representations at Avdeevo.

It is quite evident that such observations can only be arrived at through the detailed examination of sufficiently large samples of culturally homogeneous representations. This explains why the half collection kept at Saint-Germain-en-Laye, while including doubles such as the Hermaphrodite and the Goitered Lady, and specimens with deformed heads, such as the Lozenge, the Punchinello and the Negroid Head, was never put in a proper perspective; even if the Hermaphrodite, as the name makes clear, was the object of countless speculations, and even if Chollot (1964), in the official catalogue of the Piette collection, had rightly pointed

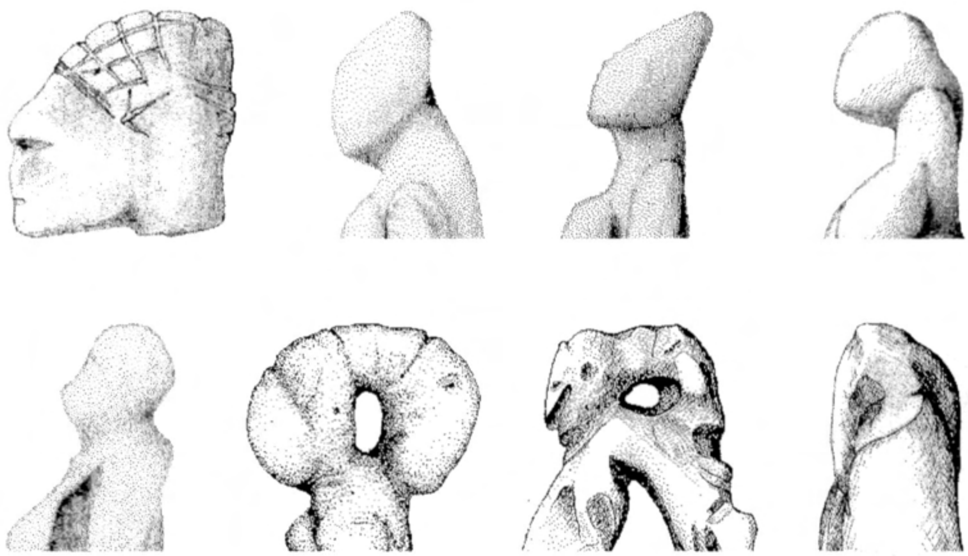


Fig. 10. Example of 'palaeo-morphing' (clockwise and from the upper left: the Negroid Head, the Lozenge, the Punchinello, the Yellow Venus, the Nun, the Doublet, the Bicephalous, and the Innominate).

out in reference to the deformity of the Negroid Head, that it displayed a "muffle léonin".

In our opinion, the notion of palaeo-morphing adds an important dimension to our understanding of the meaning and function of the female figurines of the MUP. It provides clear indications of the existence of a very complex system of beliefs which included the possibility, for selected beings, of changing from one state to the next, from a fully human character to a non-human one. As plastically illustrated by the Doublet and the Bicephalous (Fig. 9), women or, perhaps more precisely, womanhood was somehow perceived by the MUP populations as endowed with the ability or the power to shift from one level of reality to another, perhaps as intermediaries between different worlds.

5. Flux of information in space and time

Our analysis of the Balzi Rossi collection has also provided us with evidence of similarities with specimens discovered in other, distant parts of the palaeolithic world. In order to understand if we are dealing with casual or accidental trait convergence, or with actual evidence of cultural relationships across vast distances, some examples will be discussed in detail.

The figurines of Kostenki-Lespugue type

Among the great variability of MUP female figurines, we underline the homogeneity of a specific type of representation, found all over Europe, and that we shall call the Kostenki-Lespugue type. It encompasses specimens that Gvozdover (1995) classifies into distinct types and sub-types.

In our definition, the Kostenki-Lespugue figurines are in an upright position, with a bent head, and the maximum width in the trochanteric region. The profile of the cranial part of the head is rounded, starting with the bent nape of the neck. The rounded shape ends in the anterior part of the head with a straight surface which connects the head to a short or even notch-like neck. The upper thorax is flat, with minute shoulders. The lower thorax bulges with voluminous pendulous breasts, directly resting on a rounded belly which, in turn, protrudes over a realistic pubic triangle. In posterior view, the back is straight. It ends with a V-shaped waist, on top of flattish buttocks exhibiting marked lateral expansion. Furthermore, each of the two buttocks is recognisable as such, and the anus or coccyx is marked. Both right and left lower limbs are fully and clearly delineated, in frontal as well as in dorsal views.

Minor variations associated with this general pattern include the realistic representation of a cap or of other details of garments, ornaments or hair, and the presence of tiny upper limbs and knees. Such objects were made from both ivory and stone.

The westernmost example of this type of sculpture is the well-known Lespugue specimen. In central Europe, the

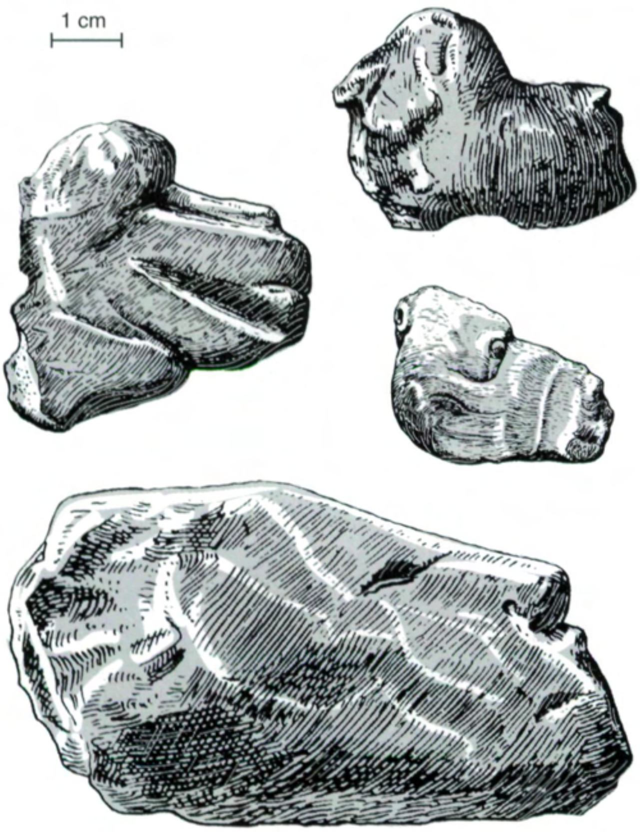


Fig. 11. Example of 'palaeo-morphing': selected 'anthropo-zoomorphic' figurines from Kostenki (after Abramova 1967).

Willendorf figurine is another rendering of the same general model. Many more are found in the sites of the Russian plains, with multiple examples at Kostenki I, Avdeevo, Gagarino, Khotylevo and, at the extreme southern limit of this vast geographical distribution, one finds the Balzi Rossi Yellow Venus (Fig. 12).

The circular masks

The masks are much rarer than the figurines, and the size of the sample does not allow, so far, for tight definitions. There is, however, some ground for a preliminary description of this particular type of representation (Fig. 13).

Masks are flat, small-sized, sub-circular representations of the face of non-human beings, either in stone, or in ivory. Drilled or partially drilled eyes are a prominent feature. The Balzi Rossi mask also exhibits a widely open, circular mouth, made by drilling, similar to the one found on the Předmostí fragment. The specimen from the former site, on the other hand, closely resembles the proximal, circular flat ends of the so-called 'spatulas' from Kostenki and Avdeevo, notably in the cat-like eyes which have been enlarged by deep transversal incisions. A pattern or series of short radial incisions located around the face – akin to a fur trim – can also be seen on many specimens.

We do not know the function of the Balzi Rossi and Předmostí masks, nor do we have much to say about the enigmatic 'spatulas' of the Russian sites. All the same, we think that some of the morphological attributes shared by the members of this admittedly small sample can be used to suggest that such specimens may well be regional variations on a yet-to-be elucidated representational theme (that of the 'mask') which extended from the Russian Plain to the Mediterranean shores of Western Europe.

The Western type figurines

A group of figurines that we have called elsewhere the Western type has already been presented in the literature (Mussi 1996, 1997). Made of coloured soft stones, they are characterised by a high level of abstraction, as well as by a plastic sense of volume. The final shape derives from a clever exploitation of the original shape of the support cobble or pebble. In these cases, symmetry seems to have been valued more than the realistic rendering of anatomy. In most instances, the rendition of the upper and/or lower part of the body corresponds to a conical element.

While there is no fully 'Western' figurine at the Balzi Rossi, it is worth noting that the Punchinello has long been compared to the Savignano Venus which is one of the finest examples of the Western group (Mussi 1995, 1996). Indeed, there can be seen on the Balzi Rossi specimen the same symmetry of the upper and lower conical ends, as well as an obvious commonality in the rendering of the protruding buttocks, in the shape of the legs, and in the final addition of a lateral incision starting at the point of the head. All in all, this indicates that some of the attributes of the Punchinello do overlap with those of the Western group, whose figurines are all characterised by conical extremities, i.e., with the ones found either further south, such as the above mentioned Savignano Venus, as well as the Trasimeno Venus, or elsewhere in Western Europe, such as the Tursac statuette, and the Mauern or Weinberg one (Fig. 14).

6. Ivory working

Links between the Balzi Rossi and other more or less distant places can be identified on the basis of more than just the typology/morphology of the figurines. Such can also be adduced from the detailed examination of various technological attributes that pertain to the manufacture or carving of objects found over vast stretches of Eurasia.

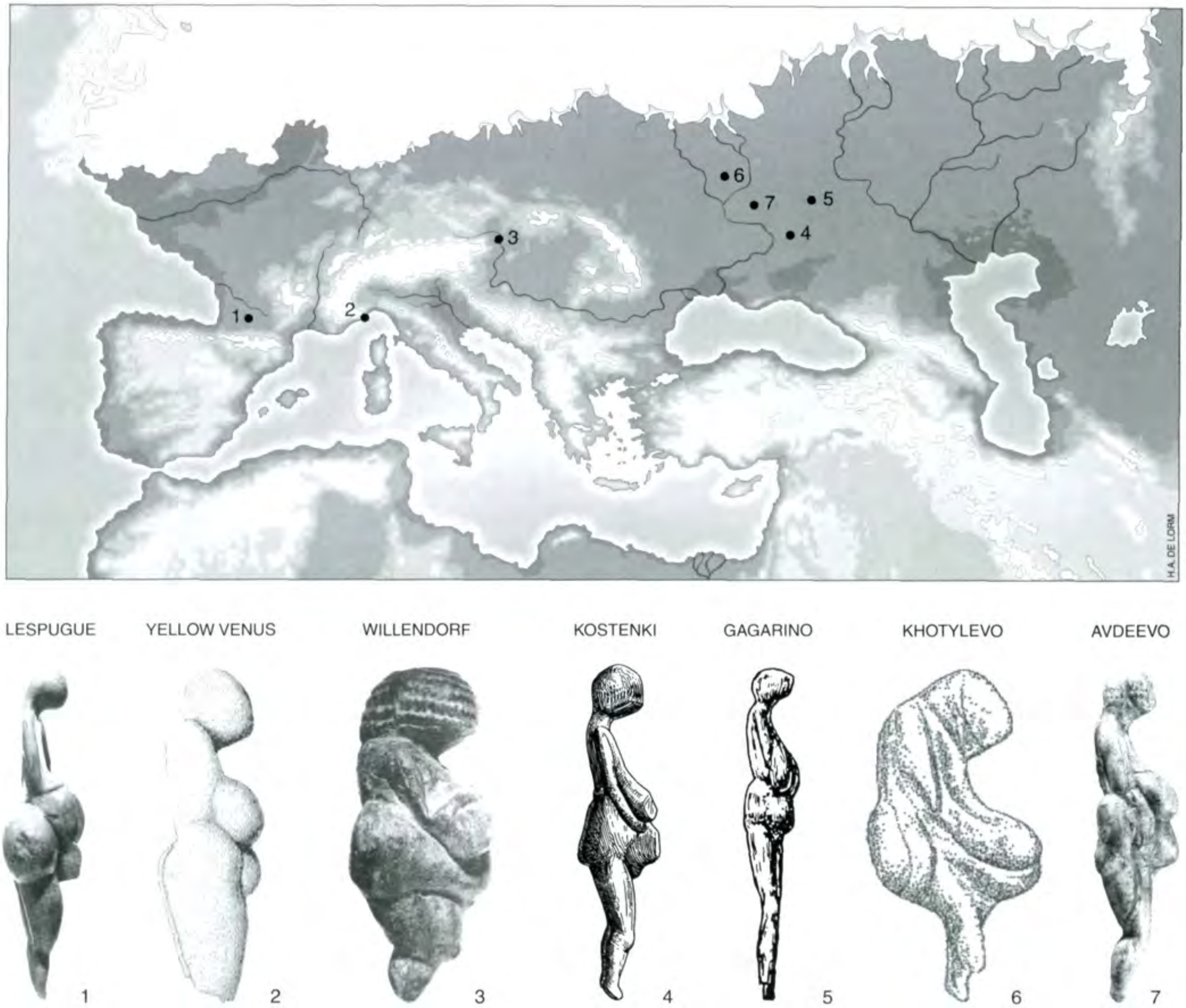


Fig. 12. The figurines of Kostenki-Lespugue type: examples and locations.

Ivory carving is truly exceptional in Italy, and unknown outside western Liguria, i.e. outside the coastal strip of land which, just south of the Alps, is the natural gate linking the Italian peninsula to Western Europe. In addition to the two ivory statuettes of the Balzi Rossi (the Abrachial and the Ochred Lady), one can only list a dozen pendants from MUP burials of the Barma Grande and the Grotte des Enfants; four more pendants from the MUP burial of Grotta delle Arene Candide, 100 km east of the Balzi Rossi (Giacobini and Malerba 1995); and, hypothetically, three points discovered by E. Rivière in the Barma Grande again, that have since been lost (Bolduc *et al.* 1996).

This scarcity of ivory items comes as no surprise, since there was a near absence of mammoths in Italy, as well as in adjacent southern France, during OIS 2 (Bolduc *et al.* 1996). By then, ivory items, while still common at high latitudes, were also becoming increasingly rare over large stretches of Western Europe, a likely reflection of ongoing ecological changes (Hahn *et al.* 1995) that were causing an important reduction of mammoth herd distribution over many parts of

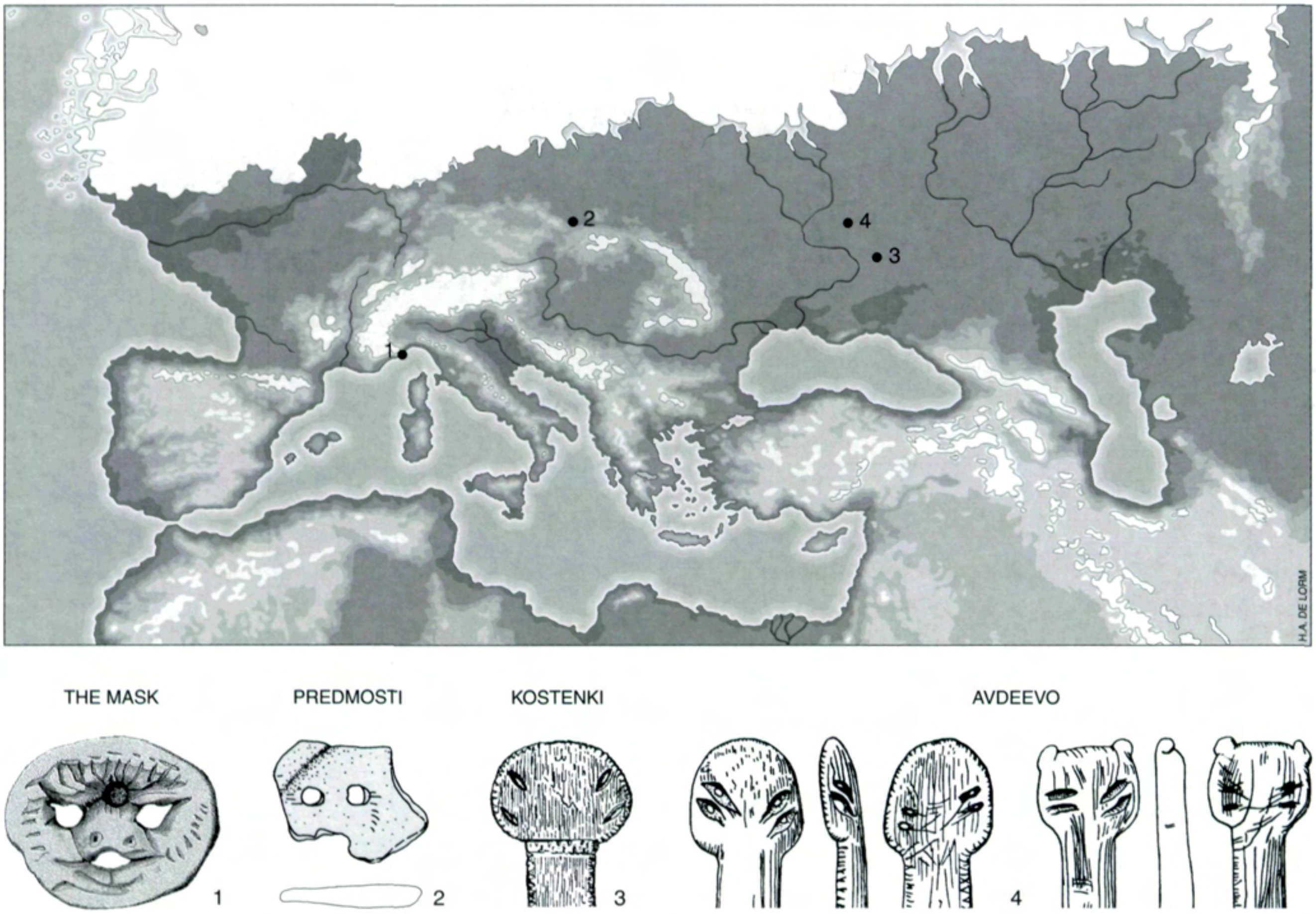


Fig. 13. The Masks: examples and locations.

Europe. As shown by ethnographic reports, the use of fossil ivory, as an alternative to fresh ivory, is well known in circumpolar regions, and has actually been suggested as a possibility at Hohle Fels by Scheer (1995). This, however, is only made possible by specific regional ecological conditions including, among other things, the presence of permafrost which allows for excellent, long-term preservation of buried organic materials, including ivory. This, however, could not have occurred in the Mediterranean region where the climatic conditions were not conducive to the development of permafrost.

Ivory carving, on the other hand, is not an improvised skill and requires quite a bit of technological expertise. Ivory itself is a hard material, with a 3 to 4 value in Mohs' scale. It dries through time, during the animal's life as well as after its death. Not surprisingly, elephant ivory is currently worked with the help of powerful electric machinery. The traditional craftsmanship includes a series of stages, such as softening, sawing, scraping, carving, drilling, and polishing. The difficulties of such a process for people using lithic tools only are well known through the study of working debris, and experimental replicas (Semenov 1964; Hahn 1986; Pawlik 1995). As a general conclusion, the skills needed to carve sophisticated ivory objects would only have been acquired through a lengthy 'apprenticeship' which, itself, would have been achieved in the context of an elaborate cultural and technological tradition. In other words, it seems most improbable that the inhabitants of the Balzi Rossi could have – following a chance encounter with a stray mammoth (also a remote possibility) – improvised themselves as qualified ivory workers. As a raw material, ivory was definitely not part of their repertoire.

Yet, the delicately carved Abrachial and Ochred Lady are definitely not beginner's work. The straight drilled hole of

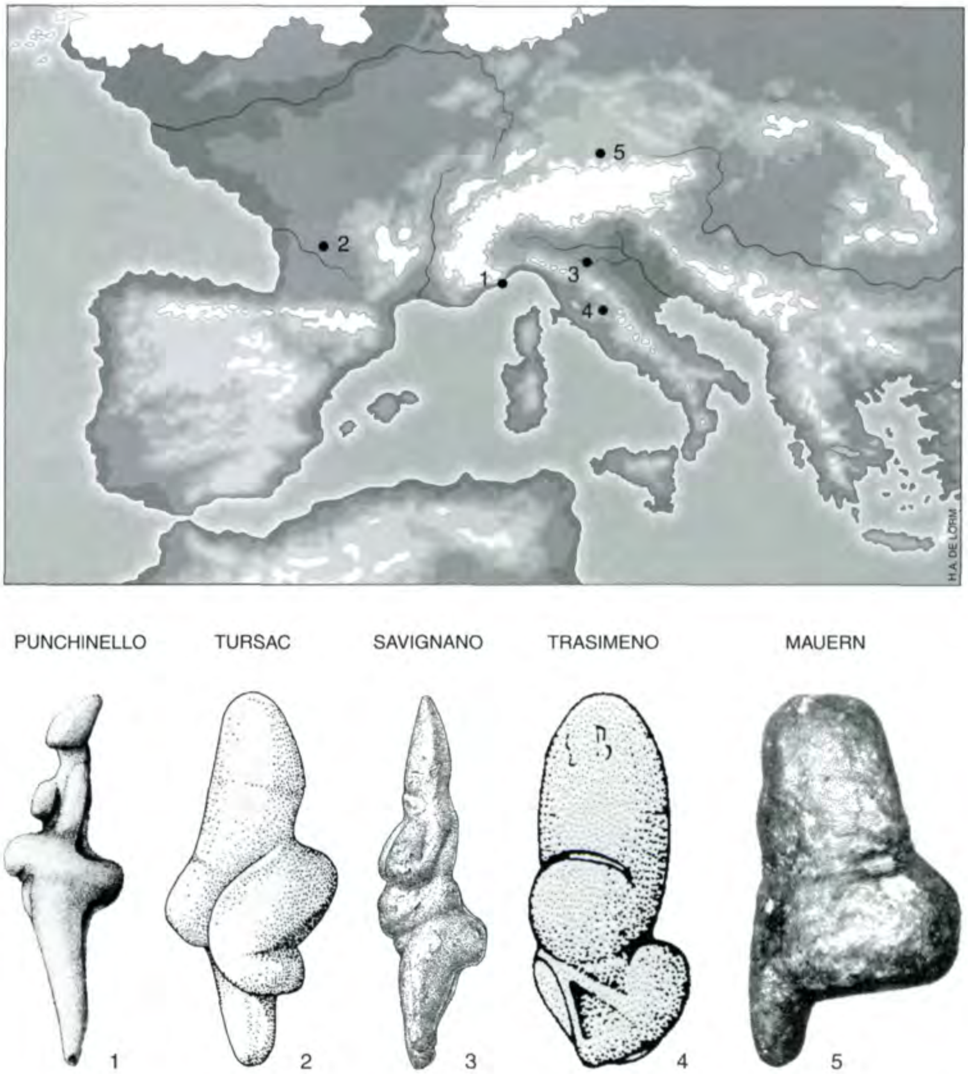


Fig. 14. The Western type figurines: examples and locations.

the Ochred Lady is a masterly perforation. The Abrachial preserves the stigmas of methodical and repetitive, even standardised actions which result in clear-cut volumes. There is no evidence of errors or re-shaping, and the artist was obviously at ease with him- or herself, and fully in command of the techniques required to shape ivory.

The presence of ivory carvings at the Balzi Rossi can be explained in three different ways which are not necessarily mutually exclusive. A first possibility is that the statuettes were originally carved much farther to the north and, following a long journey involving, perhaps, inter-group trade, eventually ended up on the Mediterranean shores. Another possibility is that they could have been carved more or less *in situ*, i.e., far away from the land of the mammoths, and this by an artist who would have acquired his or her skills elsewhere, and would have made use of imported pieces of ivory. The third possibility is that the statuettes were carved near or at the Balzi Rossi, after the exceptional killing of the stray mammoth mentioned earlier, but, once again, they would have been made by an artist who would have had prior knowledge – acquired earlier and elsewhere – of the technique required to process ivory.

Whichever the preferred explanation is, the inescapable conclusion is that the presence of ivory carvings at the Balzi Rossi is evidence of links or long distance contacts, during OIS 2 times, between the shores of the Mediterranean and higher European latitudes.

7. Discussion

The evidence presented so far – especially as it pertains to various aspects of typology, technology, and modes of display and, even, ideology – can be used to suggest that various elements of European (and beyond) MUP imagery were actually shared. Reference is not made here to simple and direct connections, but to various types and levels of affinities that we feel are best explained in a context of a dynamic time-transgressive process of change and adaptation. Some of the examples that point to this fluid and subtle pattern of relationships are given below.

Heads and faces of the Kostenki-Lespugue figurines

Looking at the bent head of the Kostenki-Lespugue figurines, it is quite clear that, at Kostenki itself just as at Willendorf, an ornamented tight cap is represented, and that the straight facet just below is the face. Such a face is flat, without any chin, and the figurine looks downwards (Fig. 15).

At Lespugue, however, the flat, anterior facet connecting head to neck clearly is the throat. The face itself, capped with hair, is straight, and displays a definite chin. The same can be seen on the Yellow Venus, whose chin is better described as protruding. That is, comparing the last two figurines to the previous ones, the face has somehow slipped upwards, squeezing the volume of the cranial part of the head, and allowing for the rendition of both a chin and a throat.

Both the hairy forward-looking figurines, and the capped, downward-looking ones, are to some extent realistic. Their posture is understandable, even if a little odd, as it is nearly impossible, for a human being, to keep both his face straight and his neck bent, or to bend the neck to the point of making the chin and throat totally disappear. Intermediate postures, however, are also found at Avdeevo: the profile of the head rather suggests a forward-looking face, with a chin and a throat, but the ornamentation of the cap is extended from the top of the head, all over the face to the putative chin. This third posture indicates that the parallel rows used as the cap ornamentation were locally perceived as being of the utmost importance for a definition of the being or entity represented by the statuette, so much so that these were applied all over anatomical features, apparently without much interest for realism.

In addition to the apparent homogeneity mentioned earlier, it is clear that the different 'postures' identified within the Kostenki-Lespugue group are also telling of the immense variability (in terms of regional and local stylistic adaptations, additions, deviations, etc.) that should be expected in the context of a tradition that once spanned all of Europe.

The rendering of buttocks

In the figurines of the Western type, the rendering of buttocks is generally rather realistic. The relief of two symmetrically protruding volumes is found on each side of a deep groove. They are clearly distinguished both from the lower limbs, and from the loins.

An example of a totally different approach to the treatment of this part of the back was noted long ago by Leroi-Gourhan (1965). He illustrated how a series of statuettes (which happen to belong to our Kostenki-Lespugue type) are characterised by a progressive enlargement of the small of the back, while the buttocks are unrealistically squeezed (Fig. 16). They eventually nearly disappear, being represented more and more like a fold, or as paired folds, making room for the expanded, saddle-like loins, with the coccyx ending up in the position of the anus.

With the Abrachial, we are somehow at the very end of this drifting representational process. The progresssively displaced buttocks are no more than a strip of flesh at a right angle with the thighs. At this point, the artist is faced with the need to fill the rest of the lower back with appropriate anatomical parts. The transversal incision which delineates the top of the wad-like buttocks – which is the last transformation of the coccyx – is eventually used to start the groove dividing two realistic buttocks, which, in the end, are placed on top of the old ones. The process of the transformation of the back, also seen in the Kostenki-Lespugue figurine, has gone full circle. A progressively deformed part of the body has become totally unrecognisable. All the same, the traditional, if incomprehensible, pattern has been carefully retained, and new anatomical landmarks have been simply added to the old ones.

Steatite and the rotating burin technique of drilling

Steatite can be seen as the southern counterpart of ivory. It is found in metamorphic rock formations and does not occur in the European plains, just as mammoths (and their tusks) are barely represented in the fauna of Mediterranean countries. Both steatite and ivory are known to be suitable for carving pendants and figurines (Mussi 1988-1989, 1991; Hahn *et al.* 1995). Both raw materials have advantages and disadvantages: steatite is coloured and even translucent, soft and easily carved, but can only be found as small pebbles in river beds at the foot of mountains, after long and painstaking searches; ivory tusks were probably more easily spotted, either on living animals or on carcasses or skeletal remains, but they are considerably harder and require technically many steps in order to be reduced to suitably-sized, manageable fragments or supports.

While the overall process of producing a carving from ivory differed considerably from that used on steatite, it appears that one particular technique was applied to both materials. We are referring to the production of holes or perforations (looking like tiny shafts with vertical walls) that exhibit both constant diameters and nearly flat bottoms.

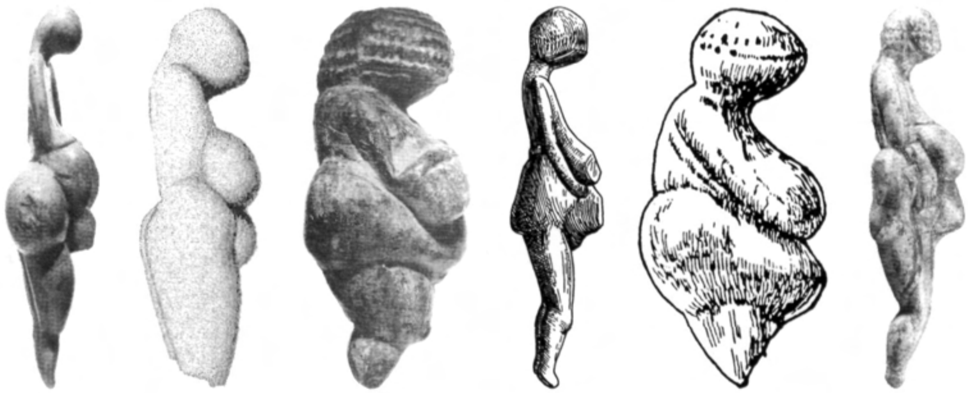


Fig. 15. The Kostenki-Lespugue figurines, with emphasis on heads and faces.

Experiments have shown that such holes can be produced by carefully rotating on the surface (ivory or steatite) that requires perforation, either a tiny burin or, better, a rectangular-shaped hafted burin spall. Such holes are easily distinguished from the conical, irregular ones that have been made with a rotating pointed tool. Ivory items displaying decorations or motifs made by holes of this type are found throughout Eurasia (i.e. from Mal'ta to Sungir', from Mamutowa cave to Gouran), while we are aware only of a single steatite object to which this particular technique has been applied: the Mask of the Balzi Rossi (Bolduc *et al.* 1996) (Fig. 2, Fig. 13).

It cannot be ruled out that this drilling method may have been first applied to steatite, or to other types of raw material, and then to ivory. However, the much greater frequency, and wider geographical distribution of ivory items decorated in this way seem to suggest the opposite.

Regardless of the actual origin of this technique, we may have here evidence of some early form of technological borrowing: the application to a different raw material, found in another environment, of a method first established elsewhere, under different technical constraints.

Another example of technical as well as stylistic adaptation is perhaps present in the rendering of the Abrachial and Ochred Lady. In both instances, the buttocks are more bulging than on most ivory statuettes (Fig. 2).

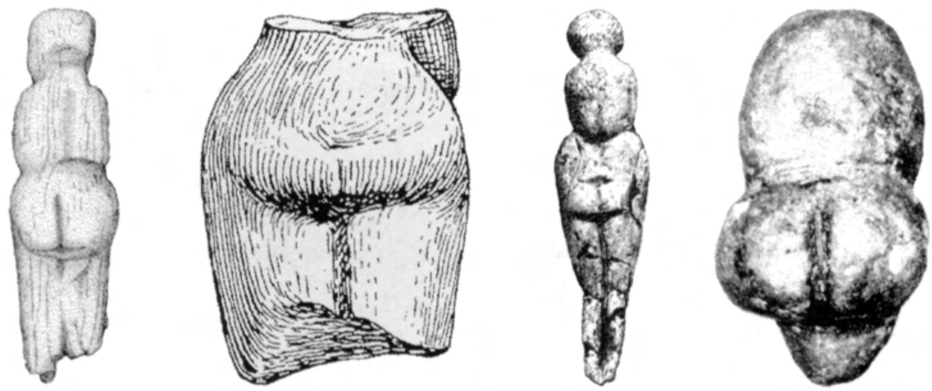
Ivory tends to split along more or less longitudinal planes of fracture. A single, protruding anatomical part would require a lot of carving in order to subtract enough ivory all around it, and make the relief appear. It is therefore no surprise that, overall, buttocks are not overly prominent on ivory figurines. Bulging anatomical details (head, breasts, and belly) are all concentrated on the anterior face of the statuettes. Relatively less work (and less waste of raw material) is required to delineate those volumes from one another. When it comes to the unrealistic volumes of the Western figurines, it has already been noted elsewhere (Mussi 1996, 1997) that they have been 'carved around' irregular pieces of stone, so to speak – which probably explains the fequently protruding buttocks, that have been described as 'steatopigic'.

The artist who carved the Abrachial and the Ochred Lady seems to have made an effort to shape the figurines in a way which, when it comes to the lower back, recalls much more the soft stone figurines of Western Europe than the ivory ones commonly found further East. In both the above mentioned examples, specific techniques or stylistic conventions appear to have been transferred and adapted to a different means and raw material support.

Western Europe and Siberia

If the variety of subtle technological changes, transfers, adaptations, and 'drifts' so far illustrated, helps to highlight the rich and complex network of exchanges which existed all over Europe during the MUP, it can also be used to propose – as suggested by similarities noted between the Balzi Rossi and Mal'ta figurines – much longer distance relationships, nearly spanning the whole of Eurasia.

We have already discussed the peculiar hairdo of the Ochred Lady (Bolduc *et al.* 1996). Its distinct volume surrounds the face, ending with a straight bang on the forehead. It is also sharply cut on the upper back and shoulders. The same general pattern can be seen in the Dame of Brassempouy, as well as in some figurines from Kostenki (no. 83-1) and Avdeevo (no. 77-1) (Praslov 1985; Delporte 1993). However, by far the best comparison can be established with one of the statuettes discovered at Mal'ta (Abramova 1995, fig. 103, no. 4) (Fig. 17). The shape of the



THE ABRACHIAL KOSTENKI AVDEEVO MAUERN

Fig. 16. The rendering of buttocks: a few examples.

hair is the same, around a featureless, convex face in a straight position. In both instances the same elongated locks, made by sinuous incisions, are evidenced in the lower part.

A straight, flat face, surrounded by a bonnet, characterises several of the Balzi Rossi statuettes, i.e. the 'Beauty' of the Doublet, both faces of the Janus, and the Bust. This peculiar rendering of faces and bonnets is not documented elsewhere in Europe, but it is found on several specimens from Mal'ta. Another element that is suggestive of some form of long-distance relationship is found on the Bust whose pointed breasts are relatively common at Mal'ta but unusual on European MUP figurines.

The lower part of the Lozenge, with its maximum width in the trochanter region, is also without any strict counterpart in Europe. The unarticulated lower limbs begin at hip level, and are essentially expressed by two folds which merge together well below the pubis. The general shape framing the belly is a smooth 'V' which ends downwards into a pubic triangle.

Several of the Mal'ta figurines display this same arrangement of the lower or distal end (Fig. 17b). The 'V' shape from hips to lower extremity is exactly the same. The belly and pubis merge together into a vast, flat and indistinct triangle. The similarity with the Balzi Rossi is even more striking if one takes into consideration, as we have suggested earlier, that a hole was once drilled at the distal extremity of the Lozenge. Such distal holes are displayed by several of the Mal'ta figurines, including some 'V' shaped ones.

In our view, the similarities that can be identified in the female imagery from the Balzi Rossi and Mal'ta are too numerous and diverse to be explained as purely coincidental, and this even if they represent, admittedly, only a very small portion of an assemblage of traits which are otherwise substantially different. Such elements of dissimilarity can be seen, for instance, in the flat rendering of the Mal'ta statuettes *versus* the vigorous sense of volumes at the Balzi Rossi, not to mention the numerous types of figurines from Mal'ta that are simply totally alien. This clearly indicates that the aforementioned similarities are best viewed as representing the faint outlines and distant echoes of a very longlasting, complex, and dynamic chain of communication that once linked various segments of the Eurasian continent.

8. Conclusions

The fascinating group of figurines assembled by Jullien is just beginning to be understood in all its intriguing complexity. Many aspects which, at the time of discovery, appeared odd and indecipherable, now can be fitted into the larger corpus of sites that has slowly developed over one hundred years of archaeological research. However, as we noted, it is only with the recent reunification of the original collection that is has become possible to throw light on what at best was a blurred if not incomprehensible pattern.

The wealth of information contained in the Balzi Rossi collection has allowed us to connect an otherwise marginal and geographically eccentric site to the wider net of MUP sites encompassing Europe. The data resulting from our analysis have also facilitated the integration of scattered evidence into a common perspective and an Eurasian context. If it is evident that diverse, stereotyped models of female figurines did exist, they, locally or regionally, were constantly subjected to subtle changes, either through technological adaptations and accommodations, or in the context of an ever-changing process of reinterpretation of traditional patterns of representation. Geographical gradients are slowly emerging but, unfortunately, we have yet to grasp the temporal ones. This is partly due to the fact that the study of palaeolithic archaeology began in Western Europe. Paradoxically, the standards of modern research were slowly

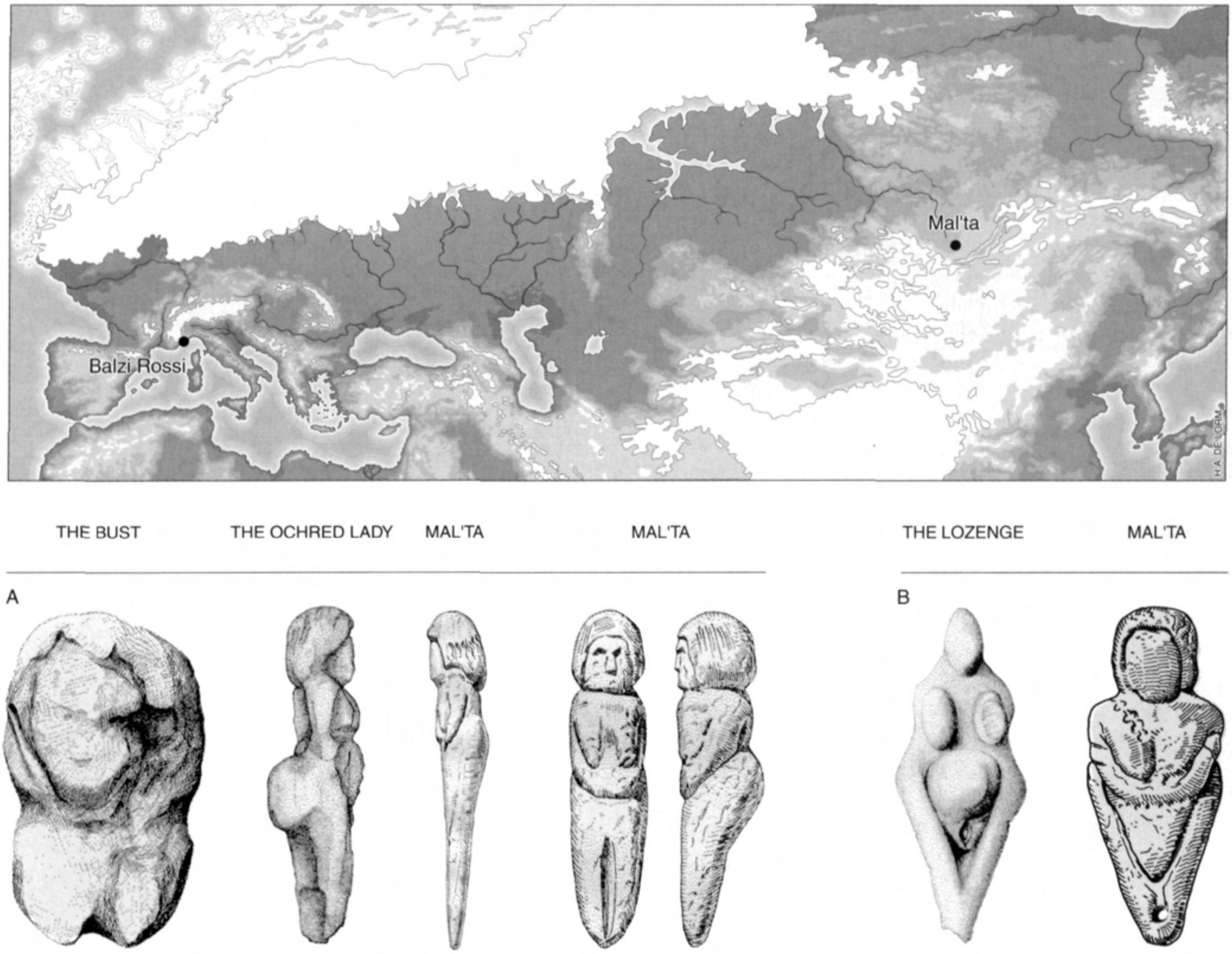


Fig. 17a and b. Hair, bonnets and 'V' shaped lower bodies: examples and locations.

achieved at the expense of many important western sites such as the Balzi Rossi.

Be that as it may, our analysis shows that many of the aforementioned elements of variability can best be explained as part of a representational continuum whose main characteristic has to do with shape shifting or transformation, and which we have called 'palaeo-morphing'. At this stage it is quite clear that the MUP figurines are, in all their artistic and symbolic complexity, the expression of a sophisticated set of beliefs or a world view. In this world, the shape of some or all beings, notably women, was not necessarily immovable, as it did show clear relationships with some sort of an animal and/or a non-human dimension, suggesting that there existed beliefs about ordinary and non-ordinary existence and that certain individuals had the ability or the power to shift from one level or dimension to another. Such a world view, and its artistic expression during the Upper Palaeolithic, was recently related to shamanism by Clottes and Lewis-Williams (1996), and had already been put into a similar perspective by Lommel (1967) and Street (1989). However, to err on the side of caution, and not to fall prey to the "tyranny of the ethnographic record" (Wobst 1978), we would rather consider MUP female imagery and palaeo-morphing as manifestations of 'proto' or 'palaeo-shamanism'. Indeed, it is unrealistic to assume that such a dynamic system of beliefs and corollary practices could have remained totally impervious to more than 20 millennia of cultural change.

In conclusion, and to place things in a broader perspective, it will suffice to note that the Balzi Rossi figurines can be viewed, in all their complexity, as intriguing signals and echoes of a rich and dynamic cultural repertoire that extended over vast territories. A repertoire that both reflects and made possible the immensely complex process of adaptation which resulted, in MUP times, in the successful implantation of humanity across the whole of the Mammoth Steppe, from the shores of the Atlantic ocean and the Mediterranean sea to the easternmost margins of the Beringian world.

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P.B. studied the story of the collection, J.C.-M. the technological aspects, and M.M. the typological ones. The conclusions are in common.

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Margherita Mussi
Dipartimento di Scienze dell 'Antichità'
Università di Roma 'La Sapienza'
Via Palestro 63
00185 Roma
Italy

Jacques Cinq-Mars
Musée canadien des civilisations
100 rue Laurier
C.P. 3100, succ. B
Hull
P.Q. J8X 4H2
Canada

Pierre Bolduc
459 Lusignan
Montréal
P.Q. H3C 1Y7
Canada

Ludmila Iakovleva

9 The gravettian art of Eastern Europe as exemplified in the figurative art of Kostenki 1

This paper focuses on the rich collection of figurative art discovered in habitation structure no. 1 of Kostenki 1 on the Don, a major site of the Eastern Gravettian, currently dated at 22-24 kyr bp. Anthropomorphic beings, as well as animals, are represented, which are mostly carved in marl, and more rarely in ivory. Women, vulvas, mammoth, felines, bears, birds and composite zoomorphs are found in series of several specimen each, while other themes are rarer. There is a patterning discernable in the spatial distribution which allows the habitation to be split into two, perhaps reflecting the social structure of the human group. In one half, carnivores and composite zoomorphs were unearthed, in the other, herbivores, notably mammoth, clustered. Birds and women were discovered all over the habitation. Female figurines, as well as animal statuettes, also display stylistic characteristics which link Kostenki to other eastern gravettian sites. The many intentionally broken soft marl statuettes have parallels with the baked clay figurines of Dolní Věstonice and Pavlov in Moravia, dated to 26-27 kyr bp. Accordingly, common stylistic and symbolic features can be recognised at gravettian sites which are distant in time and space.

1. Introduction

During that part of the Upper Palaeolithic which chronologically corresponds to the Gravettian, several areas with concentrations of sites yielding mobiliary art are known on the great Eastern European plain. The Gravettian of Eastern Europe is principally known from the sites of the Don and Desna which belong to the Willendorfian-Kostenkian tradition of the late Gravettian with *pointes à cran*. The Gravettian of the Dniestr basin in the Ukraine (Molodova V, Korman IV), of Moldavia and Romania (Mitoc) is part of a different gravettian group. The same applies to the streletian site of Sungir', as well as the sites attributed to this culture.

Two regions, geographically close to each other, can be identified. They contain important sites with a particularly rich mobiliary art which belongs to the eastern gravettian culture. These two regions are the Don, with the two sites of Kostenki 1, layer 1 and Gagarino, and the Desna, with the two sites of Avdeevo and Khotilevo 2.

Table 1. ^{14}C dates identifying the chronological division in the Don and Desna regions (after Boriskovskij 1984).

SITE	DATE	LAB. no.
Kostenki 1, layer 1	22,300 ± 230 bp	GIN 1870
	21,300 ± 400 bp	GIN 2534
	22,300 ± 200 bp	GIN 2533
	22,800 ± 200 bp	GIN 2530
	23,000 ± 500 bp	GIN 2528
	23,500 ± 200 bp	GIN 2527
	24,100 ± 500 bp	GIN 2529
Avdeevo	21,200 ± 200 bp	GIN 1569
	22,400 ± 600 bp	GIN 1969
	22,200 ± 700 bp	GIN 1970
	21,000 ± 200 bp	GIN 1748
Khotilevo 2	23,660 ± 270 bp	LU 359
	24,960 ± 400 bp	IGAN 73
Gagarino	21,800 ± 300 bp	GIN 1872

The importance of these sites is demonstrated by the presence of a large number of both figurative and decorative mobiliary art objects. They also offer the possibility of pinpointing the archaeological context of each of these objects within a habitation structure. Information on this last point is very rarely available in Western European sites, thereby underlining the importance of the sites on the great Eastern European plain.

These sites have a series of ^{14}C dates that accurately identify the chronological division in this region (see Table 1).

2. Habitation structures of the gravettian sites

The reconstruction of habitation structures in gravettian sites such as Avdeevo, Kostenki 1, layer 1 and Khotilevo 2 cannot be considered in detail because they are still under excavation. Available data indicate a relatively complex habitation structure: a large oval living area with hearths aligned along the major axis. In this large oval area many natural or artificial hollows can be found in the ground. Surrounding this area, large pits of varied shapes are present.

Based on morphological criteria, several of these large pits have been interpreted as semi-underground dwellings with bones and mammoth tusks used as structural elements in the protection and covering of these dwellings. The other pits have been interpreted as storage pits for bones and other types of objects (Efimenko 1958; Praslov and Rogatchev 1982: 43-50). All these semi-underground constructions are found a few metres from each other in a circular pattern around the large central oval area. The interpretation of this area as one large living space is still under discussion. A particular site may contain several of these habitation structures, as shown by Kostenki 1, layer 1 and Avdeevo.

In Kostenki 1, layer 1, four habitation structures have been found, of which only no. 1 has been totally excavated. This habitation structure of 36 x 15 m consists of a large oval area with ten hearths along the central axis, surrounded by four semi-underground dwelling pits and ten storage pits (Efimenko 1958; Fig. 1). The second habitation structure of Kostenki 1, layer 1, measuring 30 x 22 m, is currently under excavation. It exhibits the same type of organisation with differences in the number of semi-underground dwellings and storage pits (Praslov and Rogatchev 1982: 45). In Avdeevo, two similar structures have been found. The first contains an area of 45 x 20 m with seven semi-undergound dwellings and eight storage pits. The second structure, currently under excavation, comprises an area of 28 × 15 m with ten surrounding pits (Gvosdover 1995: 2).

The similarity between these ensembles shows the existence of a relatively elaborate habitation structure, characteristic of Avdeevo and Kostenki 1, layer 1 and perhaps diagnostic of the Eastern Gravettian.

The organisation of the Khotilevo 2 habitation is currently less clear. The excavation so far undertaken has only revealed a series of hearths and storage pits (Zaverniaev 1974: 142-161).

At present of all these habitation structures, only habitation structure no. 1 of Kostenki 1, layer 1 has been fully excavated, giving a certain precision to the archaeological context of the objects (Efimenko 1958).

3. The mobiliary art of habitation structure no. 1 of Kostenki 1, layer 1

Habitation structure no. 1 of layer 1 of Kostenki 1 has yielded one of the richest collections of figurative art in Eastern Europe. The repertoire of images can be classified in the first instance into two major groups: anthropomorphic representations and animal representations.

The anthropomorphic representations are female statuettes, sculpted in the round in marl and ivory. Those in marl are numerous whereas only a few ivory statuettes exist. The carved vulvas were executed in marl.

The animal representations are highly varied. They are statuettes of animals carved in the round in marl: mammoths, felines, bears, horses and also birds. There are also special representations of zoomorphic heads, sculpted in marl, as well as very schematic animal statuettes and broken statuettes whereby it is difficult to identify without ambiguity the animal species represented, such as rhinoceros or wolf. Among these animal images, only the statuettes of mammoths, felines, bears, birds and zoomorphs are found in series of many specimen.

The preference for the use of marl in the creation of these little works of mobiliary art is one of the specific traits of Kostenki 1, layer 1. Ivory sculptures are only found in a few examples.

Of the collection of figurative art found in habitation structure no. 1 of Kostenki 1, layer 1, the majority of the animal and female statuettes are incomplete. They consist of heads and body fragments of the sculptures, the majority of which bear traces of breakage. In fact, the majority of the statuettes abandoned in the habitation shows signs of ancient damage, thereby demonstrating signs of the creation and destruction of these works in the habitation space.

The spatial distribution of the objects of figurative art within this habitation structure no. 1 in layer 1 of Kostenki 1 can be reconstructed from the excavation reports of P.P. Efimenko (Efimenko 1958: 341-401).

4. Analysis of the spatial distribution of the animal statuettes

Analysis of the spatial distribution of the animal statuettes enables us to distinguish two separate parts of the habitation, almost equivalent in dimension.

In the first part, between hearths 10 and 6, are found several statuettes of heads of carnivores (7 examples), all the zoomorphic heads (7 examples), heads of birds (6 examples) and one head of a horse. Two feline heads (squares G-29 and G-31; Figs 2:6, 7) and one bear head (square H-28; Fig. 2:11) are situated near hearths 10 and 9. In the same zone two bird heads (squares E-30 and K-29; Figs 2:14, 18) were also found, as well as a feline head (square E-30; Fig. 2:8) and a zoomorphic head (square I, K-29; Fig. 2:22). Two more bear heads were found near hearth 8 (squares I-26 and K-25; Figs 2:13, 12). One zoomorphic head was also found in square I-26 (Fig. 2:24), while another zoomorphic head was found on the other side of hearth 8, in square F-26 (Fig. 2:21).

In the next zone, around hearths 8 and 7, several animal statuettes were found separately on the habitation surface and in small pits. The lack of detail on these figures and their fragmented state do not allow us to define without ambiguity the type of animal. Amongst these, four zoomorphic heads were discovered. Two heads were found in square I-24 (Figs 2:26, 27), near to hearth 7 and a further two at a short distance in square M-24 (Figs 2:23, 25). A bird head was also found in this area, in square M-24 (Fig. 2:17).

In the next zone, close to hearth 6, one bear head was found in square K-21 (Fig. 2:10), one horse head in square K-20 (Fig. 2:28) and two bird heads in squares L-21 and H-21, 22 (Figs 2:20, 15).

In the second part of the habitation, between hearths 5 and 1 and in two semi-underground dwellings, several whole and partial statuettes of mammoths were found (5 examples), as well as bird heads (5 examples), a horse head and other partial indeterminate statuettes. Between hearths 5 and 6, in neighbouring squares, a fragmented statuette of the body of a herbivore was found (square K-15), as well as a fragment of a body of an indeterminate animal (square I-14) and a horse head (square E-14; Fig: 2:29). Another partial statuette was found in a small hollow (squares N, M-11, 12) between hearth 4 and semi-underground dwelling A.

An unfinished mammoth statuette was found in square P-18, at some distance from hearths 6 and 5. The other statuette of a mammoth was unearthed near hearth 1 in square P-7 (Fig. 2:5).

In semi-underground dwelling A, a complete mammoth statuette (square Q-12; Fig. 2:1) and a bird head (square Q-11; Fig. 2:19) were discovered. In semi-underground dwelling B, two intact mammoth statuettes were found in squares A-16 and B-15 (Figs 2:3, 4). In this dwelling a fragment of a bird head (square A-16) and a head suggestive of a feline (square B-14; Fig. 2:9) were also found.

The three other bird heads were found separately on the habitation surface (squares G-10, L-10, F-13; Fig. 2:16).

Fragments of indeterminate animal statuettes and disputed determinations have not been included in this analysis.

5. Analysis of the spatial distribution of the female statuettes

In habitation structure no. 1 in layer 1 of Kostenki 1, the female statuettes in marl and ivory are similarly incomplete.

The female statuettes in marl include heads, torso fragments and fragments of the lower parts of the female body. Amongst these numerous objects, rough shapes and finished works, partially broken or smashed into several pieces (Figs 3:1-26), are distinguishable. Only a few marl statuettes represent more or less complete female figures (Figs 3:27-32). The first one is a large, unfinished statuette, reconstructed from several pieces collected in different parts of the archaeological layer (Fig. 3:29). The second is a small statuette, also unfinished, and with a broken lower part (Fig. 3:28). The third is a female representation with an incomplete profile, engraved on a fragment of a limestone *plaquette* (Fig. 3:27).

In this habitation structure no. 1, only three ivory female statuettes were found, also damaged a long time ago (Figs 3:30-32). The first one, the most complete, was slightly damaged at breast and stomach level (Fig. 3:32). The second has neither head nor legs, both of which were broken formerly (Fig. 3:31). The third was also broken at the neck, breast and stomach (Fig. 3:30).

The female statuettes were widely dispersed through the entirety of habitation structure no. 1 (Kostenki 1, layer 1). The heads and body fragments of the female statuettes were located on the habitation surface and in small hollows (natural or artificial pits). In certain cases they were found near hearths.

- The heads were found near hearth 8 (square L-26), near hearth 5 (square I-16), near hearth 4 (square L-13), near hearth 2 (square K-10), and near hearth 1 (square O-7).
- Female body fragments were found near to hearth 8 (squares K-27 and K-28) and hearth 5 (square I-17).
- Further heads and female body fragments were found on the surface and in the small pits in the area between hearths 5 and 4.
- Other heads and female body fragments were also found dispersed over the whole habitation space.

In this habitation structure some female representations were clustered together in small storage pits (Efimenko 1958: 346-349; Abramova 1995: 76). In particular, a carved fragment of a female torso and a *plaquette* with an engraved female profile were found in a small pit in square D-5, E-5. They were found there with a decorated bone bladelet and a perforated tooth of a blue fox.

The three ivory female statuettes were abandoned in small pits in different zones of the habitation. The ivory female statuette, without either head or legs, was put in a small pit in square D-6 (Fig. 3:31). The second one without a head was found in a pit in square N-8, with an ivory headed spatula and fragments of a similar female figurine in marl, which has been restored (Figs 3:30-29). At the other end of the habitation, in square D-27, the third ivory statuette, almost completely intact, was found at the bottom of a pit, in association with a fragment of a bird head and a decorated ivory bladelet (Fig. 3:32).

Partial female statuettes, carved in marl, were also found in the semi-underground dwellings. In semi-underground dwelling A, fragments of the torso of three female statuettes were discovered (squares P-10, Q, R-10, R-10). In semi-underground dwelling B, two heads and fragments of the bodies of two female statuettes were found in square A-15. Carved vulvas were found in a large area of the habitation, from the lines of square 24 to the lines of square 10.

6. Conclusions on the spatial distribution of the figurative art

The partial female statuettes were distributed either widely or clustered throughout the habitation surface, either close to or

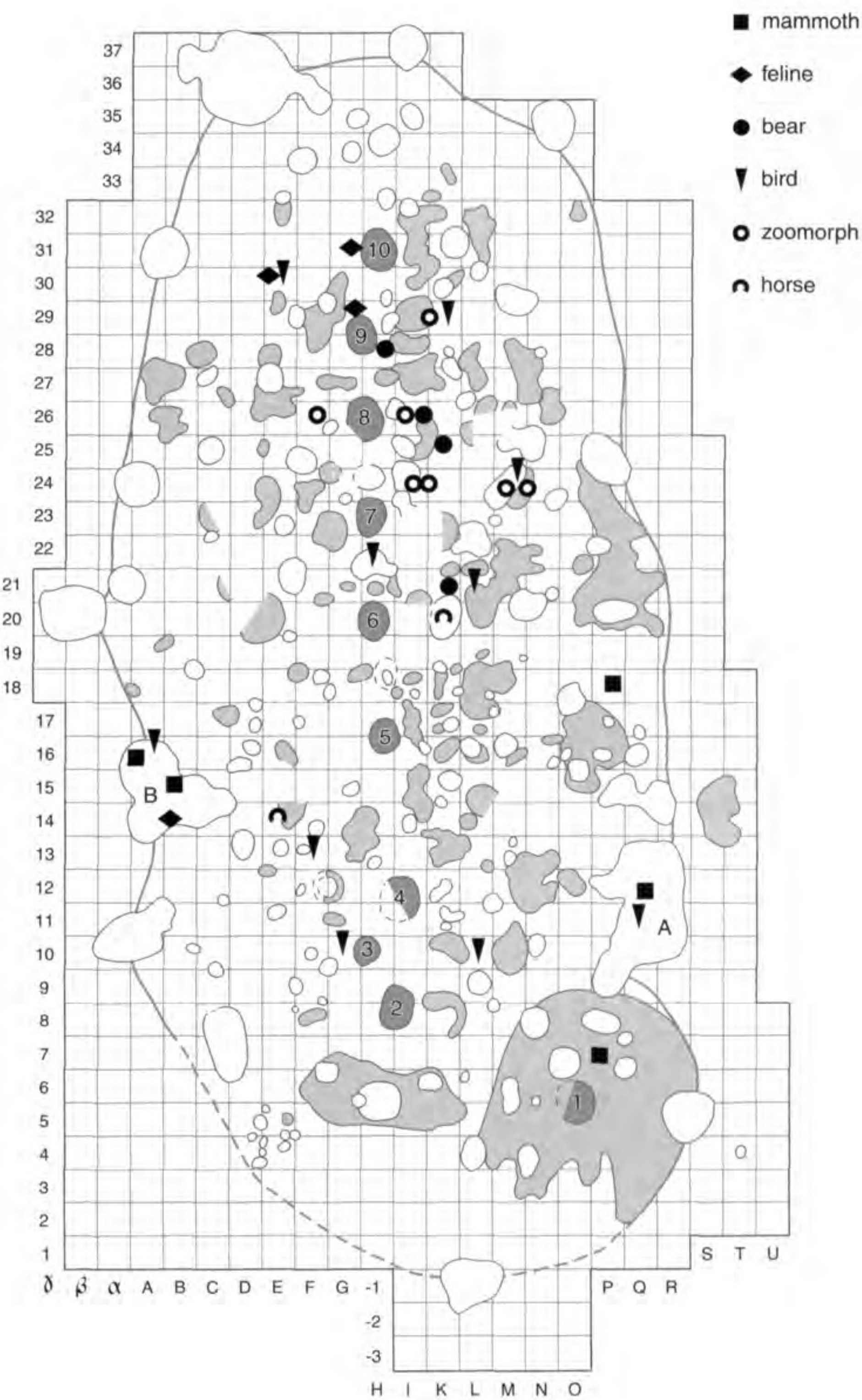


Fig. 1. The spatial distribution of the animal statuettes (of figure 2) in habitation stucture no. 1 of Kostenki 1, layer 1 of P.P. Efimenko's excavations (after L. Iakovleva).

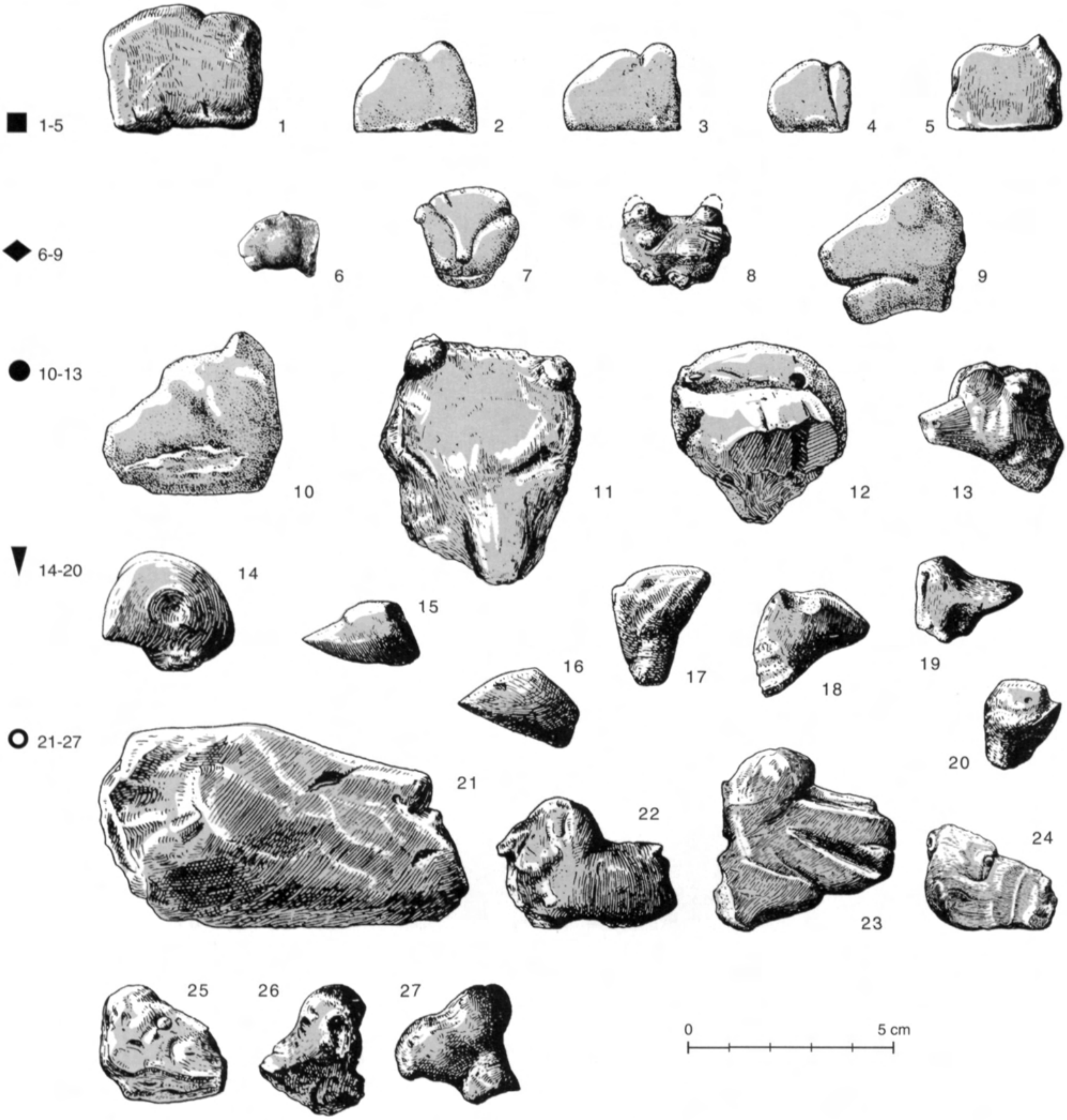
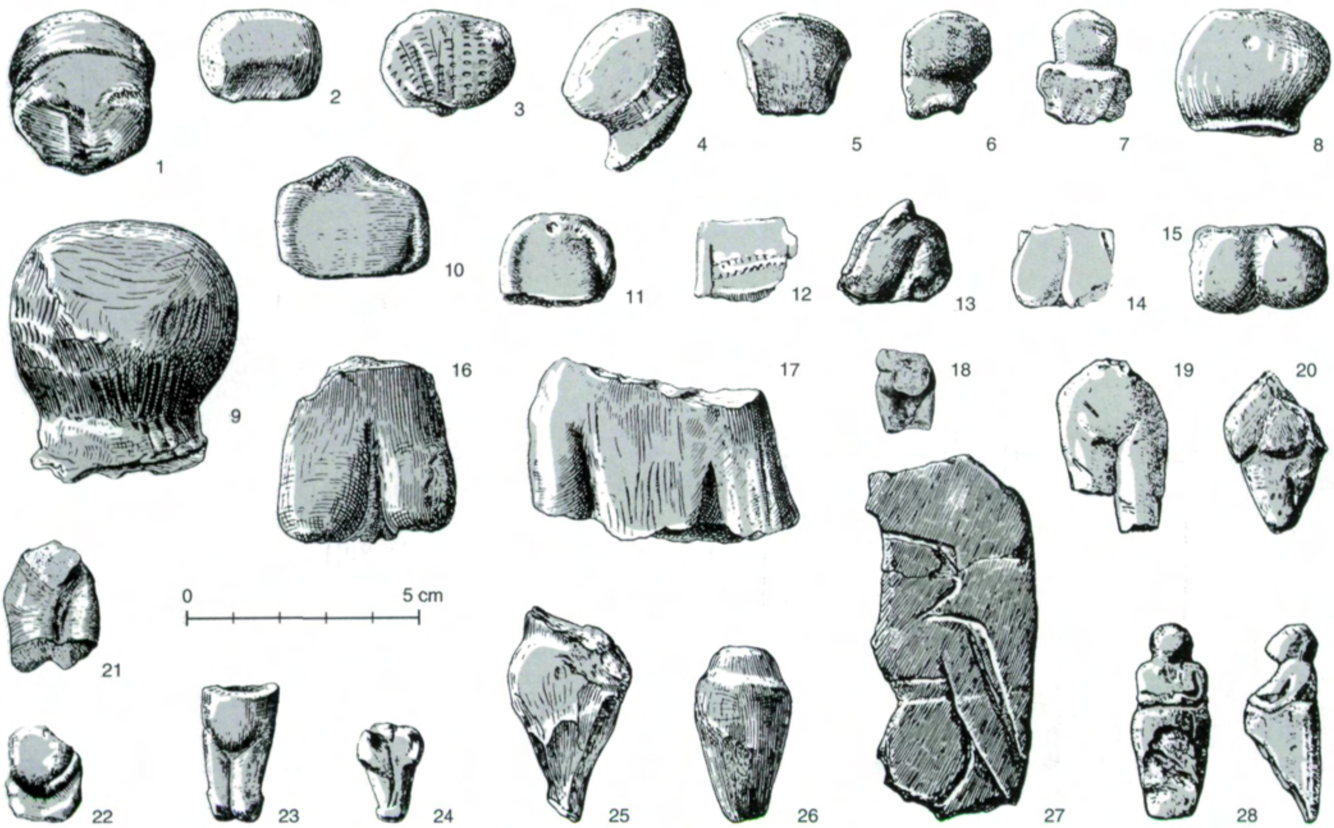


Fig. 2. Marl animal statuettes from habitation structure no. 1 of Kostenki 1, layer 1 (reconstructed from the data of P.P. Efimenko).
1-5: mammoths, 6-9: felines, 10-13: bears, 14-20: 'bird' heads, 21-27: zoomorphic heads, 28-29: horse heads. The graphical symbols associated with the various groups indicate the location of these objects in figure 1. See text for further explanation.



at a distance from the hearths. They were also found either in or outside the pits, and in the semi-underground dwellings, illustrating the diversity of their positioning in the habitation. It is interesting to point out that the carved vulvas are only present in one large zone of the habitation, whereas the female statuettes have a much larger spatial distribution.

The spatial distribution of the broken animal statuettes is characterised by similar variability. Nevertheless, the spatial distribution of each kind of animal statuette differs clearly in the two parts of the habitation: the carnivore statuettes and the zoomorphic statuettes were located in one part of the habitation, whereas the herbivore statuettes, notably mammoths, were located in the other part of the habitation. This spatial distribution has perhaps a certain meaning which allows a distinction between one part of the habitation and the other.

The bird statuettes and female statuettes, which were found throughout the habitation structure, in several cases near animal statuettes, were in one part of the habitation close to felines and bears and in the other part of the habitation close to mammoths. This spatial distribution perhaps also demonstrates a further special meaning, which may be inferred from the spatial association of the figurative statuettes of the habitation.

7. The artistic traditions of Kostenki 1 within the context of eastern gravettian art

The figurative art of habitation structure no. 1 in layer 1 of Kostenki 1 has given us the richest collection of gravettian art of Eastern Europe, within a precise and well-dated archaeological context. The wealth of the figurative repertoire of Kostenki 1 demonstrates that the preference for female representations in series in the eastern gravettian art is one of the characteristics of mobiliary art in open air settlements on the great plain, as confirmed by the series of female statuettes from Gargarino, Khotilevo 2 and Avdeevo.

The animal representations of Kostenki 1 also demonstrate another characteristic, with series of animal statuettes of different species. This tradition is also confirmed by the herbivore statuettes of Kostenki 11, layer 2 (mammoths and rhinoceros) and Kostenki 4, layer 1 (mammoths). However, it should be pointed out that neither in Gagarino, nor in

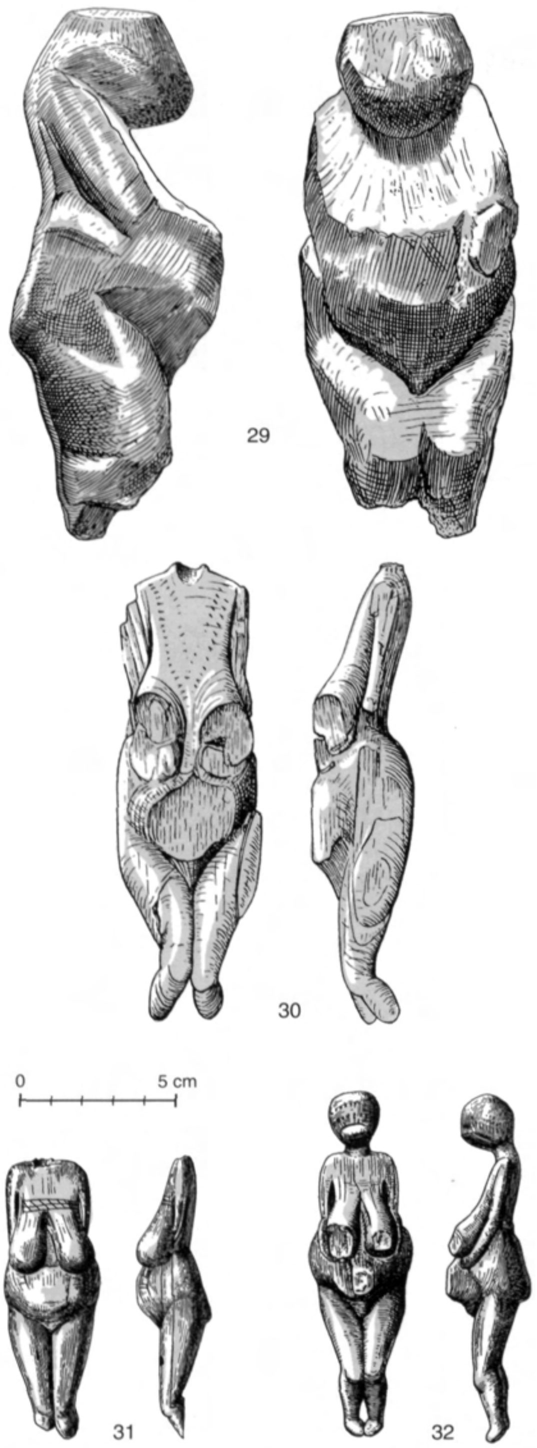


Fig. 3. Marl and ivory female statuettes from habitation structure no. 1 of Kostenki 1, layer 1 (reconstructed from the data of P.P. Efimenko).

Khotilevo 2, any animal statuettes were found. From Avdeevo, only three mammoth figurines are known, while female statuettes are absent in Kostenki 11 and Kostenki 4.

Kostenki 1 is the only site where within a large collection of figurative art sculpted in the round both female statuettes and carved vulvas, and animal statuettes and composite zoomorphs co-occur in one habitation structure. The choice of representations of certain species of animals, notably herbivores (mammoth) and carnivores (felines and bears), which have different distributions in the habitation space makes this collection of figurative art very characteristic. The presence of series of carved vulvas and a series of birds and some rare horses completes the choice of this repertoire.

The mobiliary art of Kostenki 1 belongs to a very discrete and well-dated occupation level, hence the assemblage can be considered as one artistic unity, which enables us to define the stylistic traditions of the gravettian sculptors.

In the series of fragmented female statuettes of Kostenki 1, a formal concept emerges of the whole variability of the representations. This is expressed by the representation of an upright, naked female body, with a straight or slightly inclined head, with arms along the body or across the stomach, and with legs which are straight or slightly bent at the knees. A lightly engraved geometric decoration suggests on certain statuettes a hairdo, bracelets with or without ornamentation, belts with or without ornamentation and other types of body decoration.

In fact, these female representations, while respecting the silhouette and proportions of the female body and enriching it with body decoration, are in line with the realist tradition of gravettian art, by the use of the technique of sculpture in the round. This formal organisation of the female body can also be seen, with some variation, in the other gravettian sites of Eastern Europe, in Avdeevo, Gagarino and Khotilevo 2 (Abramova 1962: 9-15, 30-31, 55-58, 1995:24-27; Tarasov 1979: 123-146 Gvosdover 1985: 27-66, 1995: 21-36; Iakovleva 1991: 6-17).

In the series of animal statuettes of Kostenki 1, another formal concept lies at the origin of the creation of small works sculpted in the round. In the case of the representations of mammoths, a simple silhouette, just accentuated by some characteristic features of the animal's body, creates an accurate image of this great mammal in very small statuettes. This tradition of a simple and fairly schematic representation of animals can be found in the other gravettian sites of Eastern Europe, at Kostenki 4, Kostenki 11 and Avdeevo. With respect to the carnivore heads of Kostenki 1, several also quite schematic representations of felines and bears are simply carved but with the precise characteristics of their species.

However, there also exists a very realistic representation of a lion. The head of this lion, carved with much care, allows us to identify the animal, not only by the face and profile of the head, but also by the anatomic details of the ears, eyes and the finely modelled and engraved mouth (Fig. 2:6).

The representations of the birds, despite the simplicity and restraint, have been finished with precision, creating particularity amongst them.

The ensemble of figurative art of Kostenki 1 also includes some special sculptures. These are zoomorphic images, showing a mixture of various animal and anthropomorphic features. These sculptures of zoomorphic heads were carved with great precision, accentuating the individuality of the subjects.

Similar representations have been discovered in both mobiliary and parietal art elsewhere, dating from the Aurignacian to the Magdalenian (Abramova 1962: 15-16; Hahn 1971: 11-23; Vialou 1986: 49; Archambeau and Archambeau 1991: 60, 75; Iakovleva 1994: 88-91, 95, 1996: 51-52; Bolduc *et al.* 1996: 22-24, 36).

8. Conclusions

The wealth of information supplied by the collection of figurative art objects from habitation structure no. 1 in layer 1 of Kostenki 1, which is characteristic of the gravettian art of Eastern Europe, demonstrates the generality of the artistic traditions of the Eastern Gravettian and the particularity of an exceptional site of this civilisation.

1. The number of figurative statuettes shows the great importance of plastic art in the habitation of Kostenki 1. The differences in the state of the statuettes – roughouts, complete statuettes and especially intentionally broken statuettes in large numbers – show the stages of creation, use and abandonment of plastic art in the living space. This complete cycle brings to light the strong link of the figurative art with the settlement, a space where art expresses the social, symbolic and aesthetic functions.

2. The plastic art objects made from marl and ivory show a remarkable mastering of these materials which are so different in quality. The preferred choice of marl as a rather soft raw material, found on the spot, for the creation of figurative statuettes in the round can, amongst others, be linked to the use of these objects when the majority were intentionally broken or smashed into several pieces in the Kostenki 1 settlement. The choice of a soft raw material that is easily broken can be compared to the production of baked clay figurative statuettes, which were found, fragmented or incomplete, in large numbers in the settlements of Dolní Věstonice 1 and Pavlov 1.

3. The repertoire of sculpted art from Kostenki 1 illustrates the richest iconography of figurative art of the Eastern Gravettian and demonstrates the deliberate choice of realistic and imaginary images. In its own bestiary, composed of animals which clearly represent the faunal species of the environment, and confirmed by the remains of the fauna in the settlement: carnivores (lion, bear), mammoth and birds. Several very schematic animal statuettes were also found, summarily presented without any accurate information on the species represented. The repertoire of animals also includes figures that are totally imaginary, represented by the zoomorphic and composite anthropozoomorphic statuettes. The distinction of these bestial figures is also expressed in the originality of each of these imaginary characters. The other large part of the figurative repertoire is characterised by rather realistic but totally different female representations. One series has female statuettes, another carved vulvas. The existence of these two different series of representations has perhaps a distinct meaning for each of the feminine imageries.

This complex figurative repertoire of the late Gravettian of Eastern Europe in Kostenki 1 (24,000-22,000 bp) bears a resemblance to the figurative collection from Dolní Věstonice 1 and Pavlov 1 of the older Gravettian (27,000-26,000 bp) of Central Europe, which is expressed in representations of series of mammoths, carnivores, summary animal subjects and also by females represented by a complete body or by vulvas. The resemblance of the figurative repertoires of these settlements, separated in space and time, demonstrates the dominant, stable traits of the gravettian iconography.

4. The spatial distribution of the figurative statuettes in habitation structure no. 1 in Kostenki 1 shows another aspect of the presence of the different subjects by their positioning and clustering in the space of the settlement. In the first place, the animal and female statuettes are widely dispersed over the area of the settlement. But a clear difference is demonstrated by the spatial distribution of certain objects in the given zones. In the positioning of the female representations this is illustrated by the limited distribution zone of the vulvas in comparison with the wide distribution of the female statuettes. The distribution of the animal figures is distinguished by a wide distribution of the bird statuettes compared to a much more restricted distribution of mammoth statuettes in one zone, and carnivore and composite zoomorphs in another zone of the settlement. This figurative assemblage within the settlement carries a meaning of its own, which perhaps can be linked to, amongst others, the social structure of the settlements.

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Ludmila Iakovleva
Directeur du recherche d'Institut d'Archéologie NAN d'Ukraine
12, Avenue des Héros de Stalingrad
254655 Kiev
Ukraine
postal address:
CNRS UMR 7041
Maison René Ginouvès
21, Allée de l'Université
92023 Nanterre Cedex
France

Yvette Taborin

10 Gravettian body ornaments in Western and Central Europe

In the Aurignacian, the redundancy in the choice of forms, sea shells, animal teeth or formed ornaments in ivory, antler or bone, is a well-known aspect. The Gravettians reduced their choice and showed considerable variability between local groups. In the western part of France, Atlantic shells were used, while in the oriental part and also in Germany some mediterranean forms exist. The fossil species are present far from the sea. Fox canines and formed ornaments in ivory or soft stone are more frequent in Central Europe than in Western Europe. Except for the production of beads in series, the gravettian people always kept the aurignacian symbolic ornaments but they diversified their fashioned ornaments in each region.

1. Introduction

The formal diversity and technical underpinnings of aurignacian personal ornaments are now well known. According to current knowledge, the Aurignacians were the first humans to develop a need for personal adornment, testifying to a cohesive society and an elaborate system of values subscribed to by all members of that society. The redundancy in the choice of forms, whether it be sea shells, animal teeth or formed ornaments in ivory, antler or bone, is astonishing. This highly selective appropriation of forms is evident from the beginning of the Aurignacian, with no period of incipiency or transition, and is a characteristic of human personal adornment up to the present.

But generations replaced each other and societies changed slowly. The power attributed to the first personal ornaments would not be forgotten, but ornaments came to express new and regionally diversifying values, and these new needs led to modifications in the choice and composition of personal ornaments.

1.1 Cultural values or tribal fashion?

Choice, composition and manufacturing techniques are not the random result of individual taste. Rather, they are a fundamental means of communicating meaning to others. The key problem for researchers is to understand the importance of a change in species choice or qualities of formed ornaments. Is it the product of a profound evolutionary change or merely a change in local fashion?

The answer in each case depends on the distribution and quantity of new kinds of ornaments. But our knowledge is limited and an absence of certain objects does not necessarily constitute proof of their true absence. One of the difficulties inherent in the study of personal ornaments is that there is a large base of chosen forms and objects common to the entire Upper Palaeolithic and hence without precise cultural value. Moreover, increases in the overall quantity and in the diversity of forms of Upper Palaeolithic personal adornment are very uneven and their status as cultural markers can only be evaluated in relation to the lithic assemblages with which they are associated. It is indeed worth noting that transformations in lithic industries and art/ornamental repertoires have different tempos and rhythms.

The only sound research approach is one which establishes differences through time with respect to a traditional 'fund' of ornaments, the basic source of which is the Aurignacian. When in turn these differences stabilise over several generations, they express a sufficiently stable and original corpus that can serve as a partial basis for defining a new culture. The approach then is to demonstrate a suite of consistent differences with respect to the preceding culture, even if the tradition emanating from this preceding culture is still alive and well.

Fortunately, new objects and forms of personal ornamentation render it possible to identify ensembles that are more fine-grained than the overall cultural division. Often their production is heavily concentrated in a given region (territory) where a group has distanced itself from its cultural predecessors. Essentially, personal ornaments, the final purpose of which is the expression of values, inform us directly about the field of ideas within a group, with the same sensitivity as art but with fewer means of expression. This recognition allows us to ask questions of personal ornaments that relate more to the identification of groups than of cultures.

The long period falling roughly between 30,000 and 20,000 bp saw the transition from the last Aurignacians to the first Gravettians, and then a long-lasting gravettian period that was relatively homogeneous in its style of lithic production, but highly diversified geographically. In its final phases, this Gravettian saw the emergence of distinct,

Fig. 1. Mediterranean seashells: *Cyclope neritea* L.

quasi-contemporaneous groups evolving in different directions.

Two questions are obvious: first, how were ornamental traditions maintained, and second, what is the role of creativity? These two domains must be approached by the category of personal ornaments because their production is subject to different material parameters (availability of raw materials; technical difficulty) according to the type of object.

2. Shell ornaments: 30,000 to 20,000 bp

Of all personal ornaments, those of shell are most dependent on local availability, the presence of contemporary marine shorelines or fossil outcrops. In my opinion, in rare cases these long-distance movements attest to inter-tribal relations founded on needs other than for shells. The continued existence of the aurignacian tradition in shell ornaments and of the role of innovation can only be appreciated region by region.

2.1 Regions close to marine shorelines

What is it that changes over the course of millennia? Firstly, the surface temperature of the ocean, which cools later than that of the continents, and the oceans' salinity which increases with the expansion of the continental ice sheets. The marine shorelines retreat, slightly in the Mediterranean and greatly on the Atlantic coast. There is no indication of significant modifications in the composition of the malacofauna. The traditional species selected by the first Aurignacians are still present. However, around 20,000 bp the most cold-sensitive Mediterranean species, such as *Homalopoma sanguineus* and *Cypraea* sp., migrated to more southerly zones, which explains their rarity in the ornaments of that period.

The choice of certain species in which to invest meaning originates in aurignacian groups in the Mediterranean zone. From the most archaic Aurignacian, we find the same perforated species at Ksar-'Aqil in the Near East, at La Cala and Fumane in Italy, at Tournal in France, and at Romani in Spain: *Homalopoma sanguineus* L., *Trivia europea* Mtg., *Columbella rustica* L., and *Cypraea* sp. are often associated with *Cyclope neritea* L. in aurignacian ornamental assemblages. These species maintain their symbolic importance until the end of the Upper Palaeolithic and some, like *Trivia*, *Cypraea* and *Columbella rustica*, were still sought after by post-glacial peoples (Taborin 1993a, 1997).

The best example of a relationship between Upper Palaeolithic men and the sea comes from the Ligurian culture in Italy, for instance in certain levels of the Grimaldi caves (Mussi 1995). It is the only example demonstrating a development in shell ornaments in coastal populations. It is of course possible that many archaeological sites located on other coastal lines have existed, especially on the Atlantic plateau. With the rise of the sea level, those sites disappeared and thus became inaccessible.

As well as keeping ancestral traditions of shell ornaments, the palaeolithic Ligurian groups gave a special and important role to a classic species of shell: the little *Cyclope neritea*, which the Aurignacians had already imbued with a symbolic sense, becomes dominant in corporal ornaments. Caps, necklaces and bracelets were composed of hundreds of *Cyclope neritea* which were sewn or threaded.

Consequently, one can wonder if the abundance and the easy access to the sources of one shell species is a factor of modification of symbolic sense. A similar case is known from Central Europe where gravettian people, located near a fossil shell level, gathered and used many of these for corporal ornaments. And in Sungir', where there was no access to shells, ivory beads were used and arranged in the manner of Western Eurpean shell ornaments.

Following Roland Barthes' ideas (1967), the meaning of an object (in French: 'le signifiant') is less important than the symbolic sense (in French: 'le signifié'). It is therefore legitimate to think that the same symbolic sense can apply to different types of ornaments. However, in the case of Ligurian ornaments, the proliferation of one shell species can lead one to think that it may express a variety of symbolic senses.

However, *Cyclope neritea* is not the only species exploited by the Ligurian people. A few *Cypraea*, the elongated *Buccinum corniculum*, *Hinia incrassata*, as well as red deer vestigial canines and fish vertebrae are discretely present along the impressive accumulation of *Cyclope neriteae*.

Some ivory beads are interesting because their claviform shape is inspired by red deer vestigial canines or *Cypraea*. The most beautiful examples come from the Arene Candide young man (Giacobini and Malerba 1995). He was wearing four claviform pendants, one near his head, one on his left wrist, and the others near both his knees. Two of the most accomplished beads are very close in shape and decoration to the magdalenian ivory beads of La Marche. This is the best example of continuity and universality of symbolic thought. Despite the rarity of this type of small pendant in the European Upper Palaeolithic, one can see that they were always appreciated.

Thus one can see small changes in the symbolic sense of Ligurian ornaments when compared to the traditional aurignacian one. None of the ornamental objects is new, not even the small ivory or bone pendants. What defines and identifies the Ligurian group for the author is the intensive use of *Cyclope neritea*. This original choice is certainly a good way to define a unity of thought in a local palaeolithic group (Mussi 1992).

The Gravettians-Initial Epigravettians of the rest of Italy do not seem to have had the same commitment to *Cyclope neritea*, nor in fact, to shell ornaments in general (except the woman from Ostuni 1; Coppola and Vacca 1995). We thus note in Barma Grande and Arene Candide a type of ornamentation in the ancestral tradition, but with modifications that can be interpreted as local fashion, rather than any kind of cultural evolution.

In the French Atlantic zone, perigordian groups had access to shells from both ocean shorelines and fossil outcrops in the Aquitaine basin. It is possible that the distance of 200-300 km for the Périgord-Lot cluster made provisioning more difficult. This is however not the case for Isturitz, where the Atlantic shoreline component is abundant. The species chosen for ornamentation are predominantly gastropods and dentalia living on the contemporary Atlantic coast. Diversity is very restrained. From most to least abundant: *Littorina obtusata* L., *Dentalium* sp., *Nucella lapillus* L., *Hinia reticulata* L. and *Littorina littorea* L. These five forms constitute the base but there are other infrequent species, some from the Mediterranean such as *Cyclope neritea*, *Sphaeronassa mutabilis* L., *Cypraea* sp., *Semicassis saburon* Bru., and others just as infrequent that come from the Miocene outcrops of the Aquitaine basin, such as *Turritella terebralis* Lmk., *Mitraria salomensis* Mayer, *Tympanotonos margaritaceus* Brocchi (Taborin 1993b).

The Perigordians of the Atlantic region thus maintained relations with the Mediterranean in an episodic way, but they primarily exploited the Atlantic coast where they selected a small number of species. To get to and from the contemporary beaches, they crossed the Miocene outcrops, and on occasions collected fossil species of similar form to the living species that they recovered on the beach.

Is it possible to identify distinct characteristics of the Perigordian with respect to their aurignacian predecessors living in the same regions and exploiting the same shell sources? The aurignacian choice of shell species for ornamentation is much more open-ended. The five dominant species are, in order of frequency: *Littorina obtusata*, *Littorina littorea*, *Dentalium*, *Nucella lapillus* and *Hinia reticulata*. But there are also significant quantities of *Natica*, *Turritella*, *Trivia europea*, and *Littorina saxatilis* Olivi. The Mediterranean component is more abundant and varied: *Sphaeronassa mutabilis*, *Arcularia gibbosula* L., *Semicassis saburon*, *Homalopoma sanguineus*, *Cyclope neritea*, *Columbella rustica*, and *Cypraea*. The same tendency exists in the shells collected from Miocene beds, of which there are many examples.

The Perigordians in the Atlantic zone retained the same choice of species as the Aurignacians of this region with respect to both Atlantic and Mediterranean species, but they reduced this choice to a very few species, precisely those that were the most numerous in the Aurignacian. The number of shells actually collected is comparable but the choice was more restricted, and *Dentalium* becomes more frequent. This tendency, already noted for the Gravettian of the Mediterranean zone, may well be a cultural characteristic (Onoratini and Combier 1995).

2.2 Regions far from marine shorelines

Regions far from marine shorelines reveal the powerful interest of local groups in sea shells. In Burgundy, Germany, Austria and in Central Europe, the Gravettians and related groups sought to obtain shells because they were part of their culture. Two procurement possibilities exist: the exploitation of fossil outcrops and long expeditions to marine shores. If neither of these was feasible, facsimiles were manufactured in other materials: bird bones for *Dentalium*, and small beads and pendants more or less round in form.

The sites of Trilobite and Renne at Arcy-sur-Cure prove that the Perigordians scoured Eocene fossil outcrops, probably those of the Paris Basin, for shell species resembling traditional, classic forms. For example, *Ampullina* resembles *Cyclope neritea*, and *Bayania lactea* is elongated like *Nucella lapillus*.

In Germany, the Gravettians had access to local fossils (Mainz-Linsenberg, Geissenklösterle, Brillenhöhle) but occasionally were able to obtain Mediterranean species such as found at Mainz-Linsenberg and Sprendlingen.

In Austria, fossil species from the Vienna Basin were collected by the Epigravettians at Grubgraben, where they apparently also found a way to obtain exotic dentalium shells. This is also the case at Aggsbach and Willendorf II (Gravettian), where dentalium shells were found in all levels.

The Aurignacians of this same region focused on the fabrication of beads in ivory. We know little about their shell collection practices. Fossil species from the Vienna region have been found in aurignacian levels at Krems-Hundssteig and dentalium shells were present at Willendorf (Hahn 1972).

The dense gravettian/pavlovian occupation in Moravia has all the characteristics of a local group that developed its own particular values, while maintaining its traditional taste for shells in spite of its great distance from marine shores. This logistical factor may explain the great creativity in ornamental forms fashioned in ivory, in river pebbles, in soft stone and in fired loess (Otte 1981).

Species recovered are often dentalia, sometimes in great numbers, such as in the Francouzská Street burial in Brno. But there are also Tertiary species such as *Melanopsis* from the Miocene and numerous and varied Miocene shell species in Dolní Věstonice I and II, Pavlov I and II, and Předmostí and Milovice (Klíma 1963; Hladilova 1997). A fine-grained comparison with the perigordian exploitation of the Tertiary outcrops of the Aquitaine Basin is possible. The species chosen from the Miocene levels of the Vienna Basin, located less than 20 km from Milovice, are more numerous but largely the same as those chosen by the Perigordians in the Aquitaine Basin.

It is equally interesting to compare closely the two perigordian/gravettian contexts with respect to the species chosen by the Aurignacians in extreme Western Europe. The similarity is striking and is reinforced by the presence of a Mediterranean species at Moravany-Podkovica.

Further east, shell traditions were difficult to maintain due to an absence of fossil outcrops. Nevertheless, sites such as Moravany-Lopata, Zakovska and Certova pec in the Vah valley and Oblazowa in the Bialka valley, show long distance procurement.

Pavlovian/Gravettian groups living near Miocene outcrops showed great interest in shells from these fossil sources, while their Western European counterparts only collected from fossil outcrops when it was convenient, preferring species (the same species collected by their aurignacian predecessors) collected from the contemporary Atlantic or Mediterranean littoral.

3. Animal teeth ornaments between 30,000 and 20,000 bp

In contrast to shells, the availability of animal teeth for ornaments was more or less the same across Europe.

For the French Perigordian, a review of the perforated or circumincised teeth allows an appreciation of the choices made. Fox canines and bovine incisors are the most frequent teeth among all groups, with fox teeth being slightly more abundant in the Pyrenees and bovine teeth slightly more abundant in the Périgord. Red deer vestigial canines are homogeneously distributed but less frequent than the two species mentioned earlier. Canines and incisors of bear, wolf, and lion are present but infrequent in all groups. Horse incisors are even rarer (except on the body of a woman from Ostuni 1; Coppola and Vacca 1995). Some species are found in exceptionally low numbers, such as for example incisors of ibex and reindeer.

In comparing some forty French aurignacian sites with perforated or circumincised teeth, we see that fox canines make up more than one third of the total, followed by bovine incisors and wolf canines. Red deer vestigial canines are relatively less numerous. There is then a slight modification in the Perigordian, with bovine incisors and red deer vestigials taking on greater importance. However, when all French regions are combined, no original contribution to the traditional repertoire on the part of the Perigordians is discernible.

Elsewhere in Europe, the most frequently cited teeth are fox canines, with wolf and bear canines trailing far behind. There are some exceptional cases, such as the horse teeth from the Francouzská Street burial in Brno and from Willendorf II, the red deer vestigials from Geissenklösterle and Hohle Fels, and the wolf teeth from the Dolní Věstonice triple burial. It seems that a general scarcity of red deer vestigials resulted in the fabrication of imitations in ivory and stone.

The Aurignacians in these same regions seem to have exercised a wider choice: fox, bear, horse and wolf canines, and horse, beaver and reindeer incisors.

4. Formed ornaments between 30,000 and 20,000 bp

This category of ornaments allows considerable creativity in raw material choice (ivory, soft stone, bone, antler) and object form. It also allows for the possibility of decorative engraving. As a consequence, fashioned ornaments are exceptionally good group markers. Availability of raw material seems to have played a minor part. Ivory, for example, was certainly easier to find in Central and Eastern Europe than in the West, but it was never absent (Taborin 1992; White 1992).

4.1 Beads and pendants

These two subcategories are distinguishable only by their relative dimensions. Beads, often non-spherical, are merely small pendants. In France, perigordian beads are rare and executed in various materials: jet, bone, amber, ochre, river pebbles. Ivory ornaments are rare.

The most widespread form is the imitation red deer vestigial, with its teardrop shape. These are usually executed in antler or ivory. Elongated pendants are abundant at Isturitz but rare elsewhere. Soft stone, jet and antler are the most frequently employed raw materials. Although ivory was widely used in the French Perigordian, it is not particularly abundant among ornaments. Some pieces are noteworthy, such as the serpent pendant from Brassempouy and the imitation cowrie from Pair-non-Pair (Fig. 2). Apparently in ornamental contexts, ivory was used for extraordinary objects.

Decoration is nonexistent or limited to a few parallel striations. There are, however, some exceptions, such as the pendant with two engraved vipers from Lespugue-Rideaux or the '*bupreste*' in limestone from Masnaigre (Taborin 1987).

The Aurignacians produced thousands of beads, most of them in ivory and from a few sites in the Périgord. Generally, there are few elongated pendants. Ivory was used widely, and also for exceptional pendants, such as those from Tuto de Camalhot and Abri Blanchard (White 1993).

Thousands of ivory beads and some ivory and schist pendants from the Sungir' burials (White 1995) confirm the aurignacian European tendency: the best technology to make beads in series and the need for rich individual ornament. But this example falls outside the geographic references of Western and Central Europe that are the subject of this article.

The attitude of the Perigordians seems to have been a continuation of that of the Aurignacians except for the production of beads in series.

In Belgium and Germany, where the use of ivory is widespread in the Aurignacian, the Gravettians continued this tradition in the production of beads and pendants. Scheer (1992) has shown the importance and the distribution of ivory pendants that imitate red deer vestigials. This form goes back to the Aurignacian, and the best examples come in the Gravettian (Arene Candide) and the Magdalenian (La Marche). It is possible that these objects are part of a wider family linked by their globular and asymmetrical form: red deer vestigials, *Cyclope neritea*, *Arcularia gibbosula*, *Cyprea*, *Trivia europea*, female silhouettes from Gönnersdorf and Roche de Lalinde, and claviform signs. This is one of the strongest indications of the eternal, transcultural values that pervade the European Upper Palaeolithic.

Certain groups adapted this traditional asymmetric form to their own particular contexts: the famous bilobate pendants from Dolní Věstonice I and the bilobate and plano-convex beads from Barma Grande. It is also worth remembering that the *Cypraea* from the male burial at Laugerie-Basse were attached in back-to-back pairs.

Apart from this group with a rather feminine valence, other forms of pendants were created, abundant in Moravia (Klíma 1963), but with isolated examples elsewhere: diadems, hair bands, rings, discs, tubes. Most are in ivory, as are the majority of perforated zoomorphic figures, which are not necessarily personal ornaments.

Fig. 2. Cowrie in ivory from Pair-non-Pair.

This superb ornament production bears little relationship to the Aurignacian in the same region.

5. General aspects of adornment between 30,000 and 20,000 bp

Viewed globally, European ornaments from this 10,000 year period show considerable variability. The Ligurian admirers of *Cyclope neritea* and the pavlovian creators of new forms in ivory and in fired loess were worlds apart! Either they were non-contemporaries or they were just wonderfully ignorant of each other… Their territories are far apart and separated by the Alps. Their cultural origins may even have been different.

What indications are there that these two groups were culturally related? The answer lies in the use of shells. Far from the sea, the Pavlovians exploited Miocene fossil outcrops in their region. They could not find *Cyclope neritea*, which originated more recently than the Miocene. So instead they collected fossil species of a similar form, in the same way as the *Cyclope neritea* deprived Perigordians to the west. The connection is tenuous; it is not personal adornment that demonstrates membership of different groups (over 10,000 years) in the same culture. It merely shows the adherence of distinctly local groups to a set of trans-cultural values.

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Yvette Taborin
Université de Paris I
3, rue Michelet
75006 Paris
France

Martin Oliva

11 The Brno II Upper Palaeolithic burial

The Brno II burial was discovered by accident in 1891, and part of it salvaged by A. Makowsky. Its position on the lowest erosion level of the Svitava River and the upper loess base date it to a time just before the Pleniglacial B. The stratigraphical position thus corresponds with that of known sites of mammoth hunters of the Gravettian (Pavlovian). The burial is characterised by several unusual features: its location outside both the site and the settlement area, the state of health of the buried man (dispersed periostitis, flection of the femur), unusual grave goods such as a male idol (the only anthropomorphic sculpture to be found in a palaeolithic burial), roundels made of different raw materials with symbolic ornamentation, many hundreds of fossil shells of a single type, a large amount of bones from a large game animal, and the absence of any item of practical (i.e., technical) use. The buried man apparently held a significant position in the ritual sphere.

1. Introduction

In September 1891 workers digging to deepen a drainage ditch on Franz Josef Boulevard in Brno (today Francouzská Street) came upon a clump of large animal bones accompanied by several unusual objects. They reported their discovery to a professor at the German technical college, A. Makowsky, who undertook a small salvage excavation there. In 1956, J. Jelínek had an inspection probe sent down in the same general area. However, as this spot lies at least 130 m away from and some 6 m higher than the actual findspot, the profile published by Jelínek *et al.* (1959) is not relevant for the burial site. The site lies on a very gentle southeast incline in the Černá Pole district of Brno, at an elevation of 208 m above sea level, and 230 m from the current bank of the Svitava River.

From Makowsky's description (1892) of the findspot, it follows that the finds were present underneath a thin sand and gravel cover, covered by 4.5 m of uniform loess without foreign admixture. The three surviving samples of the 'cultural layer' of Makowsky's research, in which *Dentalium* shells as well as sandy sediment with small pebbles were found, likewise attest to the nature of the layer where the find was made.

The base of the third ('Husovice') terrace, the sedimentation of which ends in the lower Würm (Musil and Valoch 1961: 238), is found in the northeastern part of the Brno basin, at a height of 5 m above the river. We are therefore dealing here with the remains of erosion activity from later times (perhaps the Interpleniglacial), basically identical with the current level of the flood plain (cf. also Karásek 1992). The burial was probably dug in an elevated section of the flood plain at a time when the river could have accumulated a terrace lying rather more to the east. The flood plain, at an altitude of 203-204 m above sea level, is approximately one km wide here. The achieved erosion level of 203 m above sea level in the Würm Interpleniglacial (?) represents the *terminus post quem* and the massive upper Würm accumulation of loess the *terminus ante quem* for the time of the burial. The chronological position of the burial thus falls entirely within the period of the Moravian Gravettian, which was recently confirmed by an Oxford AMS radiocarbon dating of 23,680 ± 200 bp (Pettitt and Trinkaus pers comm.).

2. Disposition of the burial

We know relatively little about the actual arrangement of the bones and grave goods since a considerable part of the contents was taken by the workers from the excavation site. Makowsky later found a tusk about 1 m long here, beneath which lay the entire shoulderblade of a mammoth and, close beside it, a human skull; near this were other human bones, likewise coloured red. The loess near the skull, from which Makowsky removed some 600 *Dentalium* shells, contained pigment as well. Also found in the burial were a large quantity of possible rhinoceros ribs measuring up to a metre in length, small fragile roundels and crumbling pieces of mammoth ivory, which, glued together, form a male figure. No charcoal or traces of fire were observed, and no objects were found at a distance greater than 2 m from the bones.

Of the disturbed part of the burial Makowsky describes 'some noticeably red stained smaller bones, between which several larger and smaller stone and bone discs were embedded' (Makowsky 1892: 75). Since he does not mention red coloration in connection with the large animal bones from this part of the burial, this apparently refers to human bones (red coloured fragments of human limbs and ribs have even been preserved). The large stone discs mentioned undoubtedly represent the two stone rings already discovered in October

Fig. 1. Human ulna from the Brno II burial with periostitic changes (scale 3:2).

(ibid.: 81). The decorated roundels were probably both found lying near the head in the part of the burial which was examined and between the postcranial skeleton, together with the stone rings. The animal bones were found near the head (mammoth shoulderblade, tusk and ribs) and the lower part of the body (tusks, rhinoceros skull, ribs, horse teeth). There is no reference to the place where the worked reindeer antler was found.

3. Description of the finds

Unfortunately not only the less than perfect circumstances of the find caused a loss of information about this unique discovery. On a later occasion, cases with collected objects, stored at first at the German *Technische Hochschule*, were lost. As Makowsky himself states, one of the two stone rings was lost and many *Dentalium* shells also disappeared over time. After the Second World War, the German technical college was abolished, and its Quaternary collection was transferred to the collections of the Anthropos Institute of the Moravian Museum. Thanks to these circumstances, the find was not lost like so many other unique items from the Moravian Palaeolithic in a fire at Mikulov Castle in 1945.

The anthropological remains and the contents of the burial have always enjoyed considerable interest from both Czech and foreign researchers, who studied these materials while they were still in the collection of the German technical college (e.g., J. Bayer, H. Breuil, H. Obermaier, O. Menghin).

The contents of the burial was subjected to thorough study at the Anthropos Institute in the 1950's (Jelínek 1959; Valoch 1959). I have drawn in part on these descriptions, and supplemented them with new information.

3.1 Human remains

Among the human remains Makowsky found was a dolichocephalic skull with preserved calvarium and a pronounced supraorbital foramen. A small protrusion (osteom), which could have been the result of a healed injury, may be observed 35 mm anterior to the lambda. The brow bone is thickly covered with grooves and unevennesses, which H. Ullrich (1982) considered to be signs of deliberate postmortem intervention. He interpreted the entire burial as the secondary deposition of an incomplete skeleton.

Fragments of the mandible, humerus, ulna, a rib and two femurs have also been preserved. On both femurs and the ulna considerable manifestations of periostitis may be observed (Fig. 1).

3.2 Animal bones

Of the animal bones, only the lesser part has been preserved: a fragment of a mammoth shoulderblade, 7 fragments of the ribs of a mammoth or woolly rhinoceros, and fragments of mammoth ivory. Makowsky (1892: 75-77) states that the workers found a pile of bones, amongst which an entire juvenile skull, parts of the skeleton and teeth of a rhinoceros, large mammoth tusks (original length approx. 1.5-2 m), the teeth of a young horse coloured ochre and, perhaps, 2 molars of a bovine. He himself unearthed a number of ribs of up to 1 m in length (supposedly of a rhinoceros), a tusk 1 m long and the nearly entire shoulderblade of a mammoth, found lying near the human skull.

3.3 Artefacts

- In the vicinity of the skull, Makowsky collected some 600 shells of the Miocene mollusc *Dentalium badense*.

Their original number was probably much higher, and they apparently originally served as decoration for head coverings. A selection of smaller specimens is evident here, and they were often cut perpendicularly at their extremities.

- A reindeer antler with polished extremities.
- A ring of marl slate (Fig. 2), split horizontally into two conjoining pieces. The edges of the fissure are slightly rounded, therefore the artefact was probably already split in prehistoric times. There are red spots and dendrites on the slightly convex dorsal side, while the other side is slightly concave. The outer periphery forms a smooth facet, and the slightly conical aperture is positioned rather eccentrically and non-axially – it forms an angle of about 80 degrees with the surface of the disc. There are traces of abrasion at places in the aperture, running vertical to the surface of the ring, perhaps the result of having been suspended. Dimensions: diameter 140 mm, aperture dorsally 50 mm, ventrally 45 mm, thickness 24 mm, weight 715 g. Another ring, now lost, had a diameter of 150 mm, an aperture measuring 22 mm and a thickness of 24 mm.
- 14 roundels made of various raw materials (Fig. 3: 1 haematite, 2-3 marlite, 4-6 bone; Fig. 4: 1-3 mammoth molar, 4-8 ivory). Some of these are decorated with short incisions on their circumference (Fig. 3: 2-3, 5; Fig. 4: 3-6), a deep radial groove (Fig. 3: 6; Fig. 4: 1, 3) or a central indentation (Fig. 3: 1, 5; Fig. 4: 4, 5, 7), which in one case goes 'through' (Fig. 4: 5). The piece in figure 4: 6 is radially drilled.
- A carving of a man (Fig. 5), of which 3 separate parts have been preserved: the head, trunk and the left arm. The proportions of the head are anatomically very exact, only the forehead is rather low and the mouth is not marked. Part of the nose apparently broke off before the figure was deposited in the earth. Traces of ochre pigment remain visible in the heavily corroded eye sockets, and the ears are indicated by a lateral widening and light vertical grooves at the same height as the eyes. The lower part was partially broken off at an earlier time, or remained unworked. The sculpture was made from the core of a tusk, the centre of which forms the axis of a vertical aperture (diameter below 5-6.5 mm, 2.5 mm at the crown of the head). Examination with a magnifying glass reveals a tangle of very fine grooves (probably traces of work) on the left cheek and the lower part of the left auricle. These are less dense on the right cheek, behind the left ear and on the chin, and are absent on the surface left where the nose was broken off. Dimensions: height 66 mm, maximum width 51 mm, maximum thickness 49 mm.

Viewed in cross-section, the trunk is straight in front and rounded behind. In profile, both outlines are more or less straight, converging slightly as they approach the head. Protruding from the frontal surface are a penis (7 mm), with a slight groove to indicate the mouth of the urinary tract, a navel (2 mm) and the right nipple (3 mm). After treatment, an aperture with cylindrical walls with a diameter of 4 mm and a depth of 6 mm appeared on the markedly smooth and rather reduced surface to the right (anatomically) of the penis. The rounded lower part of the back is furrowed by a 14 mm long, 3 mm deep groove, undoubtedly representing the rectum. Viewed from below, it is evident that here as well the natural axis of the tusk was used to make an aperture running through the entire trunk (diameter below 7-5.5 mm, above 5-6 mm). The entire surface of the trunk shows marked traces of corrosion and has been worn down considerably, even the break on the left side. This argues against the opinion, adopted from Makowsky (1892: 82; Rzehak 1911; Valoch 1959: 25) that this part of the idol was damaged in later times. A magnification of this broken

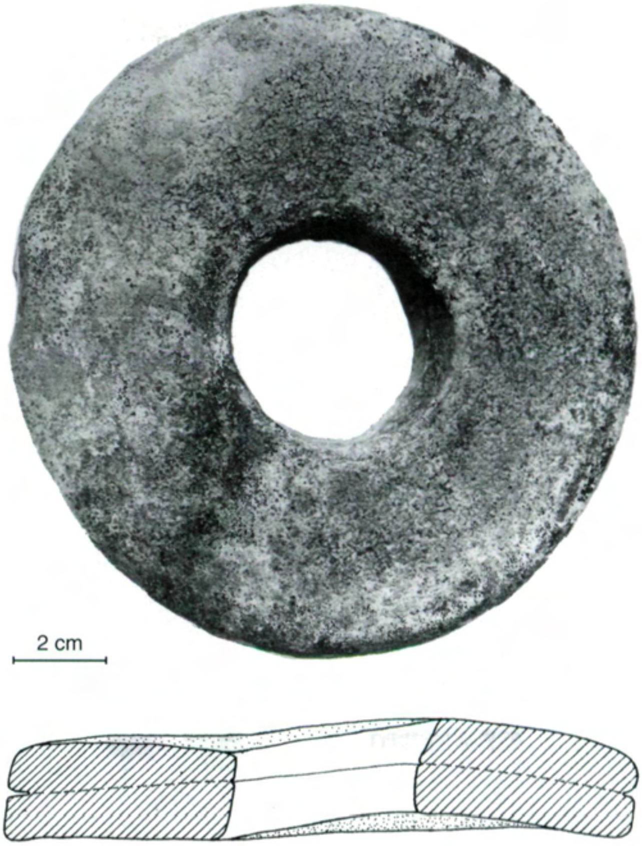

Fig. 2. Brno II, ring of marl slate.

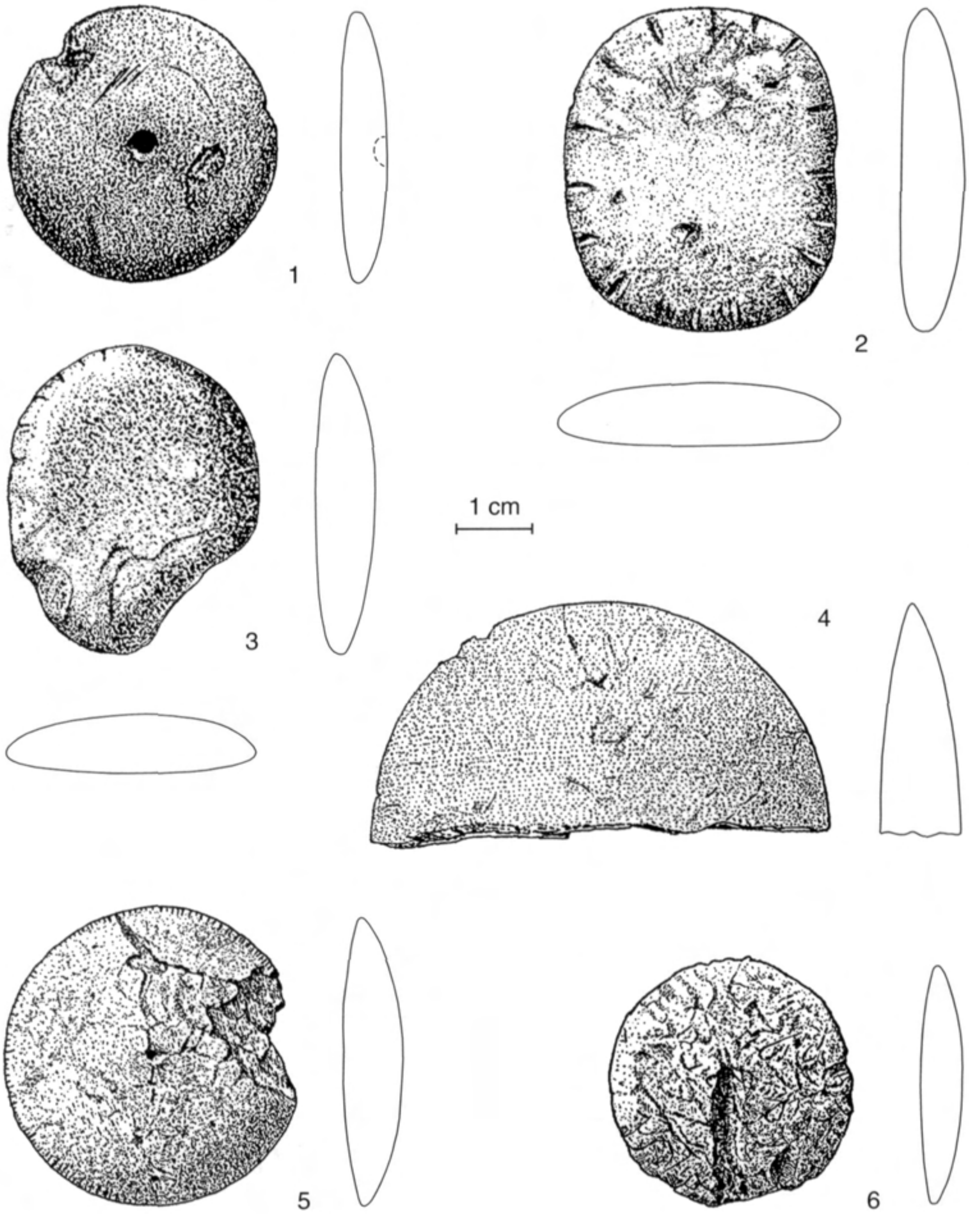

Fig. 3. Brno II, roundels of stone (1-3) and bone (4-6).

surface shows numerous grooves differing in direction, length and degree of sharpness. It cannot be reliably determined whether human activity (the working of the surface) or sediment action played the greater role in producing these grooves. The sharpest and longest incisions are, however, deliberate, as they change direction several times. Grooves which originated naturally run in a straight line or arch slightly (D'Errico and Giacobini 1988: fig. 7-9). Most of these traces of 'work' are found precisely on the broken left side of the sculpture. Dimensions: height 137.5 mm, width above 22 mm, below 37 mm, maximum thickness 52 mm.

The left arm was connected to the idol's left side which was broken a long time ago. It has a round smoothed shoulder and a delicately formed elbow, while the hand is missing (an old break). The inner side of the shoulder is formed by an even surface with two distinct bunches of grooves. One deep groove separates the shoulder from the

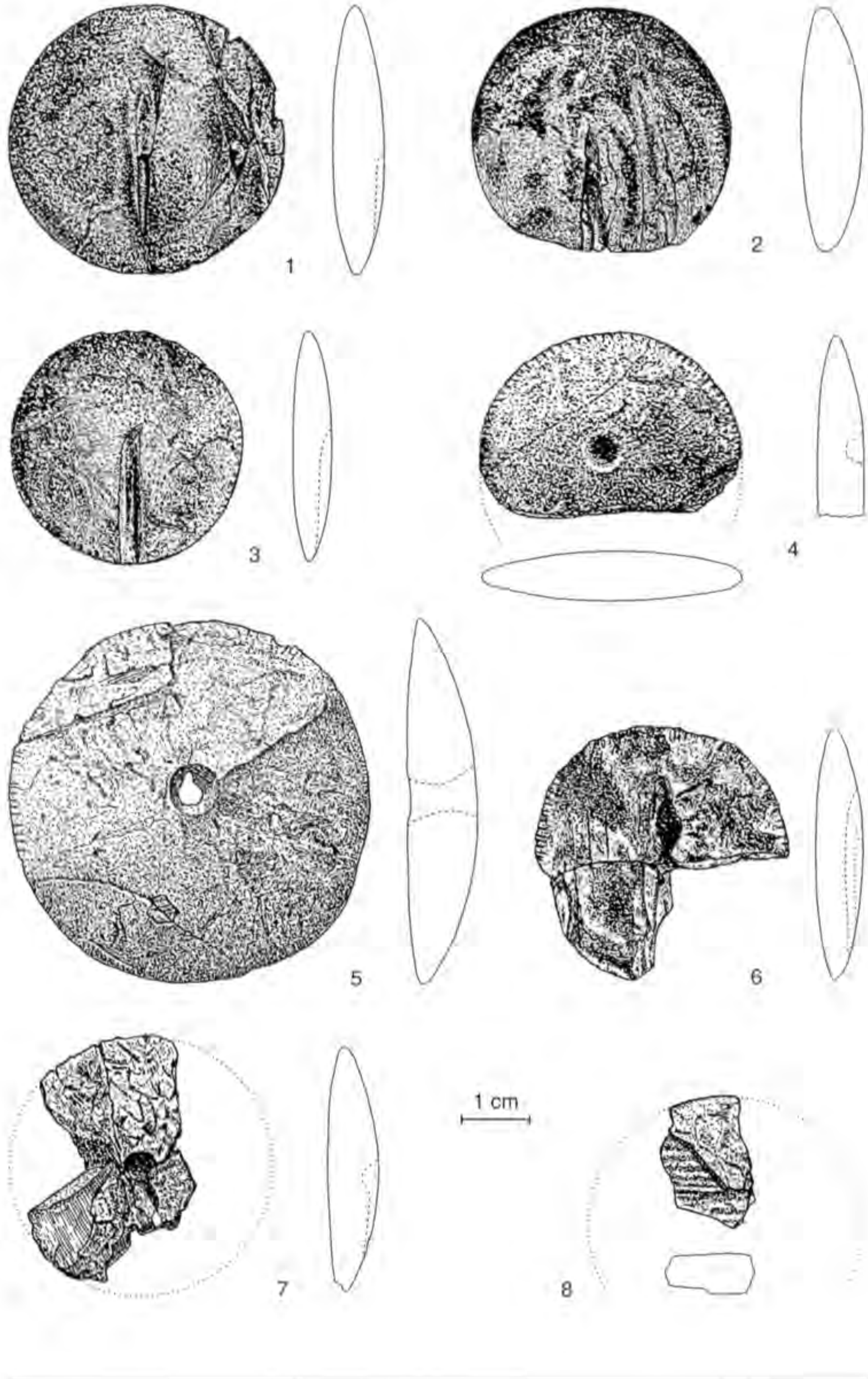

Fig. 4. Brno II, roundels of mammoth molars (1-3) and ivory (4-8).

Fig. 5. Brno II male idol of ivory

arm, while another groove from the inner side of the elbow emphasizes the effect of a bent limb. The surface is corroded. Dimensions: length 98 mm, thickness at the shoulder 23 mm, at the elbow 17 mm.

Makowsky (1892: 82) believed that this was a fragment of a small statue made from a single piece of mammoth ivory. It was only Rzehak (1911) who recognized that the arm could not form a single piece with the trunk because of the disposition of the lamellae, and he therefore assigned it to a different sculpture. Not until much later did Valoch (1959: 20) interpret it unequivocally as a figurine made up of several parts. One can only agree with this explanation. There remains, however, the question of how the individual parts were connected to one another. The head and trunk could perhaps have originally formed a single unit, but then the aperture along the axis of both parts would not be necessary (nor would it have been necessary for the aperture to run through the entire trunk in order to join it with the head). We cannot observe any modification on the intact right side of the trunk which would serve the purpose of attaching the right arm, insofar as this would have been the mirror image of the preserved left arm, i.e., with a vertical surface at the shoulder. It cannot, therefore, be ruled out that the left arm was adapted to the flat secondary breakage on the left side. It fits the trunk best when the upper part of the arm is directed slanting towards the back or, in the reverse direction, with the arm slanting upwards. The reduced polished surface with an aperture at the lower part of the right side of the trunk probably served to attach a movable right leg. The absence of the lower limbs and the right arm need not mean that Makowsky overlooked them in his examination – which is, in any case, very unlikely. Considering the secondary modification of the broken left side of the idol and the overall disintegration of its surface, it may be assumed that the figure was put into the grave in an already incomplete state. The origin of the aperture along the axis of the head and trunk is also unclear. It may be said with certainty only that its presence is deliberate. Either this was a case of the selection of an exceptional piece of raw material with a pathologically extended nerve canal (however, such specimens practically never occur, according to Musil), or the aperture was drilled or widened by some means which cannot be specified in greater detail (cf. the unusual lateral drill hole in the roundel in figure 4: 6).

– A worked fragment of ivory, cylindrical in shape, probably belonging to a different artefact.

4. Discussion

The Brno II burial of a man unquestionably belongs to the Gravettian or Pavlovian, as Valoch (1959) convincingly documented for the first time. The uncommon circumstances of its discovery and its unusual contents, however, distinguish the Brno burial site from other palaeolithic graves. Among these unusual features are, in particular:

– the burial's position in a flood plain, outside the site and the settlement area of the gravettian population in Moravia,
– the state of health of the deceased.

Periostitis is among the so-called non-specific infectious bone diseases (sometimes the term osteomyelitis is used, in which case, however, the entire bone, including the spongiosis, would have to be affected). X-ray pictures of the ulna (Fig. 1) show that pathological changes here are limited to the periosteum. With regard to the fact that pathological changes affect not only the femur but also the ulna and humerus, an infectious or metabolic origin seems more probable, while a traumatic origin may be ruled out. The inflammation was chronic, and the man must have been in considerable pain for years, which undoubtedly manifested itself in his psychological state as well (the connection of this phenomenon to shamanism has been emphasized by M. Eliade [1974: 27-28], among others). Non-specific infectious bone inflammations are common from the Neolithic onward (Steinbock 1976: 82), while no such case from the Palaeolithic was published until 1996. A connection between bone inflammation and the curvature of the femur in the man from the burial on Francouzská Street can be neither proved nor denied. The man from the Brno II burial may be pictured as an unusually robust, muscular individual of middle age (Jelínek 1959: 20-21) with neuroticised chronic pain throughout his entire body.

Another peculiarity involves the unusual grave goods: the Brno II burial was provided with considerable amounts of bones from large game animals; however, the circumstances of the find do not allow a determination as to whether the bones composed some kind of 'tomb' (as, for instance, at Kostenki 2 and 18: Boriskovski 1963; Praslov and Rogacev 1982) or were placed here as symbolic attributes. In contrast to cases of animal bones occurring in graves in palaeolithic settlement sites, their direct connection with the burial is apparent here. The significance of this part of the contents is thus of a more symbolic nature, and is apparently tied with the deceased's exceptional status. There is extensive literature on the transcendental aspects of deposits of bones of large game animals (for example, Holmberg 1925: 34 ff.; Zelenin 1936; Friedrich 1943; Lot-Falck 1953: 202-218; Findeisen 1957: 24-28; Paulson 1963; Eliade 1974: 158 ff.). From this perspective it is not possible to interpret the large mammoth bone dumps found in moist depressions in the vicinity of gravettian sites (Předmostí, Dolní Věstonice I and II, Milovice, Spytihněv) as mere waste material or supplies of raw materials or fuel.

The exceptional status of the deceased is also shown by the large occurrence of decorations made from fossilised

Dentalium badense Partsch molluscs, which never occurred on a massive scale anywhere in the South Moravian Miocene. In the burial on Francouzská Street, these shells were concentrated around the skull, that is, around that part of the body which is most closely associated with transcendental and symbolic aspects (cf. Taborin 1982: 45). Mollusc decorations in Upper Palaeolithic graves in Italy were likewise concentrated around the head (Zampetti and Mussi 1991: 151). The extensive abrasion on the longitudinal ribs of the shells bears witness to long use. The gathering together of such a large number of fossils of the same type could have lasted for several generations.

The male idol found here is the only anthropomorphic sculpture known from a palaeolithic grave thus far (Delporte 1993: 92), and its composition departs from the analogy of the European Palaeolithic in several respects. Figurines representing a human being, often clothed and placed in a household or ritual area, function as amulets or protective spirits with defined powers. The shaman captured the spirit of maladies, people and animals in them (Friedrich 1941-43: 30), and they became thus the instruments of various ritual performances (Dupré 1975: 90-91), often in connection with hunting magic – luring out the shadow soul of the animal (Paulson *et al.* 1962: 79, 81).

The most important shamanistic tool is, of course, the drum. Its existence in the Brno II burial is perhaps evidenced by the polished reindeer antler. Although in this form it could have served as a soft hammer in the fabrication of the chipped industry, the smooth surface of its functional part rules out such a use (cf. E. Boëda). It is therefore possible that it was a drumstick.

The set of decorative roundels has a certain analogy with that in Kostenki, namely, the round silt objects from Kostenki 1 and 4 (Abramova 1962). Particularly noteworthy is the fact that their execution is similar (and always perfect in terms of craftsmanship), even though the raw materials used varied, requiring different processing techniques. The most demanding must have been the three roundels made of rough-outs, which were obtained by dividing mammal molars diagonally to their natural lamellar structure. The marginal incisions are so light and inconspicuous that we might hesitate in designating them as decorative elements; perhaps they had some hidden meaning known only to their possessor. With the exception of the one item that is drilled through, the objects lack any kind of modification which would allow them to be strung or sewn on, thus excluding them from the large range of decorative objects of the Moravian Gravettian. This could be a case of cosmological symbols expressing 'centre' and 'radiation'; nor can a sexual significance of these deep radial grooves be ruled out (Breuil 1924: 549; Valoch 1959: 28).

Shaman circles, which our rings distinctly resemble, also served as cosmological symbols (Eliade 1974: 29, 148). A practical function has never been convincingly determined for them, and it is interesting that such a ring was also found near the mass grave in Předmostí (Valoch 1960). Isolated deposits of entire series of such objects have also been encountered in Moravia (Jiřice, Bořetice?). They recall the circular pectorals found in the shaman's grave at Ust'Uda in Siberia (Okladnikov 1975: tab. 126).

The analogies with sub-recent shamanism shown by the Brno burial site are truly surprising, and certainly could be due in part to chance. In any case, they indicate the deceased's exceptional status in the religious and ritual sphere. If this were merely a gravettian hunter, why would he be buried alone in open terrain outside the settlement, and equipped for the next world solely with objects which cannot be used either as weapons or for decoration?

Several of the themes of palaeolithic art (Clottes and Lewis-Williams 1996), the conspicuous depositing of bones (Ozols 1971; Tromnau 1992) and several burial sites have often been presented as possible evidence of prehistoric shamanism. Besides the Brno II burial, the burial sites at Paviland and Grimaldi-Grotta del Caviglione are also included in the Gravettian. Both were discovered in the last century and information about them is not precise (cf. May 1986). The grave of a man from Arene Candide in Liguria (Cardini 1942, lower Epigravettian) and that of a woman from St. Germain-la-Rivière (Blanchard *et al.* 1972, Magdalenian) stand out for their unusually rich furnishings.

Each of these graves exhibits certain features which may be linked to the exceptional status of the deceased in the ritual sphere: non-profane objects, roundels, rich ornamentation around the head, pathological phenomena, the bones or horns of large game animals, or the unusual design of the grave. The graves mentioned are also characterised by the distinct presence of ochre, which has been found in only half of all recorded palaeolithic burials (Binant 1991: 129). This indicates the prestigious status of those individuals who, even after death, were represented otherwise than as brave hunters.

Of all these graves, the one found on Francouzská Street in Brno is the oldest and, at the same time, the one which provides the most complete selection of 'shamanistic' attributes. 'Religionists' will presumably not be satisfied with such an assertion. They will find, for instance, that evidence of the ecstatic practices essential for a shaman is lacking. Although the similarity of attributes could attest to the existence of similar mechanisms, the question of which ideas, which myth they were derived from still remains.

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Martin Oliva
Moravské Zemske Muzeum
Zelný Trh 6
65937 Brno
Czech Republic

Lars Larsson

12 Plenty of mammoths but no humans? Scandinavia during the Middle Weichselian

Because of the almost total glaciation of Scandinavia during the Late Weichselian, the evidence for conditions during the Middle Weichselian is extremely fragmentary. Much of northern Scandinavia was probably covered by land ice, and in the southern parts the period ended with a rapid glaciation process slightly before 20 kyr bp. The existing palaeoecological analyses show arctic to subarctic vegetation. Fauna is mainly documented through parts of mammoth skeletons. Radiometric datings show the presence of this large gregarious animal in Denmark and southern Sweden until c. *20 kyr bp. There is no unambiguous evidence of human presence during the Middle Weichselian. Since there was land contact between southern Scandinavia and the continent, there were no geographical obstacles to prevent people from settling in the area. The fact that the area was used by herds of herbivores should have made it attractive to humans. Because of the much lower and hence today inundated coastal zone, there are no direct remains of coastal settlement from this period in Europe. During the deglaciation phase at the end of the Late Weichselian there was rapid colonisation of the long Atlantic coast of Scandinavia. This suggests that knowledge and use of marine environments was built up over a long period. Coastal settlement during the Middle Weichselian may therefore have been a significant feature of Western European settlement.*

1. Biological data

Because of the destructive effect of the land ice, along with changes caused by the deglaciation, there are few remains that can be dated to the Middle Weichselian (Mangerud and Berglund 1978). Very few limnic deposits with organic content in southern Scandinavia dating from after the Brørup and Odderade interstadials have been assumed with certainty to be *in situ* (Andersen 1979; Berglund and Lagerlund 1981; Kolstrup 1992).

On the island of Sejerø in the southern Kattegat, a pollen bearing sequence consisting of some organic content in clayey sand and silt has been dated to *c.* 36 kyr bp (Houmark-Nielsen and Kolstrup 1981) and should therefore be correlated with the Hengelo interstadial. The pollen analysis shows that *Pinus*, *Salix*, and *Betula* together comprise less than 10% of the pollen content. Cyperaceae and Gramineae dominate. Thermoluminescence datings of meltwater deposits in southwest Denmark show that the land ice reached these areas between 22 and 20 kyr bp (Kronborg 1983).

A fluvial deposit covered with till beds from Gärdslöv, in southernmost Sweden, has been dated between 32 and 21 kyr bp (Miller 1977); it shows a certain admixture of organic material (Berglund and Lagerlund 1981: 354). The vegetation can be interpreted as arctic-subarctic.

As regards the evidence from Norway, it suggests that the Atlantic coast was free of ice around 30 kyr bp and that there was fauna indicating a relatively warm period, called the Ålesund interstadial (Mangerud 1991). A cover of ice probably began to form after this in the higher parts of Norway (Sejrup *et al.* 1994). There is considerable uncertainty about the extent of the land ice but it probably was at its greatest between 29 and 22 kyr bp. It is possible that the outermost coastal tracts were ice free during all or most of the last glaciation.

In northernmost Scandinavia there are several locations with organic deposits from the Weichselian (Hirvas *et al.* 1981; Lagerbäck and Robertsson 1988; Olsen 1988). This is because there was extensive permafrost and limited movements in the ice covering the area after the Eemian. An ice-free stage in the northeastern part of Sweden preceding the last glaciation is designated the Tärendö interstadial (Lagerbäck and Robertsson 1988; Aronsson *et al.* 1993). This is characterised by steppe vegetation with some shrubs and birch but also by stages with intensive frost weathering. The Tärendö interstadial may possibly be contemporary with the Odderade. No younger organic deposits are documented, which might mean that the stage preceding the glaciation comprised a cold period in which the glaciation began much earlier than it did further south.

Opinions are divided about how far south the ice sheet may have reached during the Middle Weichselian. It is also possible that the extent of the ice sheet varied significantly (Andersen and Borns 1994: 53; Lundqvist and Robertsson 1994: 124; Donner 1995).

2. Fauna

The period before the extensive glaciation in the late part of the Middle Weichselian comprised a vegetation showing

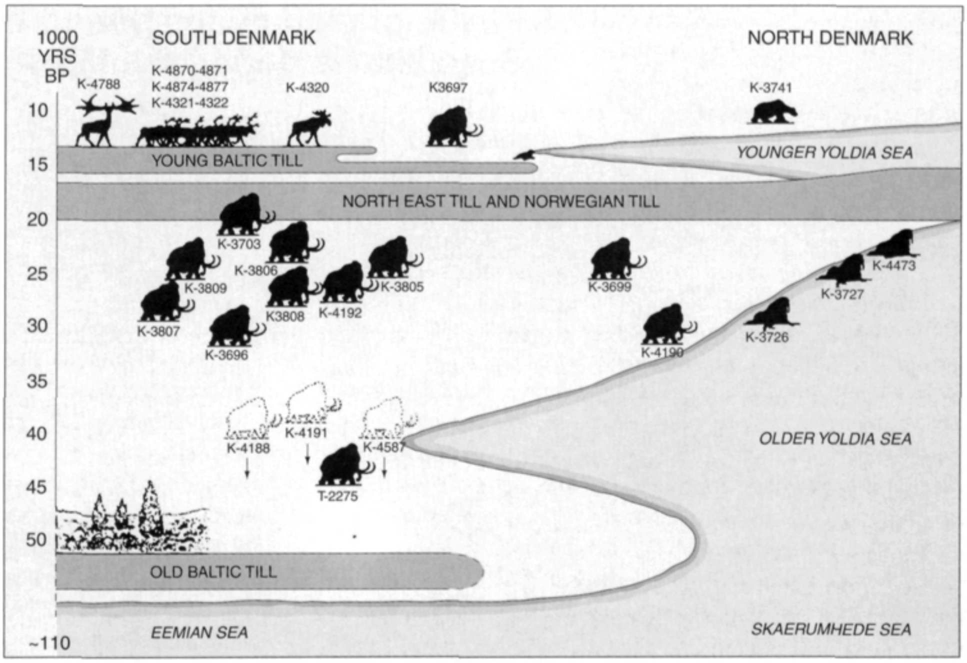

Fig. 1. A tentative presentation of the relation between land and sea in Denmark, and the occurrence of certain animal species based on ^{14}C datings. (After Aaris-Sørensen *et al.* 1990)

considerable similarities to a mammoth steppe as defined by Guthrie (1982). The finds of mammoth show that living conditions were good for certain animals. A considerable amount of material has been found. The dominance of mammoth may be due to that fact that the large skeletal parts of these animals are best able to survive the decomposing forces associated with glaciation and the subsequent course of deglaciation. These skeletons are also easiest for nonexperts to detect when quarrying or digging. There are 125 finds from Denmark, over twenty from Sweden, somewhat fewer from Norway (concentrated in the south), and nine from Finland (Aaris-Sørensen *et al.* 1990; Lepiksaar 1992). Of these finds, 15 from Denmark have been ^{14}C dated.

Three samples gave infinite values, one find dated to *c.* 45 kyr bp, one dated to the Late Weichselian (13,240 ± 760/690 bp) (K-3697), whereas ten finds, scattered over the whole of Denmark, gave values between 32,460 ± 970/870 bp (K-4190) and 21,530 ± 420 bp (K-3703) (Aaris-Sørensen *et al.* 1990) (Fig. 1).

Datings of mammoth finds in southern and western Sweden agree well with the Danish results. Of four datings, one is Late Weichselian – three values between 13,360 ± 390 bp (Lu-796) and 13,090 ± 120 bp (Lu-796:2) – while the other three gave values of 36,000 ± 1550/1300 bp (Lu-880), 31,200 ± 3000/2650 bp (Lu-746), and 22,000 ± 900/800 bp (Lu-887) (Berglund *et al.* 1976: 185). Although there are few datings from the area outside southwest Scandinavia, they corroborate the same pattern as in southwest Scandinavia. The four Norwegian ^{14}C dated mammoth finds give values between 46 and 19 kyr bp (Berglund *et al.* 1976: 184). Finds of mammoth in the southern part of northern Sweden probably belong to an Early Weichselian interstadial; this is supported by an infinite value given by a radiometric measurement (Lundqvist 1974; Lundqvist and Pleijel 1976).

The mammoth had suitable living conditions in the latter part of the Middle Weichselian, as is partly evident from the palaeoecological data. The datings also show that mammoth occurred in southwest Scandinavia as late as 22 kyr bp, probably slightly later, thus supporting the hypothesis that the development of land ice in this area followed a rapid course not preceded by any protracted fall in temperature.

The existence of an environment suitable for mammoth also suggests that several other animal species may have existed (Kahlke 1994) in certain parts of Scandinavia. Finds of parts of skeletons of *Megaloceros giganteus*, *Rangifer tarandus*, *Ovibos moschatus*, and *Bison priscus* have been taken to belong to the Middle Weichselian (Aaris-Sørensen *et al.* 1990: 27; Aaris-Sørensen 1992). A find of musk ox from the west coast of Sweden has yielded a date of 32 kyr bp (Liljegren and Lagerås 1993).

Of special interest are three finds of walrus, *Odobenus rosmarus*, from northern Denmark, ^{14}C datings of which show them to belong to the period 31-23 kyr bp (Møhl 1985). These finds which, like the mammoth, come from the biggest species in its particular environment, had the greatest resistance to decomposing forces. Their skulls and tusks are also easily identifiable by the general public as differing from other material. The walrus finds indicate the occurrence of a rich marine fauna where different species of whale, seal and fish must have occurred.

In cave deposits from a coastal site of western Norway there are finds of bones from a considerable number of sea birds, reindeer, and arctic fox. No clear evidence was found of human presence in this cave. The datings indicate that the deposit comes from a milder period – the Ålesund interstadial – which is dated *c.* 30 kyr bp (Larsen *et al.* 1987). The occurrence of reindeer and arctic fox suggests that there were certain ice-free zones along the coast. Datings of reindeer in the same coastal region with values around 12.5 kyr bp can hardly be explained by immigration of this species in the initial stage of the deglaciation (Lie 1990). The most probable explanation is that there were refuges on the west coast of Norway which were big enough to provide a habitat for a herd of reindeer during the glacial maximum, as well as during a considerable period before this.

3. Human activity?

Traces of human presence in Scandinavia during the Middle Weichselian are highly uncertain. A dozen flakes which may date from the period prior to the most recent glaciation have been found in a series of gravel pits at Seest, on the western outskirts of Kolding, southeast Jutland (Westerby 1957). The finds of animal bones and flint artefacts originate from at least seven gravel pits in the Kolding Ådal. The sediments in the gravel pits consist for the most part of fluviatile sand and gravel deposits. Unfortunately, all the artefacts were found in secondary positions. The most likely explanation is that the sand and gravel deposits from which the bones and flint come were deposited by meltwater during the Late Weichselian, but a dating to the Early Weichselian cannot be ruled out (Holm and Larsson 1995).

In connection with a rescue excavation at Rollsbo in western Sweden, charcoal was found in transgression layers (Hernek 1996). No artefacts were found, however. A radiometric dating of charcoal from this horizon gave a value of 29,980 ± 740 bp (Ua-5476). The charcoal was probably found in secondary position, and it is not possible to determine its relation to any human activity that may have occurred.

Although traces of human activity in the Middle Weichselian can be questioned, certain factors should be seen as important circumstantial evidence for the presence of man in Scandinavia at this time. The mammoth steppe with its fauna was an attractive environment for humans. As geological studies have shown, there was a narrow strait between continental northern Europe and the Fennoscandian peninsula (Fig. 2), which would have allowed migration for seasonal occupation or for other reasons.

In northern Russia, where the last glaciation did not have a great destructive effect, settlement sites have been found up to the 64th parallel (Pavlov and Indrelid, this volume). This latitude divides Scandinavia into two areas of roughly equal size. In addition, the effect of the North Atlantic on northern Scandinavia would probably have been on such a scale that the climatic conditions that allowed settlement in northern Russia must have existed in parts of Scandinavia.

Marine sediments show that a broad inlet of the sea reached in as far as the present-day Kattegat, covering the north of Jutland, while considerable parts of the North Sea were dry land (Houmark-Nielsen 1989: fig. 11; Petersen 1985: fig. 4) (Fig. 2). A freshwater basin covered parts of the southern Baltic with an outflow diagonally across Scania. Opinions are sharply divided, however, about the extent of the land ice during the period 30-22 kyr bp. Some scholars think that large parts of the Fennoscandian peninsula were ice free, while others say that only southwestern Sweden and parts of the Norwegian Atlantic coast were ice free.

The distribution of settlement remains during the last glacial maximum shows that traces of human activity occur a few hundred kilometres south of the ice margin (Otte 1990: fig. 3.5). Roughly the same pattern can be detected at the ice margin in Late Glacial times in northwestern Europe. There does not seem to have been any settlement in the vicinity of the ice. Settlements during the Gravettian in the northern parts of continental Europe are located at a considerable distance from the maximum extent of the land ice (Weniger 1990: fig. 9.1). If this distribution reflects true conditions, the distance of these sites from Scandinavia would seem to suggest limited or no utilization of this area by the people settled in northwestern Europe during the ten thousand years immediately preceding the glaciation. In contrast, the settlement on the Russian Plain appears to have come closer to the ice margin than in western Europe (Soffer 1990). This can be well related to the new findings of studies of the northern Ural areas (Pavlov and Indrelid, this volume). This could be viewed as suggesting that contact between a postulated settlement in Scandinavia and its continental counterpart would chiefly have been maintained through eastern connections.

When considering the spread of settlement in the Upper Palaeolithic, coastal settlement is of limited interest on account of the find situation. Because of the lower water level during much or all of the Weichselian, what was then the coastal zone is now under water.

Although there are no coastal settlements preserved, finds from inland settlements nevertheless show some evidence of coastal contacts. At Late Upper Palaeolithic sites in southern

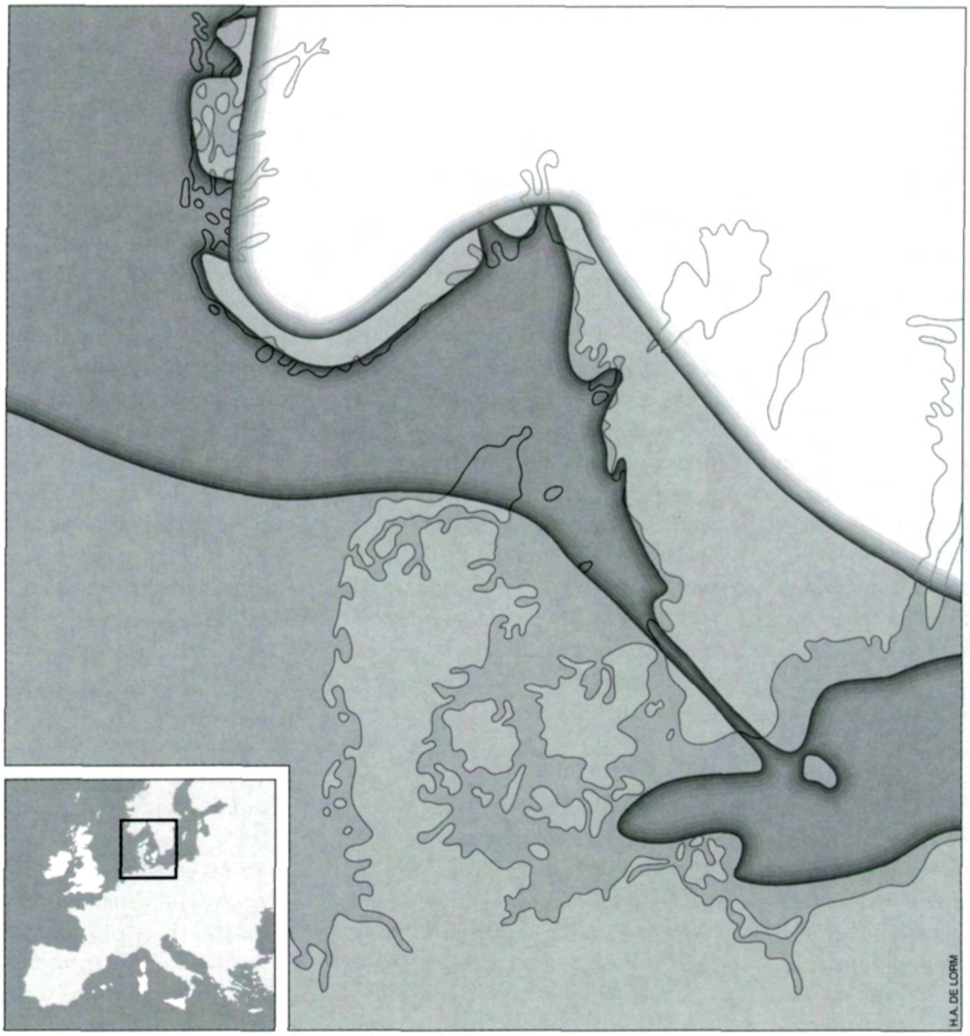

Fig. 2. The relation between land, water, and ice in southwest Scandinavia 35-25 kyr bp, based on *Houmark-Nielsen 1989*.

Europe, finds have been made of bones of fish, birds, and mammals from a marine environment (Cleyet-Merle 1990; d'Errico 1994; Burov 1995; Cleyet-Merle and Madelaine 1995). Ornaments made of seashells collected on the shores of the Atlantic Ocean, Mediterranean Sea, and Black Sea were popular in Late Upper Palaeolithic societies. They appear in the graves from this period, and are also found at some settlement sites far away from the coast. Shells have been found at central European sites and on the Russian steppes (Strauch and Tembrock 1978: 231 ff.; Soffer 1985: 440 ff). These finds must be taken as an indication of coastal activity during this period. In palaeolithic art we occasionally see depictions of marine fauna such as the great auk, seal, and flat-fish (Cleyet-Merle 1990; Clottes and Courtin 1994; d'Errico 1994; McDonald 1994; Cleyet-Merle and Madelaine 1995). These are found as far as 200 kilometres inland from the present coast.

In the north of the Iberian peninsula there is evidence of the collection of marine molluscs as food during the Solutrean (Straus and Clark 1986: 354). These finds indicate that coastal exploitation and fishing in the sea had some kind of importance even far from the coastal zone itself.

Environmental conditions during the deglaciation in southwest Scandinavia show significant similarities to those that existed before the glaciation. However, there is still no evidence to suggest that human migration into the interior took place in direct conjunction with the retreat of the ice. The probable reason for this is that the ice melted quickly (Björck *et al.* 1988), which led to a delay in the establishment of a flora attractive to the arctic fauna. The situation is completely different when we consider the utilization of new stretches of coast which emerged from the ice. A fauna-rich environment could be established very quickly here. The oldest stretch of coast with good preservation conditions, thanks to banks of shellfish and other factors, is found along the Swedish North Sea coast (Fredén 1988), which is easily accessible for investigation thanks to uplift. Finds of bowhead whale, blue whale, and white whale, of bearded seal, harp seal, and ringed seal, as well as several species of saltwater fish, have been documented (Liljegren and Lagerås 1993). Several finds of polar bear have also been made (Berglund *et al.* 1992).

The oldest finds of human settlement are dated *c.* 10 kyr bp (Kindgren 1996). The location of the sites, and the fact that the coastal zone was less than 100 km from the ice margin, shows that the economy was distinctly oriented to marine food. The number of settlement sites until 9.7 kyr bp, when the arctic/subarctic fauna disappeared, is very large, not least in relation to the number of inland sites in other parts of Northern Europe. This shows that the coastal zone was already well utilised in the initial phase of immigration. Along the Norwegian Atlantic coast, during the deglaciation there was a fauna corresponding to that of the west coast of Sweden (Bang-Andersen 1996). The oldest settlement in southwest Norway can be dated *c.* 10 kyr bp. The oldest settlement remains in northern Norway are of roughly the same age (Thommessen 1996). This shows that land was quickly occupied along a stretch of coast 1600 km long, not counting the fjords.

With the present state of research, we have no knowledge of coastal settlement during the Weichselian. However, the oldest coastal zones accessible for investigation show considerable human exploitation. In view of the indications from the interior mentioned above, and the evidence from the coast of Northern Europe, there are good grounds for assuming that coastal settlement was significant in a late part of the Upper Palaeolithic. From other parts of the world, such as Africa and Australia, there is evidence showing that humans were able to use the marine resources and to travel by boat over open waters during the Middle Weichselian (Troeng 1993: 152). There is therefore every reason to suspect that hunting, fishing, and gathering in the coastal region was part of Western European settlement even in the period before the large-scale glaciation.

We get food for thought when analyses of inland settlement consider factors such as seasonal migrations, resource utilization, and population density. It is unfortunate that the studies that have been conducted of the floor of the North Sea and the North Atlantic in connection with oil prospecting have not been done in conjunction with archaeological experts. There are Late Glacial remains on the bed of the North Sea. A flint flake was brought up by chance by a drill core from a depth of 143 m (Long *et al.* 1986). It should have been possible to work out reasonable settlement models and to look for sites on the basis of these models. Through successful efforts on a similar basis, it has been possible to localise sites of Mesolithic age in underwater positions in eastern Denmark and southern Sweden (Larsson 1983, 1999; Fischer 1995). The finding of Upper Palaeolithic settlement sites near the coast requires much greater efforts. In view of our very poor knowledge of what was a very significant environment for humans, this work would be an important contribution to palaeolithic research.

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Lars Larsson
Institute of Archaeology
University of Lund
Sandgatan 1
22350 Lund
Sweden

Pavel Pavlov
Svein Indrelid

13 Human occupation in Northeastern Europe during the period 35,000 - 18,000 bp

Upper Palaeolithic sites have been discovered in the Northern Urals between 50°-68° North, and 60°-70° East, which provide evidence of the colonisation of a subarctic environment before the LGM. A first group of sites, all in the open, is dated between 36 and 25 kyr. The lithic industry belongs to the so-called 'biface tradition', and displays links with the Kostenki-Streletzkian culture. The second group includes both cave and open air sites, which are related to a human occupation starting no later than 18 kyr. The lithic industry belongs to the 'blade tradition'. Horse remains are dominant at most sites of the first group, with the exception of Byzovaya, where they nearly all belong to mammoth, probably drifted ashore after catastrophic drowning. Reindeer remains prevail at all sites of the second group.

1. Introduction

In this paper we will present data concerning the Upper Palaeolithic settlement in the northern part of Northeast European Russia and discuss problems relevant to the initial settlement of this region.

The sites in question are dated to the period *c*. 35,000-18,000 bp and are situated northeast of the Russian Plain, near the western foothills of the North and Sub-Polar Ural mountains, between latitudes 58°-68° north and longitudes 60°-70° east. The sites are located within two large river basins, the Kama river, which drains into the Caspian inner basin, and the Pechora river, which drains into the Arctic Ocean. At present this part of Russia includes several climatic and vegetational zones, from the arctic tundra to the southern part of the taiga.

The first palaeolithic sites in this extreme northern part of Europe were discovered in the Pechora Sub-Urals in the beginning of the 1960's by V.I. Kanivets and B.I. Guslitser. These sites are the Medvezhya cave at latitude 62° north, and the Byzovaya site at latitude 65° north (Guslitser and Kanivets 1965; Kanivets 1976). Together with the Talitsky site at latitude 58° north, situated in the Kama basin and discovered by M.V. Talitsky in 1938 (Talitsky 1940; Bader 1960; Sherbakova 1994), these sites remained for many years the only sources of evidence for Upper Palaeolithic settlement in the European high latitudes.

New data were collected by P.Yu. Pavlov and B.I. Guslitser during the years 1982-1992. These investigations continued in 1994 and were carried out by the present authors within the framework of the joint Russian-Norwegian interdisciplinary research project PECHORA (Paleo Environment and Climate History Of the Russian Arctic). The project is financed by the Norwegian Research Council, the University of Bergen, and the Ural Division of the Russian Academy of Sciences.

2. The northernmost Upper Palaeolithic sites of Europe

The Upper Palaeolithic sites in the northeastern part of European Russia are divided into two chronological groups: one from the Middle Valdai interpleniglacial (40,000-24,000 bp) and the early part of the Late Valdai glacial (23,000-16,000 bp), and one from the very end of the Pleistocene/Late Glacial period (Pavlov 1988; Guslitser and Pavlov 1993a). In the present paper we will only consider data belonging to the older of the two groups. This material is primarily derived from a few excavated or partially excavated sites, of which six will be briefly presented here.

Material from three of the sites (Talitsky, Byzovaya and Medvezhya) has been published in Russian, but with a few exceptions (Guslitser and Pavlov 1993a and 1993b with references) not in a western language, which may be the reason why these sites are little known to western scholars.

The sites of Garchi I, Mamontovaya Kurya and Pymva Shor I have recently been excavated by the authors and have not been published before.

2.1 Talitsky

The Talitsky site is situated on the Chusovaya river, a tributary of the Kama river, at latitude 58° north (Fig. 1). The available archaeological and geological data indicate a date during the Bryansk interstadial (30,000-24,000 bp). The only available radiocarbon date, about 18,000 years bp, is younger than the expected archaeological age and is rejected (Sherbakova 1994).

The faunal material of the site includes reindeer, mammoth, horse and lemming. The archaeological inventory is characterised by prismatic and unifacial cores, but also flat

Fig. 1. The main Upper Palaeolithic sites in the central part of Eastern and Northeastern Europe.
1: Kostenki; 2: Sungir'; 3: Talitsky; 4: Garchi; 5: Medvezhya; 6: Byzovaya; 7: Mamontovaya Kurya; 8: Pymva Shor.

cores occur. Blades and blade tools are frequent, of which endscrapers, sidescrapers, truncated blades, backed blades and blades and microblades with lateral retouch are characteristic. Round flake scrapers occur, as well as notched pieces, shouldered borers, nosed tools and scaled pieces. Together with this material were also found large, massive tools such as choppers and large sidescrapers. Among the bone inventory beads, needles, points and hacks may be mentioned.

The cultural connections of this site are disputed. Talitsky (1940), Bader (1960) and Pavlov (1988) believed that the site may be connected with Siberian Upper Palaeolithic cultures, while Efimenko (1953) and Rogachev (1961) emphasised the similarities with the Kostenki-Gorodtsovskaya culture and looked for an East European origin. Some authors have also discussed the possibility that the Talitsky site may represent a special Urals tradition of the Upper Palaeolithic cultural development (Petrin 1986; Sherbakova 1986).

2.2 Garchi I

The Garchi I site is situated on the top terrace of the right bank of the Kama river at latitude 59° north (Fig. 1). There are two find concentrations on the terrace, about 75 metres apart. Charcoal from a hearth in the main concentration has yielded a radiocarbon date of 28,750 ± 795 (TUa-941).

Almost all tools are made of flakes. Most cores are flat. Scrapers form the most frequent category, of which practically all have a triangular or oval shape with ventral retouch. Some of the scrapers have high edges and are typologically close to aurignacian types.

Triangular bifacial points may be divided into three types. The first one has a notched base, typical for the early Kostenki-Strelezkian sites. The second type is represented by elongated points with a straight base, of Sungir' type. The third type may be described as a large point with a well-marked base angle.

The sidescrapers show straight longitudinal forms made on blade-like, large flakes with a unifacially retouched working edge from the dorsal surface. Two fragments of scrapers with concave edges have double-sided retouched working edges.

The archaeological material of the Garchi I site is a close parallel to that of Kostenki I, layer 5 on the Upper Don.

The faunal remains of Garchi I are scarce, due to unfavourable preservation conditions. However, bones of reindeer, horse and mammoth have been identified.

2.3 Medvezhya cave

The Medvezhya cave site is situated on the upper Pechora at latitude 62° north (Fig. 1). There are three dates from the cultural layer: 16,130 ± 150 bp (LE-3060), 17,980 ± 200 bp (LE-2876) and 18,700 ± 180 (GIN-8399). These dates are much younger than the age suggested by Guslitser and Pavlov (1992), based on geological and paleontological data (30,000-25,000 bp).

The archaeological inventory includes types like endscrapers on blades, round flake scrapers, notched pieces and truncated blades, blades and microblades with lateral retouch, and nosed tools. Some heavy tools, especially large sidescrapers contrast by their size with the rest of the lithic material. Among the bone inventory, small mattocks, points and hacks made of ivory may be mentioned.

The stone and bone implements of the Medvezhya cave show many similarities with the material of the Talitsky site, as well as other palaeolithic cave sites of Northeast European Russia.

2.4 Byzovaya

The Byzovaya site is situated on the right bank of the Pechora river at latitude 65° north (Fig. 1). The following radiocarbon dates have been obtained from the cultural layer

Fig. 2. Mammoth tusk with incisions, Mamontovaya Kurya.

of the site: 33,180 ± 2030 (LU-4007); 29,170 ± 340 (LU-3983); 29,160 ± 430 (LU-3979); 28,510 ± 310 (LU-3992); 28,485 ±290 (T-13439); 28,230 ± 920 (LU-4010); 27,915 ± 365 (T-13441); 27,740 ± 480 (T-11498); 27,490 ± 330 (LU-3989); 27,110 ± 240 (LU-3995); 25,740 ± 500 (LE-3047); 25,540 ± 380 (Guslitser and Liiva 1972).

The archaeological material is characterised by an extremely high frequency of tools. More than 40% of all stone artefacts are tools. Cores are represented by prismatic and flat forms, the main blanks for tool making being flakes. Leaf-like bifaces are present. Scrapers with high edges occur, but types with flat edges on elongated blanks are more frequent. Specimen with double edges are also known. Flakes with denticular and fine marginal retouch are very common. The range of implements also includes choppers and large tools of hammer-types.

Mammoth bones represent 98% of all the faunal material at the Byzovaya site. Remains were also found of reindeer, horse, musk ox, brown bear, wolf and lemming.

2.5 Mamontovaya Kurya

The Mamontovaya Kurya site is situated on the left bank of the Usa river, a tributary of the Pechora, at latitude 66^{O} north, just on the polar circle (Fig. 1).

A 40 cm thick find-bearing layer with bones of mammoth, reindeer, horse and wolf was found buried beneath a 13-15 metre thick deposit of laminated sand and silt. A mammoth tusk with man-made incisions (Fig. 2) has been dated to 36,630 +1310 -1140 bp (T-11403). Teeth of mammoth and horse from the same layer yielded dates of 34,360 ± 630 bp (T-11504), 36,770 +2620 -1980 bp (T-11503) and 37,360 ± 970 (LU-4001) (Indrelid and Pavlov 1995).

Stone artefacts are very few. A biface fragment is the only tool found at the site so far.

2.6 Pymva Shor I

The Pymva Shor I site is situated in a small river valley, 2 km from the Adzva river, a tributary of the Usa river, at latitude 67^{O} north (Fig. 1).

The site is situated close to a limestone rock with karst formations, including a small cave. The upper layers are of Holocene age. At a depth of 1.1-1.2 metres an Upper Palaeolithic layer was found. A radiocarbon date gave an age of 21,910 ± 250 bp (T-11501). Recently from a cultural layer of the site much younger dates were obained: 11,125 ± 80 (TUa-1394); 11,460 ± 80 (TUa-1393); 13,090 ± 60 (CAMS-38221) and 13,530 ± 60 (CAMS-38222).

Artefact finds are few, including prismatic cores, small, crude blades and a large scraper-like tool. The material shows parallels with the artefacts of the Medvezhya cave.

The bone material from the Upper Palaeolithic layer includes hare, polar fox, reindeer, musk ox, bison and horse.

3. Archaeological material and cultural traditions

The archaeological material from the three oldest sites, Mamontovaya Kurya, Garchi I and Byzovaya, is characterised by a developed biface technique. At the three youngest sites, Talitsky, Pymva Shor I and Medvezhya, the biface elements are almost absent. At these sites a crude blade industry occurs.

Consequently, two Upper Palaeolithic technological traditions can be recognised in the northeastern part of European Russia, a biface tradition lasting until at least

25,000 bp, and a blade tradition appearing not later than 18,000 bp.

3.1 The biface tradition

The biface tradition is present at the oldest site, Mamontovaya Kurya, as early as 36,000 bp and as far north as latitude 66°34'. The amount of material from this site is however too small to draw any firm conclusions on cultural connections.

The finds from the Garchi I site reveal the most characteristic typological and technological elements of the Kostenki-Streletzkian culture, as represented by layer 5 at the Kostenki I site (Anikovich and Rogachev 1984; Anikovich 1991). These include a flaking technique based on a prevalence of flat cores, a retouching technique with flat bifacial and plano-convex retouch, tool types like triangular scrapers, some of which have ventral retouch, elongated scrapers, bifaces, triangular bifacial points with a basal notch, and triangular points with a concave base.

It should be noted that the finds from Garchi I also include material that is typologically older as well as younger than Kostenki I, layer 5. Among the earlier elements, and showing similarities with Kostenki XII, layer 3, is tabular flint with plano-convex retouch, and bifacial scrapers with concave edges. The latter elements include triangular points of Sungir' type.

Garchi I is not the only site from the Kostenki-Streletzkian culture that was discovered recently in Northeast Russia. Testpits at the Zaozerye site, situated 80 km south of Garchi I, have revealed similar material from comparable stratigraphic conditions. In addition, at least three Upper Palaeolithic localities, not yet excavated, are known in the vicinity of Garchi I, with finds of triangular bifacial points of Kostenki-Streletzkian types.

Also the Byzovaya site is clearly connected with the bifacial technological tradition, as bifaces are represented by at least two types, leaf-like tools and tools with strongly concave edges. It should, however, be mentioned that points and borers have not been found at the Byzovaya site.

Russian scholars have different opinions on the cultural affinities of the Byzovaya site. Kanivets (1976: 69-70) thought that layer 5 at Kostenki I was the closest analogy to Byzovaya. Bader (1978: 240) also noted the technological and morphological similarities between these two assemblages, but he suggested that Byzovaya may represent a culture of its own, within the Kostenki-Sungir' cultural area (1978: 224). In order to understand the relation between Byzovaya and the Kostenki-Streletzkian culture, Rogachev and Anikovich found it important to compare the material from these sites with that of the Sungir' site (25,450 ± 380 bp and 25,740 ± 500 bp). They suggested that both sites had a common origin within the Kostenki-Streletzkian complex (Anikovich and Rogachev 1984: 187; Anikovich 1986: 46). However, Bader evidently did not find it possible to connect the two sites, since he never made such comparisons in his works.

In our opinion, there are similarities as well as differences in the lithic material of the Byzovaya and Sungir' sites. Both show a prevalence of flake tools, especially scrapers, and both sites have bifaces. However, Byzovaya lacks several of the most characteristic types of the Sungir' site, in particular triangular bifacial points, scaled pieces, pointed knives, large cordiform unifaces, disc-like bifaces, burins, and elongated scrapers (Bader 1978). Art objects are also absent at Byzovaya. On the other hand, Byzovaya shows forms that are not typical at Sungir', such as large bifacial knives and needle-like points.

In our opinion, Byzovaya and the sites of the Kostenki-Streletzkian culture, including Sungir', are similar only in the main manifestations of the lithic technology. The similarities may indicate genetic relations between these sites, possibly resulting from a common Middle Palaeolithic origin. But based on the current definition it seems at present difficult to include the Byzovaya site in the Kostenki-Streletzkian culture, even though the main sites of this culture and the Byzovaya site seem to be of the same age.

3.2 The blade tradition

The younger cultural tradition recognised in the northern region has the following lithic characteristics.

The flaking technique is based on prismatic and secondary worked cores, even though flat forms also occur. Short blades are quite common. A characteristic feature is the occurrence of large chopper type tools, and crude scrapers which by their large size sharply contrast with the bulk of the lithic material from these sites. The tool inventory includes endscrapers on blade fragments, rounded scrapers on flakes, sidescrapers, denticulates, small backed blades, scaled pieces, shouldered borers, retouched blades and microblades, and truncated blades.

Bone implements are also found, including beads, needles, and inserted points, some of which are made from mammoth tusk, and antler mattocks.

4. The natural environment

Details of the Late Pleistocene natural environment in Northeast European Russia are poorly known. The present knowledge concerning fauna and vegetation is mainly based upon fauna studies of small rodents from cave deposits in the North Urals (Guslitser and Pavlov 1987, 1992), and palaeozoological (Kuzmina 1971, 1975) and palynological (Guslitser and Loseva 1979) studies from the whole region.

Generally the climatic conditions during the middle stages of the Middle Valdai (40,000-30,000 bp) may be characterised as unstable and rather cold. The vegetation consisted of wide, open spaces of tundrasteppes with sparse forest cover along some river valleys (Guslitser and Loseva 1979).

During the Bryansk interstadial (30,000-24,000 bp) slightly warmer conditions prevailed. This is clearly indicated by the presence of animals typical of the Upper Palaeolithic complex, like mammoth of late type, woolly rhino, reindeer, horse, bison, musk ox, polar fox, and lemming (Kuzmina 1971, 1975).

A considerable fall in temperature can be traced over all of North European Russia at the beginning of the Late Valdai, with a climatic minimum during the period 23,000-18,000 bp. Over the entire region clear cryogenic rock deformations can be traced in the deposits of river terraces. Block-fall horizons in karst cavities were formed, which were caused by an increase in the processes of frost weathering.

With the possible exception of the Medvezhya cave and Pymva-Shor I, no settlement sites have been found in the region dating to the Late Valdai. Such sites are, however, known from the South Urals, among these is the well-known Kapova cave with wall paintings (Bader 1966).

5. Subsistence and settlement strategies

The Kostenki-Streletzkian sites have provided detailed information on food management and subsistence strategies for the Upper Palaeolithic population of the Russian Plain during the second half of Middle Valdai. The main large mammal resources were mammoth, horse, bison and reindeer.

Also in the northern region we find the same species in the Upper Palaeolithic bone assemblages, but reindeer seems to be more frequent at most sites of the European North Urals than at the sites of the Plain. One exception is the Byzovaya site, where 98% of all bones were of mammoth. Practically all bones were unbroken and belonged to individuals of different ages and sex. Cultural remains found together with the bones are primarily stone tools, with a prevalence of knives. The topographic location of the site is also of interest, being on the riverbank in a bend of the Pechora river. All these aspects make it, in our opinion, possible to suppose that the Byzovaya site is a 'mammoth bone cemetery', like the one discovered at Berelyokh in Yakutia (Baryshnikov *et al.* 1977; Vereschagin 1977). If so, the tools found at Byzovaya may have been used in the processing of mammoth carcasses at the place where the animals drifted ashore after catastrophic drowning. According to O. Soffer (1985: 279), the living site of the scavengers should be expected nearby, but not at the very spot of the carcass remains. The high frequency of tools, especially cutting tools, and the low frequency of waste flakes strongly indicate that the Byzovaya site is not an ordinary living site.

Mamontovaya Kurya, still under excavation, shows some of the same traits as Byzovaya, but so far the amount of material is too small to draw any further conclusions.

The only site in the northern area with possible dwellings is Garchi I. An oval shaped, thin cultural layer with artefacts and bone remains revealed two hearths along its long axis. This may represent some kind of dwelling construction, perhaps like those studied by Rogachev in the upper layer of Kostenki IV (Rogachev 1957), or those reconstructed by Bader for the Sungir' site (Bader 1978). It should, however, be pointed out that the possible structure of Garchi I has not yet been totally excavated.

The sites of the biface tradition of Northeast Russia, including those of the Kostenki-Streletzkian culture, are known only as open air settlement sites. No cave localities of this tradition have so far been found in this region.

Cultural remains of the blade tradition are however frequently, but not always, found in caves. A common trait for practically all Upper Palaeolithic cave sites in the Urals is a scarcity of stone implements. Faunal remains from the cultural layers of the caves are dominated by reindeer bones.

6. Conclusions

Despite the fact that our material is fragmentary and is derived from only a small number of sites, we find it important to present these preliminary results, since this region, the foothills of the North and Sub-Polar European Urals and the Northeast of the Russian Plain, are little known to West European archaeologists. In our opinion, the palaeolithic sites in the European subarctic region have great importance for understanding the processes of initial settlement of Northern Europe and early human adaptation to arctic climates and natural environments. Their location between Europe and Asia makes them interesting in the discussion of the spread and development of Upper Palaeolithic cultures in the north of Eurasia.

On the basis of the presented material, we think the following inferences can be drawn:

1. Two technological traditions can be identified in the present subarctic region of Northeast European Russia during the Upper Palaeolithic: a bifacial tradition recognised between 36,000 and 25,000 years bp, and a blade tradition, appearing not later than 18,000 bp.
2. Within the bifacial tradition, the Garchi I site at the Upper Kama river can be directly related to the Kostenki-Streletzkian culture. This site, radiocarbon dated to 28,750 ± 795 bp, and showing close typological similarities with Kostenki I layer 5 is, with its position close to the Mid Urals at 59° north 56° east, the northern and easternmost known site of the Kostenki-Streletzkian culture.
3. The bifacial tradition in the region includes sites from the Kostenki-Streletzkian period which are typologically different from this culture.

4. The Upper Palaeolithic blade tradition, including microblades, is represented in several cave sites, as well as at open air sites, while cultural remains of the biface tradition have never been found in caves in this region.

5. The sites of Mamontovaya Kurya at 66^{O} north and Pymva Shor I at 67^{O} north constitute the northernmost known evidence for palaeolithic settlement in Europe, and at this high age, 36,000 and 13,000 bp respectively, the northernmost known traces of man in the world.

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P.Yu. Pavlov
Institute of Language, Literature and History
Department of Archaeology
Russian Academy of Sciences
Kommunisticheskaya st. 26
167010 Syktyvkar
Russia

S. Indrelid
University of Bergen
Unit of Archaeology
Bergen Museum
Harald Harfagrasgt. 1
5020 Bergen
Norway

Sergey A. Vasil'ev

14 The Siberian mosaic: Upper Palaeolithic adaptations and change before the Last Glacial Maximum

*The paper reviews various aspects of the Mid Upper Palaeolithic record in Siberia, covering the warm Lipovka-Novoselovo phase of the Karginsky mega-interstadial (*c. *30,000-25,000 bp) and early (Gydansky) phase of the Sartan Glaciation (from* c. *25,000 bp). The majority of sites are clustered in the river valleys of Southern Siberia. The Early Sartan saw the flourishing of a culture of hunters of reindeer and mammoth, as evidenced by diverse bladelet lithic industries, rich series of bone and antler implements, personal ornaments, and mobile art objects.*

1. Introduction

When asked to take part in this volume and to submit a paper on Pleistocene Siberia during the 10,000 years before the Last Glacial Maximum, I posed myself the question: "what do we really know about palaeolithic culture during this time span?" Working for many years on the archaeological record of Northern Asia, we are dealing mostly with sites dating to the second half of the Last (Sartan) Glaciation, i.e. between 16,000 and 10,000 bp, as there are not many sites in Siberia dated between 30,000 and 20,000 bp. The first site coming to mind was Mal'ta, the world-famous site which since its discovery can be found in every general textbook on palaeolithic archaeology. Nevertheless, the site remains until today truly enigmatic, especially in the light of the results of ongoing excavations (cf. below). Meanwhile, due to results of recent discoveries in the Altai, Yenisei, Angara, Lena, and Trans-Baikal regions, more than 20 clearly stratified sites relevant to the subject of this paper, have become known. The scarcity of data and the apparent lack of fine-grained chronological and palaeoenvironmental frameworks make it difficult to present an overview and hamper a comparison with the rich and diverse European evidence. Thus a brief description of the main sites is called for before an attempt is made to distill general features of the Mid Upper Palaeolithic (MUP) development in Siberia. One final remark before the presentation of the core of the paper is necessary. The scope of the paper is limited to the territory of Siberia *sensu stricto*, i.e. from the Ural Mountains to the Arctic/Pacific watershed, thus omitting the data (however far from numerous) from the Russian Far East.

2. Environmental history

The first half of the period under consideration is the mid-Zyrianka (Weischelian) warm phase, in Russia known as the Karginsky interglacial or mega-interstadial, which divides the last glacial into the Early (or Lower Zyrianka, Ermakovo, Murukta) and Late Zyrianka (or Sartan) Glacials. Kind (1974) has suggested a detailed subdivision of the Karginsky (Fig. 1). She places the Karginsky interglacial between 50,000 and 25,000 bp. Between 42,000 and 35,000 bp, the climate was noticeably warmer, especially around 39,000 bp, and this period was named the Malokhetsk warm phase. A drastic climatic deterioration began around 34,000 bp, and the following 3000 years became known as the Konoshchel'e cold episode. The last 6000 years, between 31,000 and 25,000 bp, form the Lipovka-Novoselovo warm phase. The Sartan began with an early maximum phase between 22,000 and 16,000 bp, which is also called the Gydan or Karaul.

In the southern part of Western Siberia, sediments at the base of the second river terrace are considered to be of Karginsky age, while the alluvial beds of the first terrace of the Ob' and Irtysh are believed to be of Sartan age. According to the stratigraphic scheme proposed for the Ob' valley around Novosibirsk, the Karginsky phase was marked by the formation of the Iskitim Soil Complex with two buried soils, which are covered by El'tsovka loess of Sartan age.

In the Altai region, in intermontane basins sediments of the second Late Pleistocene interglacial are represented by lacustrine and glacial beds of the Bel'tyr Formation, identified in a number of depressions and alluvial beds of the '15 m river terrace' deposits. Occasionally, these are overlain by moraines of the Akkem (or Late Artybash) Glaciation. In the Katun' and Biia valleys, a Karginsky age was suggested for the alluvium of the third or Yenisei Terrace, lying 20 to 30 m above the floodplain, and for the buried soils embedded in the subaerial sediments. The beginning of the last glacial was marked by the formation of alluvium of the second or Talitsa Terrace, which lies about 14 to 18 m above the current river. For the neighbouring Kuzbass, a Karginsky age was suggested for gravel, sand and till deposits of the second terrace, as well as for loam deposits of the Krasnobrodsk Formation. Here, the alluvium of the first

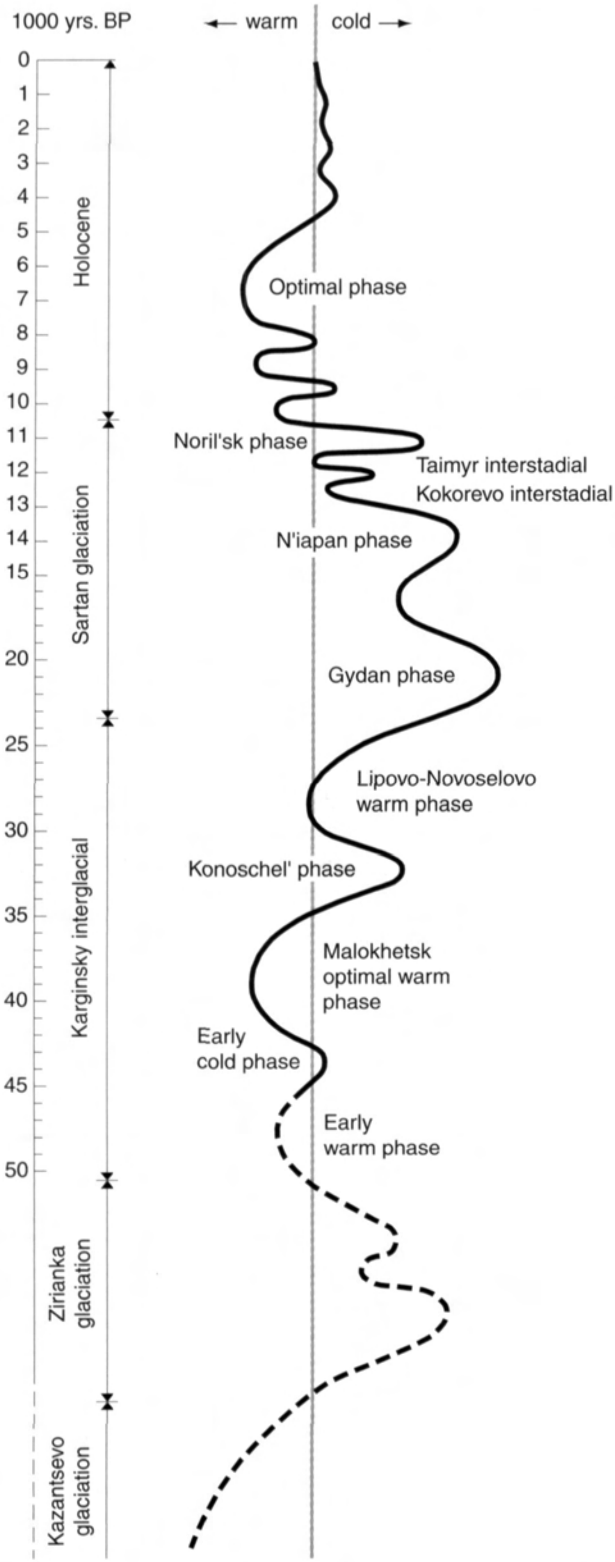

Fig. 1. Climatic curve for the Late Pleistocene (after Kind 1974).

terrace, lying at 10 to 15 m above the river, and subaerial loam deposits are correlated to the El'tsovka Soil, and are thus of Sartan age. In the Minusinsk Depression, the upper portion of the fluviatile sediments of the Krasnoiarsk Terrace is considered to be of Karginsky age, while alluvial sand and sandy loam deposits of the second or Ladeiki Terrace are thought to be of Early Sartan age (Nalivkin and Sokolov 1984).

For the high terraces along the Yenisei, a somewhat different stratigraphic scheme was proposed (Derevianko *et al.* 1992). According to these authors, the Karginsky is represented by the Kurtak Pedocomplex lying below the loess-like Bezguzin sandy loams of Sartan age.

In the Angara valley, deposits of the second terrace and the basal parts of the first terrace, at respectively 14 to 16 m and 10 to 12 m above the river, are considered to be of Karginsky age. In the Upper Angara area, Karginsky status was assigned to a buried soil with evidence of cryoturbation, lying over alluvium of the '15 to 16 m' terrace, along with the bottom part of the fluviatile deposits of the '12 m terrace'. Researchers stationed in Irkutsk recently suggested a new scheme for the subdivision of the Late Quaternary subaerial sediments (Vorob'eva *et al.* 1990). In this scheme, the second phase of the Karginsky is represented by two buried soils of the Osa Soil Complex, overlain by the Early Sartan solifluction layer and loess-like sandy loam and loam deposits dated to *c.* 24,000 to 17,000 bp.

In the Trans-Baikal, deposits of the so-called Stepanovsky Horizon, which developed as alluvium in the second terrace 7 to 9 m above the river, are considered to be of Karginsky age. The upper part of the terrace is believed to be of Sartan age. The Oshurkovo Horizon is also believed to be a Sartan deposit, and it includes alluvium of the first terrace ('5 to 7 m terrace') with much evidence of permafrost activities, and slope deposits and colluvial sediments (Nalivkin and Sokolov 1984).

As can be seen above, there are still hiatuses in our understanding of the Quaternary geological history of Siberia. The same can be said for our knowledge of the palaeoenvironment of the region. The sheer vastness of the region simply does not allow us to have any sort of general picture of the geographic and climatic history of the past, but what we know may be summarised as follows.

Climatic conditions during the Karginsky are believed to be similar to today's. During the optimum phases, woodlands expanded as far north as the lower reaches of the Ob' and Yenisei. Northern parts of West and East Siberia were mostly covered by bush tundra, dominated by such species as dwarf birch, alder, willow sedges and grass. Woodland conditions of course differed from area to area. Thus, while in the west the Yenisei valley was dominated by dark coniferous taiga, and rare fir-larix and birch woodland

Fig. 2. A provisional palaeogeographic map of Siberia during the Karginsky Maximum (after Giterman *et al.* 1968) and the Mid Upper Palaeolithic Sites.
1. muss and marsh tundra; 2. bush tundra; 3. forest-tundra; 4. montane tundra; 5. pine woodland; 6. montane tundra and elfin woodland; 7. dark coniferous forest; 8. pine-larch woodland with birch; 9. pine-birch woodland; 10. forest-steppe; 11. montane dark coniferous and mixed forest with pine and larch, and highland steppe; 12. steppe; 13. pine and Siberian pine forest with fir; 14. montane larch woodland with Siberian pine, pine, and birch; 15. coniferous and deciduous forest; 16. montane dark coniferous forest with deciduous trees; 17. Palaeolithic sites (A. Ust'Karakol I, Anui II; B. Dvuglazka; C. Mal'ta; D. Nepa; E. Kamenka I; F. Kunalei; G. Sokhatino II).

covered the northern part of the Middle Siberian Plateau, light coniferous pine-larix forests were most common in Yakutia in the east. Southern parts of West Siberia were steppes with wormwoods, forb, grass and various herbs. Although the piedmont of the Altai Mountains was covered by pines, Siberian pines, firs, silver firs and alders, there is no unambiguous evidence for a discontinuity of glacial activities in the Altai region during the Karginsky, so that the region may have been under glaciation throughout the Zyrianka. In the Angara valley, woodland conditions existed in the form of pine and Siberian pine forest with some firs and birches. The western Trans-Baikal, especially in the Selenga and Chikoi valley, was dominated by wormwood steppe conditions, but pine-larix forest developed on the slopes. The eastern Trans-Baikal saw a similar development of wormwood and grass steppe with small-scale forests developing at higher altitudes (Giterman *et al.* 1968; Fig. 2).

With the advent of the Sartan, glacial activities markedly increased in the northern part of West Siberia. Opinions vary about the extent and intensity of the Sartan glacial advance, but many believe that large ice sheets covered the whole of the North Siberian lowlands, as well as the Iamal and Gydan Peninsulas in the far northwest, and they joined the mountain glaciers coming from the northwestern part of the Middle

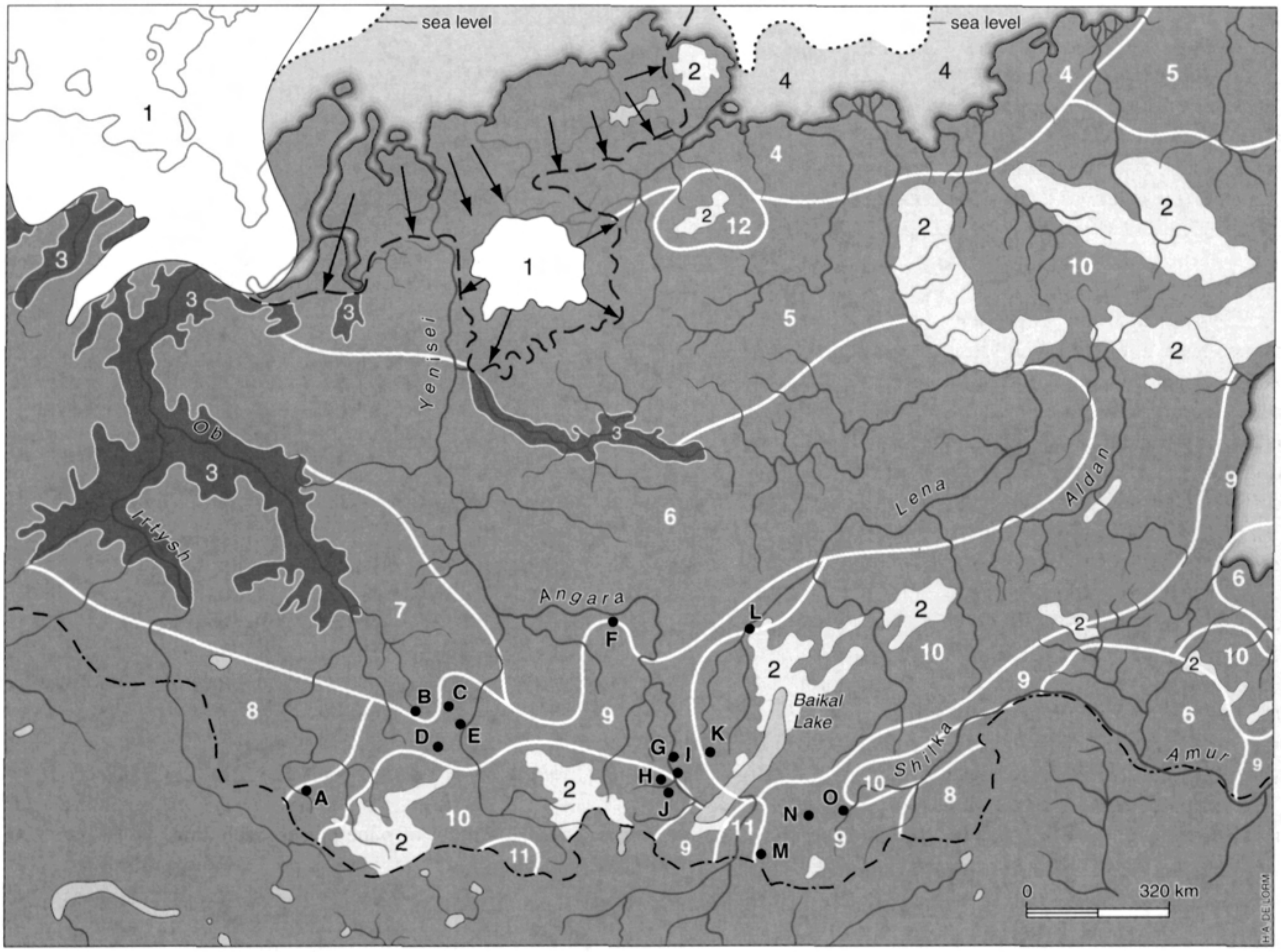

Fig. 3. A provisional palaeogeographical map of Siberia during the Sartan Maxima (compiled after Velichko, Faustova, Isaeva, Avenarius, Muratova, Spasskaia and others) and Mid Upper Palaeolithic Sites.
1. Well-definable ice sheets; arrows indicate presumable extension of glaciers; 2. montane glacier; 3. glacial basin; 4. periglacial tundra with some vegetation; 5. tundra; 6. forest-tundra; 7. patches of larch-pine-birch forest mixed with tundra-steppe and light coniferous-birch woodland; 8. forest-steppe; 9. montane forest and patches of forest; 10. montane tundra dominant by xerophitic steppe vegetation; 11. Steppe.
Palaeolithic sites: A. Anui II; B. Shestakovo; C. Achinskaia; D. Malaia Syia; E. Sabanikha, Kurtak IV, Novoselovo XIII, Kashtanka I; F. Ust'Kova; G. Igeteiskii Log I; H. Mal'ta; I. Buret'; J. Sosnovyi Bor; K. Makarovo VI, Shishkino VIII; L. Alexeevsk I; M. Chitkan, Mel'nichnoe, Studenoe II; N. Masterov Kliuch; O. Arta II.

Siberian Plateau, notably the Byrranga (Taimyr) Mountains and Putoran Plateau. This means that glaciers expanded as far as the Nizhniaia Tunguska River. Farther to the south, along the drainage of the Ob' and Irtysh, gigantic basins developed near the edges of the ice sheets (Velichko 1984). However, some reject such a 'gigantic ice sheet' model (cf. Zubakov and Borzenkova 1990). These authors suggest different dates for the formation of end moraines of supposedly Sartan age, and tend to believe that glaciation was restricted only to piedmont parts of the Putoran Plateau and the Circumpolar Ural Mountains.

The South Siberian mountain systems were also under the influence of glaciers so that valleys and gorges were filled by ice. In the Altai, the Sartan glaciers covered the high lying hills and adjacent river valleys. But in the Kuznetsk Alatau and the East and West Sayans, glaciation was less extensive so that only the innermost parts of the mountains were covered by small glaciers. The dry climatic conditions of the Trans-Baikal region impeded the development of glaciers. This of course does not mean that the region was completely free of ice, and hints of glaciers can be seen on some shore ridges around Lake Baikal, as well as those in the Stanovoi Highland to the north.

The beginning of the Sartan was marked by drastic climatic shifts, which resulted in general dessication and expansion of the periglacial landscape. Dominance of rare birch woodland and bushes is characteristic for the southern parts of West Siberia, where small-scale forests lined the river valleys. The Middle Siberian Plateau was covered by periglacial vegetation (e.g., grass, forb, wormwood, lycopods, etc.) but with woody species of birch, alder and larix. In the Minusinsk Depression, a mixture of birch forest and steppe during the early phases of the Sartan was later replaced by forbs and grass steppe conditions, while the forest found a refuge in the surrounding highlands. In the Angara basin, steppes expanded at the cost of forest of rare pine and larix taiga and birch woodland. In the Cis-Baikal and Trans-Baikal, periglacial steppes with dwarf birches dominated, and in the Chikoi valley xerophitic species of semi-desert environments were not uncommon. Yakutia was dominated by a cold periglacial steppe landscape (Giterman *et al.* 1968; Fig. 3).

Let us complete this review of the palaeoenvironment of Siberia with a brief remark on the faunal assemblage known from archaeological localities (Table 2). The Siberian MUP is well associated with characteristic faunal assemblages of the period. Typical species include a 'late' form of mammoth, horse, Asiatic wild ass, 'short-corned' bison, wild sheep or argali, saiga, snow sheep, reindeer, and arctic fox. This faunal composition is enriched by the occasional woolly rhinoceros, red deer, wolf, red fox, brown bear, etc. (Vereshchagin and Baryshnikov 1984).

3. Regional record

3.1 The Altai

While West Siberia has not yielded any traces of human presence before the Final Pleistocene, let us begin our brief survey from the Altai Mountains. In spite of the enormous richness of the territory in mousterian and Early Upper Palaeolithic remains, data on the time span under consideration are scanty. These were mostly obtained in recent years and what is published is still too sketchy. The cold Konoshchel'e phase saw the development of Early Upper Palaeolithic blade industries dated at *c.* 31,000-29,000 bp (Kara-Bom, Kara-Tenesh, Ust'Karakol I and II, Anui I, etc.).

Ust'Karakol I, at 9 to 11 m above the Anui River, yielded a handful of artefacts which were discovered above the main, third cultural layer. This Layer 2 produced bones of bison and red deer with a radiocarbon date of *c.* 29,000 bp (all relevant radiocarbon dates are shown in Table 1; for faunal remains cf. Table 2). Palynological data indicate a cold steppic environment with thick *Artemisia* vegetation (Derevianko *et al.* 1990). A new excavation campaign (Derevianko *et al.* 1995) revealed a series of about 15 cultural horizons attributed to different phases of the Mousterian and the Upper Palaeolithic. However, their character and correlation with old excavations is uncertain. The authors referred to the Lipovka-Novoselovo phase remains of a pedocomplex in which Layers 5 and 6 are embedded. A radiocarbon date of *c.* 26,000 bp is reported for the former horizon.

The site of Anui II, located nearby on the 8 to 9 m terrace, produced Upper Palaeolithic layers, dated by radiocarbon to between 26,000 and 20,000 bp (Orlova 1995).

3.2 The Chulym Basin

The Chulym River Basin, located northeast of the Altai, yielded slightly more data relevant to Early Sartan human settlement. In the Kuzbass region, the oldest site is Shestakovo which is located in the Kiia River basin. Results of an investigation carried out by Okladnikov and Molodin (1980/1981) remain until today hardly touched upon in the literature. Artefacts were associated with a gravel lens embedded in sediments of a 20 to 30 m terrace. Faunal remains include mainly mammoth. A radiocarbon date of *c.* 23,000 bp is reported (Lisitsyn 1996b). A number of storage pits filled with mammoth bones was unearthed. Among the cores are small single- and double-platform ones, flat and prismatic, butt-ended and conical ones. Most tools are retouched small blades but there are also splintered pieces, points, micro endscrapers, etc. The assemblage includes a remarkable number of bone pieces, including an elongated dagger, awls, and engraved and ornamented items.

The recent renewal of the exploration revealed a number of components and the assemblage mentioned above is now referred to Layer 6 which yielded radiocarbon dates in excess of 20,000 bp. A bone piece interpreted as a rough-out of a statuette is reported (Derevianko and Zenin 1995a, b).

Farther to the north in the Chulym Valley, the MUP is represented by Achinskaia. First discovered by Avramenko (1963), this site was excavated by Matiushchenko (Anikovich 1976) and by Larichev. Results of the last campaign are not very well known (Larichev and Arustamian 1987). The site was located in a large ravine in the valley of a small tributary of the Chulym. The cultural layer was unearthed within slope loamy cryoturbated deposits at a terrace-like level corresponding to the high terrace of the Chulym. Faunal remains consist of horse and saiga (dominant species), while mammoth bones were also identified. An Early Sartan age seems to be more consistent with both the geological and archaeological evidence.

The excavations revealed several fireplaces. The discovery of an in plain view round concentration of mammoth tusks and femurs is reported, which is interpreted as the ruins of a dwelling structure. The inhabitants of the site exploited local pebbles which abound on the slopes of the valley. Most

Table 1. Selected Radiocarbon Dates of the Middle Upper Palaeolithic Sites of Siberia.

LAB. NO	SAMPLE	FINDSPOT	DATE (BP)	REFERENCE
SOAN-2614	B	Ust'Karakol I, Layer 2	28,700 ± 850	Derevianko et al. 1990
SOAN-3261	C	Ust'Karakol I, Layer 5 (new enumeration)	26,305 ± 280	Derevianko et al. 1995
SOAN-3005	C	Anui II, Layer 12	26,810 ± 290	Orlova 1995
SOAN-3006	C	Anui II, Layer 8	24,205 ± 420	Orlova 1995
SOAN-2868	C	Anui II, Layers 4 or 3	27,125 ± 580	Orlova 1995
SOAN-2862	C	Anui II, Layer 3	22,610 ± 140	Orlova 1995
SOAN-3007	C	Anui II, Layer 3	21,280 ± 440	Orlova 1995
SOAN-2863	C	Anui II, Layer 3	20,350 ± 290	Orlova 1995
SOAN-1380	B	Shestakovo, Layer 6	22,980 ± 125	Lisitsyn 1996b
SOAN-3218	?	Shestakovo, Layer 6	20,770 ± 560	Derevianko and Zenin 1995a
SOAN-1684	?	Shestakovo, Layer 6	20,490 ± 150	Derevianko and Zenin 1995a
LE-4918	B	Malaia Syia	25,250 ± 1,200	Lisitsyn 1996a
SOAN-1124	C	Malaia Syia	20,300 ± 350	Derevianko et al. 1992
LE-4808	B	Dvuglazka, Layer 4	26,580 ± 520	Lisitsyn 1996a
LE-3747	A	Sabanikha, surface finding	25,950 ± 500	Lisitsyn 1996a
LE-4796	C	Sabanikha	25,440 ± 450	Lisitsyn 1996a
LE-3611	C	Sabanikha	22,930 ± 350	Svezhentsev et al. 1992
LE-4701	C	Sabanikha	22,900 ± 480	Svezhentsev et al. 1992
LE-2833	C	Kurtak IV, Strata 11-12	27,470 ± 200	Svezhentsev et al. 1992
LE-3357	B	Kurtak IV, Stratum 11	24,890 ± 670	Svezhentsev et al. 1992
GIN-5350	C	Kurtak IV, Stratum 11	24,800 ± 400	Svezhentsev et al. 1992
LE-3351	C	Kurtak IV, Stratum 11	24,170 ± 230	Svezhentsev et al. 1992
LE-4156	B	Kurtak IV, Stratum 11	24,000 ± 2,950	Svezhentsev et al. 1992

The AMS-dates are indicated by an asterisk; other dates are conventional. Sample key: A=antler; B=bone; C=charcoal; H=humus

favoured were quartzites, silicified limestone, sandstone, etc., while occasionally flint, jasper and silicified wood were used. The industry is characterised by blades. There are small single-, double- and triple-platform prismatic type cores. Among the tools are denticulates and notches, retouched bladelets, endscrapers (including carinated and nucleiform pieces), truncated bladelets, backed bladelets, burins, splintered pieces, and sidescrapers. Ivory points, a pendant and a phallus-like statuette ornamented by two spiral dotted lines (Fig. 4:1) are also reported.

Malaia Syia, located on the eastern slope of Kuznetskii Alatau, in the Belyi Iius River valley, is one of the most controversial occurrences in Siberia. Investigated by Ovodov, the site was later the object of fieldwork by Larichev, the results of which are essentially unpublished (cf. brief reports in: Derevianko *et al.* 1992; Larichev and Kholiushkin 1995). The site is located on the slope of a ravine about 32 to 35 m above the modern river level. Thick culture-bearing strata (later subdivided into three horizons) are associated with loamy slope and fan-like deposits which bear traces of redeposited buried cryoturbated soil. The faunal assemblage is dominated by reindeer, wild sheep and ibex. Palynological analysis indicates a cold steppe environment with *Artemisia* and Gramineae. A sample of charcoal from the strata, mostly collected in the second horizon, yielded a date in excess of 20,000 bp and a bone sample a date of *c.* 25,000 bp, while other bone samples are surprisingly older (*c.* 34,000 bp). Taking into account the geological and palaeoenvironmental data, one could speculate about an Early Sartan age of the upper part of the culture-bearing strata. What has been published cannot provide a firm basis for the description of cultural material because all data on this supposedly multicomponent site were presented in sum.

3.3 The Yenisei Basin

The oldest occurrence seems to be the assemblage of Layer 4 of the Dvuglazka rock shelter, overlying mousterian strata. According to a radiocarbon date, it could be of Late

Table 1 continued. Selected Radiocarbon Dates of the Mid Upper Palaeolithic Sites of Siberia.

LAB. NO	SAMPLE	FINDSPOT	DATE (BP)	REFERENCE
LE-4155	C	Kurtak IV, Stratum 11	23,800 ± 900	Svezhentsev *et al.* 1992
LE-2833	C	Kurtak IV, Stratum 11	23,470 ± 200	Svezhentsev *et al.* 1992
LE-3739	C	Novoselovo XIII, Layer 3	22,000 ± 700	Svezhentsev *et al.* 1992
GIN-6999	C	Kashtanka I, Layer 2	29,400 ± 400	Derevianko *et al.* 1992
IGAN-1048	C	Kashtanka I, up from Layer 2	24,400 ± 1,500	Derevianko *et al.* 1992
IGAN-1050	C	Kashtanka I, up from Layer 2	23,830 ± 850	Derevianko *et al.* 1992
SOAN-2853	C	Kashtanka I, Layer 1	24,805 ± 425	Derevianko *et al.* 1992
IGAN-1049	C	Kashtanka I, Layer 1	21,800 ± 200	Derevianko *et al.* 1992
GIN-6968	C	Kashtanka I, Layer 1	20,800 ± 600	Derevianko *et al.* 1992
GIN-4327	B	Igeteiskii Log I, Stratum 6	24,400 ± 100	Vorob'eva *et al.* 1990
SOAN-405	C	Igeteiskii Log I, Stratum 4	23,760 ± 1,100	Vorob'eva *et al.* 1990
LE-1592	C	Igeteiskii Log I, Stratum 4	23,508 ± 250	Vorob'eva *et al.* 1990
LE-1590	C	Igeteiskii Log I, Stratum 4	21,260 ± 240	Vorob'eva *et al.* 1990
GIN-7706	B	Mal'ta	21,000 ± 140	Kuzmin 1994
GIN-7709	B	Mal'ta	20,700 ± 150	Kuzmin 1994
GIN-87	B	Mal'ta	14,750 ± 120	Tseitlin 1979
SOAN-1680	B	Buret'	21,190 ± 100	Abramova 1989
KRIL-381	C	Ust'Kova, Middle Component	23,920 ± 310	Drozdov *et al.* 1990
AA-8882	B	Shishkino VIII	21,190 ± 175*	Aksenov 1993
SOAN-3032	?	Kamenka I, Component B	28,815 ± 150	Lbova 1996b
SOAN-2904	B	Kamenka I, Component B	28,060 ± 475	Lbova 1996b
GIN-6124	H	Kunalei, below Layer 3	21,100 ± 300	Konstantinov 1994
AA-8888	B	Masterov Kliuch, Layer 4	24,360 ± 270*	Meshcherin 1996
LE-2967	C	Arta II, Layer 3	23,200 ± 2000	Kirillov and Kasparov 1990

The AMS-dates are indicated by an asterisk; other dates are conventional. Sample key: A=antler; B=bone; C=charcoal; H=humus

Karginsky age. The most dominant faunal remains are wild sheep, but there are also bones of horse, wild ass, Baikal yak, etc. Palynological evidence indicates a cold xerophitic forest-steppe environment with some fir (Kol'tsova 1992). The small lithic collection is characterised by blade technology, and a single-platform core on a pebble was found. The tools include retouched blades, endscrapers on retouched blades, and points. A wedge-like bone tool with decoration and pendants are worth mentioning (Abramova 1985).

Other stratified occurrences of Early Sartan age can be found in a small portion of the left bank of the Yenisei river (now the Krasnoiarsk reservoir) in the northern part of the Minusinsk Depression. At Sabanikha (Lisitsyn 1995), artefacts were discovered above the brownish sandy loam (which is believed to be a buried soil of Karginsky age) in the sediments forming a 40 m level above the river. Red deer, bison and wild sheep dominate the fauna. Charcoal from unearthed fireplaces yielded radiocarbon dates of *c.* 23,000 bp. The lithic industry is based on blade technology and comprises large single- and double-platform cores, retouched blades, endscraper/points, bifacial sidescrapers, choppers, etc. Other finds include bone and antler pieces – adzes, points, needles and stone beads.

The main assemblage of Kurtak IV (Lisitsyn *et al.* 1995) is roughly of the same age as Sabanikha. Located on a terrace-like level at 60 to 80 m, the Upper Palaeolithic layer was found in the upper laminated sandy loams (slope and fan cone deposits). The majority of bones are from mammoth, with some bison, red deer, brown or cave bear, etc. Palynological data indicate cold steppe and forest-steppe environments with rare pine-birch-larch woodland. The buried soil below the artefacts yielded a radiocarbon date in excess of 27,000 bp, while numerous dates for the cultural layer cluster tightly around 24,000 to 23,000 bp. Excavations also revealed fireplaces. The lithic collection is surprisingly archaic-like and consists of pebble cores, numerous endscrapers, retouched flakes, sidescrapers, becs, notches and pebble tools. Other finds include ivory and bone tools and ornaments.

Table 2a. Large Mammals from the Siberian Mid Upper Palaeolithic Sites.

SITES		Ust'Karakol I	Shestakovo	Achinskaia	Malaia	Syia	Dvuglazka	Sabanikha
LAYERS		1	6		2	1	4	
REFERENCES		1	2	3	4		5	6
Proboscideae								
Mammoth	*Mammuthus primigenius*		•	•			•	
Perissodactyla								
Horse	*Equus caballus*		•	•	6 (1)		62	
Asiatic wild ass	*Equus hemionus*				2 (1)	1 (1)	62	
Woolly rhinoceros	*Coelodonta antiquitatis*						13	
Artiodactyla								
Red deer	*Cervus elaphus*	•			6(1)	1 (1)	1	•
Roe deer	*Capreolus capreolus*						2	
Reindeer	*Rangifer tarandus*		• (?)		23(1)	2 (1)	•	•
Yak	*Poephagus baikalensis*						•	
Bison	*Bison priscus*	•			7(1)	5 (1)	7	•
Wild sheep	*Ovis ammon*				• (?)	1 (1)	87	•
Snow sheep	*Ovis nivicola*						1	
Saiga antilope	*Saiga tatarica*			•				
Ibex/Saiga	*Capra/Saiga*			•				
Ibex/Sheep	*Capra/Ovis*			•	53 (5)	3 (1)		
Carnivora								
Wolf	*Canis lupus*			•			2	
Arctic fox	*Alopes lagopus*			•				•
Red fox	*Vulpes vulpes*						2	
Corsac	*Vulpes corsac*						1 (?)	
Brown bear	*Ursus arctos*		•					
Cave hyena	*Crocuta spelaea*						29	

Lisitsyn (1996b) regarded the lowermost layer of Novoselovo XIII as slightly younger. The site is located at the 30 to 35 m terrace-like level. The upper part of the section shows sandy loams with cultural strata of Late Sartan age, while in the underlying laminated sandy loam, the third cultural layer, dated by radiocarbon to *c*. 22,000 bp, was unearthed. It was accompanied by reindeer bones. The excavation revealed a hearth and a slab-lined hearth. The lithic assemblage is rather small.

Among the other Early Sartan sites, Kashtanka I (Derevianko *et al*. 1992) deserves to be mentioned. From exposed surfaces, cultural horizons embedded in cryoturbated buried soils of the Kurtak Formation below the sandy loams of Sartan age were unearthed. The main (first) cultural layer is associated with the upper part of this pedocomplex, underlain by humified sandy loams and a buried chernozem-type soil. The redeposited artefacts from the former strata are labelled Layer 2. The main layer produced a faunal assemblage dominated by reindeer and bison, while bones of red deer and bison were identified from the second layer. Palynological data indicate cold climatic conditions with a vegetation typical of rocky slopes on the borderline between woodland and steppe. Layer 2 produced a radiocarbon date in excess of 29,000 bp while the overlying strata and Layer 1 yielded ages from 24,000 to 21,000 bp. Excavation of Layer 1 revealed a hearth and several fireplaces. Archaeozoological analysis of reindeer antlers and other evidence indicate autumn as the season of

Table 2b. Large Mammals from the Siberian Mid Upper Palaeolithic Sites.

SITES		Kurtak IV	Novoselovo XIII	Kashtanka I		Igeteiskii Log I	Mal'ta
LAYERS			3	2	1		
REFERENCES		6	7	8		9	10
Proboscideae							
Mammoth	*Mammuthus primigenius*	•					(16)
Perissodactyla							
Horse	*Equus caballus*				2 (1)	•	(2)
Asiatic wild ass	*Equus hemionus*	•					
Woolly rhinoceros	*Coelodonta antiquitatis*					•	(25)
Artiodactyla							
Red deer	*Cervus elaphus*	•			1 (1)	1	
Roe deer	*Capreolus capreolus*						
Reindeer	*Rangifer tarandus*		•	•	223 (5)	•	(589)
Elk	*Alces alces*	•					
Bison	*Bison priscus*	•		•	41 (2)		(5)
Aurochs	*Bos* sp.					•	
Wild sheep	*Ovis ammon*	•					
Snow sheep	*Ovis nivicola*						• (?)
Sheep	*Ovis* sp.						(1)
Carnivora							
Wolf	*Canis lupus*	•					(1)
Arctic fox	*Alopes lagopus*						(50)
Red fox	*Vulpes vulpes*	•			2 (1)		(3)
Brown bear	*Ursus arctos*	• (?)					• (?)
Wolverine	*Gulo gulo*						(4)
Cave lion	*Panthera spelaea*	•					(1)

occupation of the site. The investigators (Bokarev and Martynovich 1992) put forward a hypothesis about the location of the site near the seasonal migration routes of reindeer across the Chulym-Yenisei watershed and believe that Kashtanka I was a short-term hunting camp. Among the reindeer bones, all skeletal parts are present which indicates the existence of kill sites nearby. The site produced a lithic assemblage essentially based on exploitation of siliceous rocks extracted from the local Yenisei pebble beaches. There are heavy single- and double-platform cores, conical microcores, endscrapers on blades and flakes, backed bladelets, sidescrapers, splintered pieces, and choppers, as well as ivory and antler pieces such as points, needles, and beads.

3.4 The Angara Basin

The Upper Angara Valley is a region with abundant MUP remains. The oldest site of this phase is Igeteiskii Log I, located on the bank of the Bratsk reservoir near the Osa River mouth, and about 38 to 42 m above the river (Medvedev 1982). Artefacts and bones of aurochs, reindeer, woolly rhinoceros and horse were redeposited in the upper part of sandy slope loams and sand and gravel deposits of an ancient ravine. A radiocarbon date of *c*. 24,500 bp is given for the lowermost artefact-bearing stratum (sixth), while samples from humified lenses of Stratum 4 of the main level of the artefact concentration and slightly above this level, are dated between 23,000 and 21,000 bp. Of course these dates indicate only the timing of the last redeposition but the Early Sartan age for the

Table 2c. Large Mammals from the Siberian Mid Upper Palaeolithic Sites.

SITES		Buret'	Sosnovyi Bor	Ust'Kova	Alexeevsk I	Nepa	Kamenka I
LAYERS			5	2			B
REFERENCES		10	11	12	13	14	15
Proboscideae							
Mammoth	*Mammuthus primigenius*	6 (2)		•			1 (1)
Perissodactyla							
Horse	*Equus caballus*		3			•	
Asiatic wild ass	*Equus hemionus*	•		•			
Horse/ass	*Equus* sp.	•					
Woolly rhinoceros	*Coelodonta antiquitatis*	8 (3)		•			2 (1)
Artiodactyla							
Red deer	*Cervus elaphus*	4 (4)	1				
Roe deer	*Capreolus capreolus*						1 (1)
Bison	*Bison priscus*	2 (2)	1				3 (1)
Carnivora							
Arctic fox	*Alopes lagopus*	•					

artefacts seems to be highly probable. The lithic assemblage looks rather homogeneous, consisting of quartzite and argillite single- and double-platform flat cores, butt-ended micro cores, endscrapers on retouched blades, retouched blades, sidescrapers, borers, etc. In addition to the lithics, a thin antler point and an antler pick are also known from this site.

When discussing the MUP of Siberia, one cannot avoid the famous site of Mal'ta. Despite its fame, we know next to nothing about the details of this site, except for certain aspects of the assemblage recovered there. Discovered by Gerasimov in 1928, the site was excavated intermittently until 1937. After an interval of nearly 20 years, he re-excavated the site between 1956 and 1958. A report of the investigations is only available in the form of short papers (Gerasimov 1931, 1935, 1964). A full report will probably never appear, while the collections are dispersed throughout Russia, kept in a number of museums in different cities. Since 1991 Medvedev has renewed the investigation which has led to a radical revision of the character of the site.

According to the traditional description, Mal'ta is located on a 15 to 16 m high terrace of the Belaia River, a left tributary of the Angara. Directly below the modern soil lies the upper cultural layer of Final Pleistocene age, which is continued by the main component associated with the upper surface of a heavily cryoturbated buried soil of presumably Final Karginsky age. Tseitlin (1979) believed that this cultural layer was deposited after the formation of the soil.

It seems extremely difficult, if not impossible, to characterise the faunal assemblage of Mal'ta, taking into account the range of opinions of the scholars engaged in identification, and the loss of some collections. However, Ermolova (1978) has compiled the relevant data and gives the following approximative statement. Reindeer is the most dominant species. Mammoth, woolly rhinoceros and arctic fox are also well represented, while bison, red deer, wild sheep, horse, wolverine and red fox are occasionally present. There are also bird and fish bones. Palynological analysis did not yield enough results for a palaeoenvironmental reconstruction, the culture-bearing strata only yielded some pollen of fir, Siberian pine and alder. Anthracological analysis indicates birch and fir. Thus a periglacial landscape, corresponding to the Early Sartan, could be deduced. A radiocarbon date of *c.* 14,700 bp was considered to be somewhat problematic while an Ionium date of 23 ± 5 kyr bp made on a piece of bone, is regarded as more consistent with the palaeoenvironmental evidence.

The main cultural layer unearthed over 1480 square metres contained many structural features, though published accounts are too brief to discuss the nature of these. Formozov (1976) compiled all excavation plans available, and deduced the existence of two rows of heavy concentrations of debris (interpreted as dwelling units) along the river

Table 2d. Large Mammals from the Siberian Middle Upper Palaeolithic Sites.

SITES		Kunalei	Sokhatino II	Arta II
LAYERS		3	5	1-3
REFERENCES		16	17	
Proboscideae				
Mammoth	*Mammuthus primigenius*		•	
Perissodactyla				
Horse	*Equus caballus*	•	•	•
Woolly rhinoceros	*Coelodonta antiquitatis*	•	•	•
Artiodactyla				
Deer	*Cervus* sp.	• (?)		
Bison	*Bison priscus*	• (?)	•	•
Saiga antelope	*Saiga tatarica*			•
Carnivora				
Brown bear	*Ursus arctos*	•		

NISP is indicated where possible; MNI is shown between brackets.
References: 1: Derevianko *et al.* 1990; 2: Okladnikov and Molodin 1980/1981; 3: Avramenko 1963, Anikovich 1976, Larichev and Arustamian 1987; 4: Larichev and Kholiushkin 1995; 5: Ovodov and Martynovich 1992; 6: Lisitsyn 1996a; 7: Lisitsyn 1996b; 8: Derevianko *et al.* 1992; 9: Medvedev 1982; 10: Ermolova 1978; 11: Lezhnenko *et al.* 1982; 12: Drozdov *et al.* 1990; 13: Zadonin *et al.* 1991; 14: Zadonin and Semin 1990; 15: Germonpré and Lbowa 1996; 16: Konstantinov *et al.* 1981; 17: Kirillov and Kasparov 1990

shore. Four concentrations (nos. 5 to 8) constitute the western group located near water. Concentration no. 5 was a hollow structure, 4 m in diameter and covering 11 square metres. Three other hollow structures (nos. 6 to 8), measuring 3.0-3.5 by 7 m, were discovered nearby. All these units are characterised by a similar spatial patterning, namely the association of concentrations with 'earth walls' bordering on one side. The true character of these supposedly artificial structures remains enigmatic.

In the centre of the main row of concentrations, one can see an elongated structure (no. 9), the so-called 'long dwelling', measuring 14 by 5-6 m. This depression of trapezoidal form consists of reindeer antlers, bones (including heavy bones of mammoth and rhinoceros) and numerous limestone slabs. Three hearths were unearthed inside it.

Further downstream, a new group of four concentrations (nos. 1 to 4; Fig. 5) was excavated (one of these structures was destroyed). The concentrations, clustered around central hearths, were abound in limestone slabs and cultural debris. In one case a supposed basement of a rectangular dwelling surrounded by slabs was identified.

In the opposite direction of the 'long dwelling', there were six other units (nos. 10 to 15), but only two of these are described. The first one, located at the northwestern part of the site, was interpreted as a round dwelling, 4.5 m in diameter, with abundant limestone slabs and antlers. The inner depression of this unit was coloured by ochre, and a slab-lined hearth was located asymmetrically, near the northeastern wall. Gerasimov (1964) reconstructed this structure as a cone-shaped tipi-like dwelling with slabs put around the perimeter and antlers on the skin roof. The last detail seems to be controversial (Ermolova 1978). Another, partly destroyed, hollow dwelling, with an inner hearth measuring 3 by 4 m, was rectangular in plain view.

An estimate of the season of occupation remains a matter of debate. According to Ermolova (1978), the character of the reindeer remains indicates traces of both winter and summer hunts. The identification of migrating birds (goose, gull) seems to corroborate the latter season. However, taking into account that Mal'ta really was a multicomponent site (cf. below), one can speculate about various habitation episodes.

Mal'ta has yielded a unique burial structure for the Siberian Upper Palaeolithic. From the scanty published

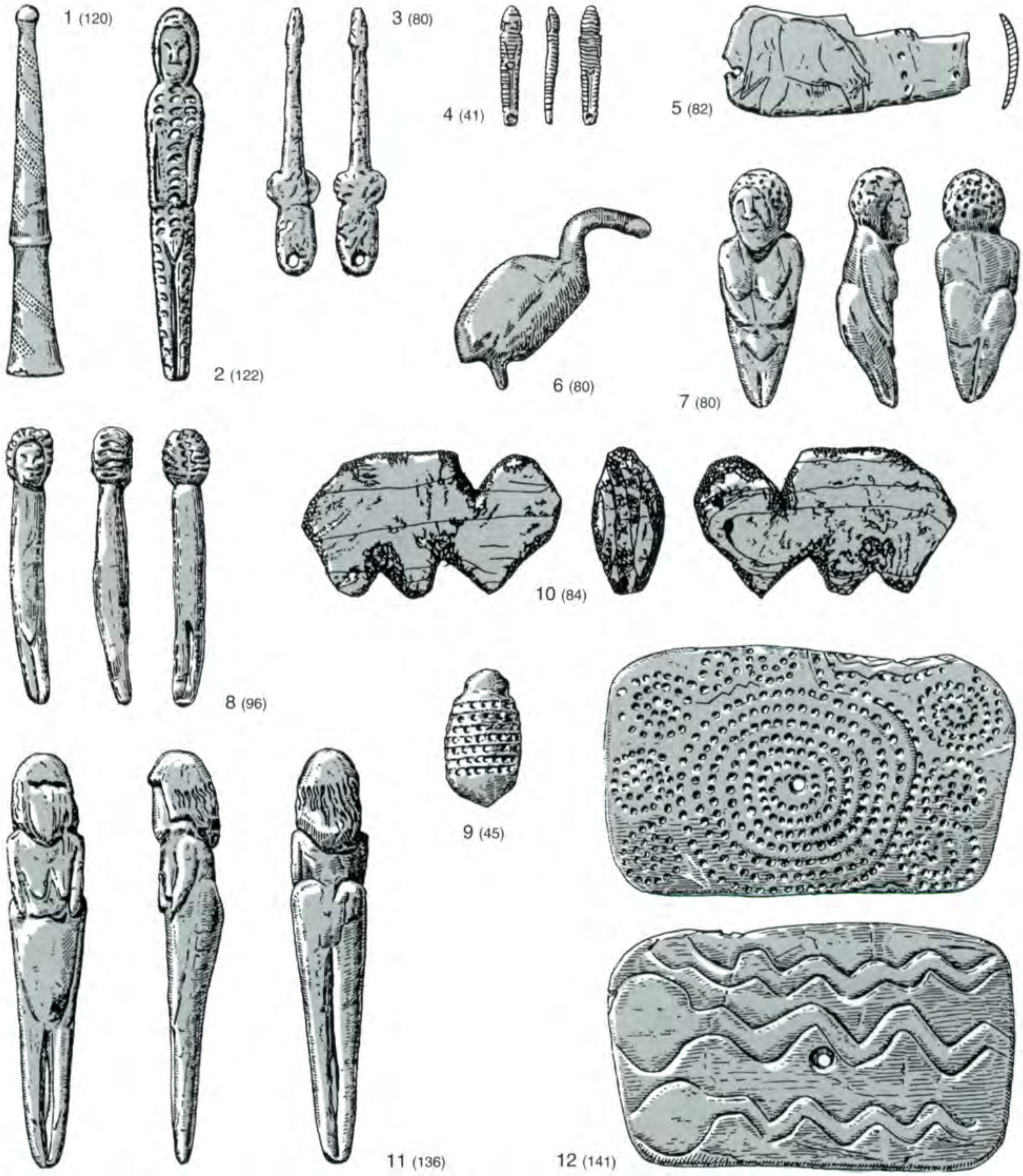

Fig. 4. Art objects from various Siberian Mid Upper Palaeolithic sites (after Abramova 1989 and Drozdov *et al.* 1990).
1: Achinskaia; 2: Buret'; 3-9, 11, 12: Mal'ta; 10: Ust'Kova. Lenght in mm between brackets.
1. ivory 'rod'; 2, 4, 7, 8, 11. feminine statuette; 3, 6. bird figurine; 5. mammoth engraving; 9. ornamented piece; 10. mammoth figurine; 12. plaquette.

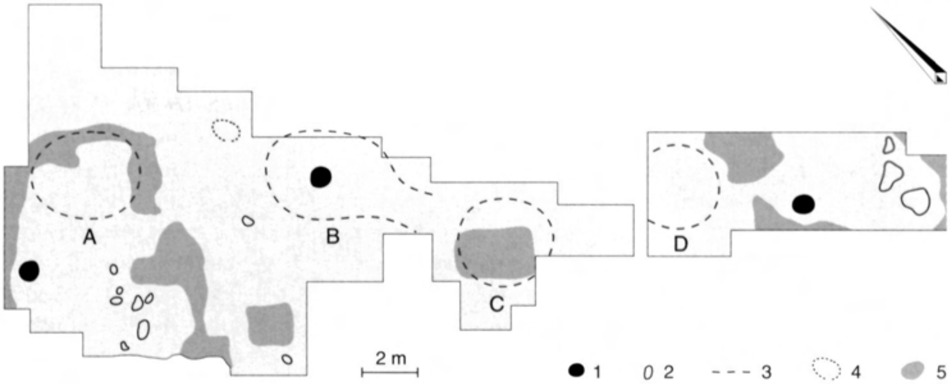

Fig. 5. Spatial structure of part of the Mal'ta settlement (after Sergin 1996).
1. hearth; 2. Artic fox, reindeer and other animal skeletons; 3. burial pit; 4. outlines of concentrations; 5. destroyed parts.

accounts (Gerasimov 1935), we learn that the burial was in an oval-shaped pit dug from the bottom of the cultural layer down into the underlying gravel bed. Skeletal remains were covered by a horizontally lying stone slab, with two vertically standing slabs nearby. Below the cover stone the badly destroyed remains were found, facing north and covered by red ochre. Only fragments of a skull and mandible, and some vertebrae and long bones were recovered. An ivory diadem was found near the skull, along with a necklace consisting of beads and pendants. An ornamented plate, fragments of a bird-shaped pendant, an ivory bracelet, several flint tools and an ivory point were grave goods. Re-examination of the remains demonstrated that the burial should have contained bones of two (not one as believed by Gerasimov) children of different ages, one younger than two years old, the other 2-3 or 3-4 years old (Alexeev and Gochman 1987).

The lithic assemblage of Mal'ta (Fig. 6) was based mostly on exploitation of flint pebbles, collected from the river gravel and extracted from limestone outcrops. Also quartzite and chert were used. All stages of raw material processing are represented – from heavy single-platform, butt-ended, discoidal and Levallois cores to small prismatic and conical cores. Among the tools, various retouched small blades (occasionally resembling châtelperronian knives), endscrapers on blades and retouched blades (including carinated types) dominate. Notched pieces are also important, along with borers, sidescrapers, single- and double points, burins, truncated blades, splintered pieces and choppers. Also reported is a unique geometric piece – a triangular microlith.

Mal'ta is also rich in sophisticated antler, ivory and bone artefacts. Among these tools are large antler implements resembling huge adzes, mortars, antler hafts with inset stone tools, awls, small spades, knives, bone and ivory points without grooves, pins with heads, rods, buttons, and needles with eyes or circular hollows. Personal ornaments include a rich series of bracelets, perforated ivory plaques, beads, pendants, etc. The burial yielded an original oval-shaped pendant with projections covered by pitting ornamentation. A unique trapezoidal perforated ivory plaquette with spiral rows of pits and zigzag lines (interpreted as snakes) on the back is well known (Fig. 4: 12).

No other Siberian site is comparable to Mal'ta in richness and diversity of art objects (Fig. 4: 3-9, 11). Abramova (1995) describes 30 female statuettes, including fragments and "preforms". They were classified into some types, such as those representing fat women, women of medium proportions and elongated figurines representing thin females. The latter type grades into almost rod-like schematic pieces. There are also small figurines whose surfaces are totally covered by incisions and pits, as well as statuettes of distinctive style, with an exaggerated middle portion of the body. Heads of statuettes are ornamented by carved lines which are usually interpreted as a headdress. There is also a series of bird figurines, 13 in total, with elongated necks and short wings. A mammoth engraving on ivory blade, an ivory figurine of an animal, probably depicting a wolverine, two elongated bird figurines interpreted as swimming birds, and a statuette of a swan are worth mentioning. In addition, Mal'ta is rich in various ivory rods and pieces covered with decorations of linear, wavy, zigzag and spiral lines, along with bracketing.

The first results of the recently renewed exploration of Mal'ta (Lipnina and Medvedev 1993) were a true sensation. Mal'ta is now regarded as a multicomponent site with an extremely complicated stratigraphy and about ten levels of artefacts so far identified. The authors believe that the main component of Mal'ta can be correlated with levels 5 and 6 unearthed in the new excavation area, while other artefacts are associated with both underlying sediments of Karginsky age and overlying Sartan strata.

Buret', located on the right bank of the Angara River is widely known as Mal'ta's 'twin'. The site was investigated by Okladnikov between 1936 and 1940, but even less information than Mal'ta is available from the published accounts. Buret' is sited on a fan cone 14 m above the river and covers a limited area, thus practically the whole surface of the site was explored. Artefacts are from the bottom part of the loams above a buried soil of presumably Late Karginsky age. The cultural layer was partly redeposited and washed. The geological conditions are well comparable with those in Mal'ta. Reindeer dominates the fauna, while bones of mammoth, woolly rhinoceros, bison, and red deer were also identified. Abramova (1989), publishing for the first time a drawing of some of the lithics that survived, reported a radiocarbon date of *c*. 21,000 bp.

Okladnikov (1941) reported the discovery of a row of four concentrations, made of limestone slabs, reindeer antlers, huge mammoth and rhinoceros bones and other cultural debris. Occasionally these slabs and rhinoceros skulls surrounded the concentrations. Two of these units (interpreted as hollow dwelling structures) revealed central hearths. However, the plans are too sketchy to express an opinion on the spatial organisation of the site.

The lithic industry is similar to Mal'ta. As well known, a number of personal ornaments and art objects, also analogous to those from Mal'ta, were discovered. Among the latter, five female statuettes made of ivory and serpentine are the most noteworthy. An elongated statuette covered by rows of half-moon shaped incisions is depicted in fig. 4: 2. In addition, a similar bird figurine as from Mal'ta and a rod-like piece with the head of a bird were found.

The dating of two other stratified sites poses many questions. The first one is Sosnovyi Bor, located on a 22 to 25 m high bank of the Belaia River (Lezhnenko *et al*. 1982; Lezhnenko 1991). Artefact-bearting strata are associated with ancient aeolian (dune) sediments. Deposited in the sands and sandy loams, Layers 3 to 6 are considered Pleistocene units. Layer 5, which produced bones of bison, red deer and horse, is according to the investigators comparable to the main component of Mal'ta (i.e., about 24,000 to 22,000 bp), while Tseitlin (1979) believed in a younger date (*c*. 16,000 bp). This layer shows clustering of cultural debris and features around hearths (some slab-lined) and isolated chipped stone concentrations. The site is interpreted as a lithic workshop specialised in the processing of cube-shaped flint nodules which were extracted from dolomite terrace socles. Here were found flat single- and double-platform blade cores, wedge-shaped microcores and their bifacial rough-outs. Tools are represented by endscrapers, burins, splintered pieces and sidescrapers (among the latter oval-shaped bifacial pieces are noteworthy), choppers and original adze-like implements.

The lower and middle reaches of the Angara River yielded no more than a handful of Pleistocene sites. Probably the most noteworthy is Ust'Kova, located on a 14 to 17 m terrace (Drozdov *et al*. 1990). Artefacts were found in cryoturbated sands, clays and loams. The middle component of the site is embedded in a carbonised loam matrix above the buried soil with the oldest component (dated to *c*. 34,000-28,000 bp). Artefacts were accompanied by bones of reindeer, bison, and horse. The age of this component is postulated at *c*. 24,000 bp. The lithic industry includes a number of foliated bifaces. Ivory and bone tools and personal ornaments (pendants, beads, rings) were discovered too. A remarkable ivory mammoth figurine, bearing traces of ochre and black pigment, is associated with this component (Fig. 4: 10). Although the overall assemblage of Ust'Kova is indisputably composed of heterogeneous materials of different ages, considering the severe cryogenic disturbances, the accuracy of a division of all the artefacts into 'components' as proposed by the authors is somewhat questionable.

3.5 The Lena Basin

The majority of prehistoric sites in the Upper Lena valley are clustered in the uppermost reaches of the river in the Makarovo-Shishkino area. The Early Upper Palaeolithic is represented by redeposited artefacts from Makarovo IV and III (the latter site is dated to *c*. 30,000 bp). Makarovo VI and Shishkino VIII could be assigned to the MUP. Shishkino VIII yielded some redeposited artefacts in a gravel lens of presumably Early Sartan age (Perzhakov 1987) with a radiocarbon date of *c*. 21,000 bp.

Downstream the Lena, the important site of Alexeevsk I, near the town of Kirensk, should be mentioned (Zadonin *et al*. 1991). Located on the bank of the Lena, at a relative height of 12-13 m, artefacts and reindeer bones were found on the surface of a loam (buried soil?) with traces of solifluction covered by loess-like loams. The soil is considered to be of Karginsky age. The site yielded a blade industry with abundant small flat, butt-ended and conical cores. Truncated and retouched blades dominate among the tools.

There are only preliminary reports which suggest an MUP occupation of the area further to the north, at the upper course of the Nizhniaia Tunguska River near the Lena Basin. A major discovery should be the site of Nepa, located on a 20 m terrace. The main cultural layer was found below the loams of presumably Sartan age and the site is believed to be Karginsky. The layer yielded several artefacts (flakes, a splintered piece) accompanied by reindeer and horse bones.

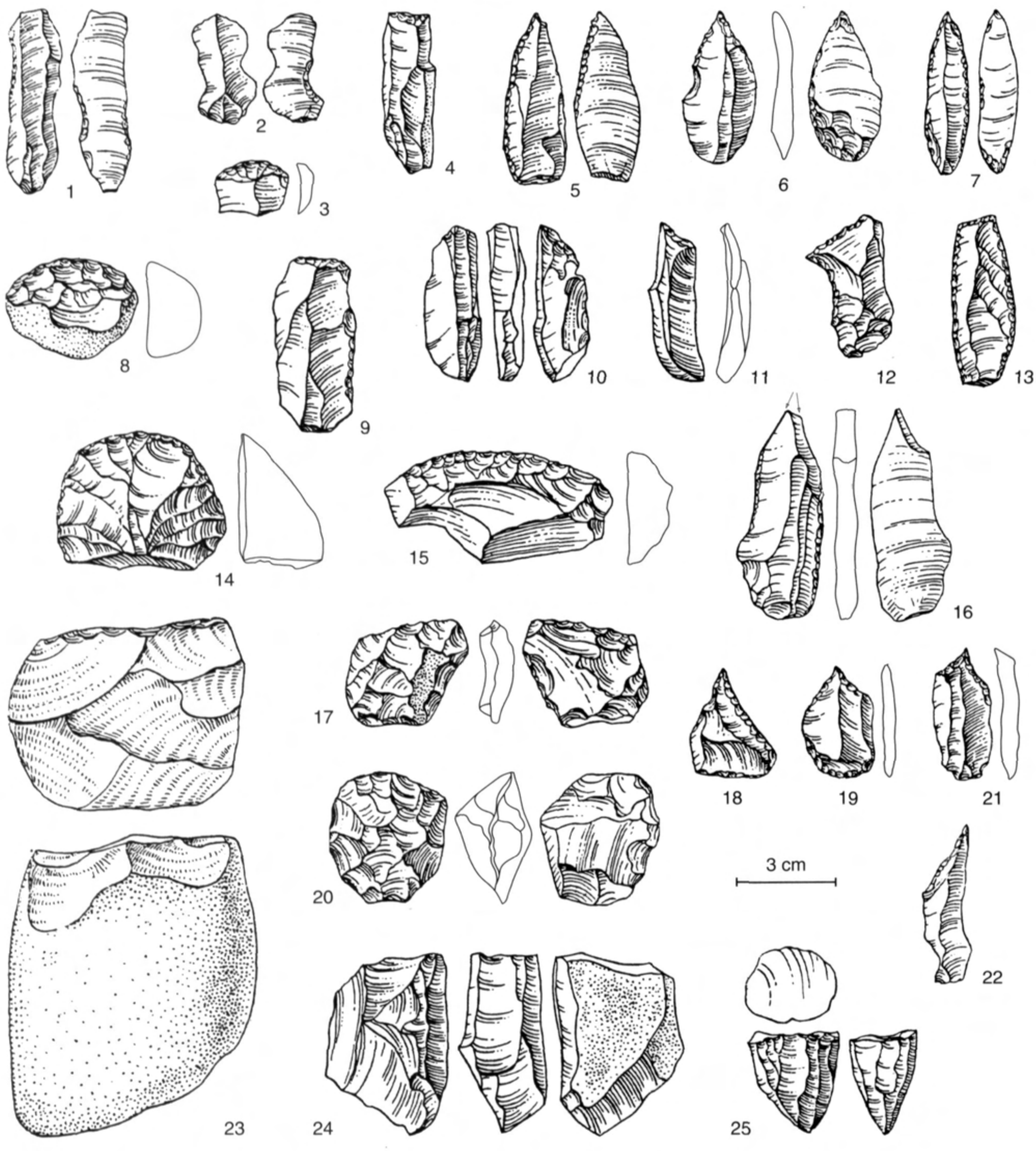

Fig. 6. Artefacts from Mal'ta (after Abramova 1989).
1, 2. notched bladelet; 3, 8, 9, 14. endscraper; 4. truncated bladelet; 5. retouched bladelet; 6, 7. point; 10, 11, 16. burin; 12. burinated tool; 13. truncated retouched bladelet; 15. sidescraper; 17. splintered piece; 18, 19, 22. borer; 20. discoidal tool; 21. endscraper/borer; 23. chopper; 24, 25. core.

record, or for speculations about long-distance migration of the European Upper Palaeolithic population. The assemblage of Mal'ta demonstrates many archaic components in the tool kit or in lithic technology since there are a number of sidescrapers and pebble tools or Levallois and discoidal cores in the assemblage. Abramova (1995), on the basis of a careful stylistical analysis of European and Siberian female statuettes, demonstrated peculiar features in the pieces from Mal'ta and Buret'. As such, the Mal'ta Culture is now regarded as having some local roots.

The Siberian MUP is, like its contemporary in other parts of the Old World, rich in artefacts reflecting their non-material way of life, such as superb mobiliary art objects and personal ornaments. No other period in the Upper Palaeolithic development in Northern Asia is comparable to this time span, which yielded a series of art objects from Mal'ta and Buret', along with isolated discoveries from Achinskaia and Ust'Kova.

This period produced the only known palaeolithic burial structure, from Mal'ta. It is rather difficult to understand the so-called 'racial type' of the Upper Palaeolithic inhabitants of Siberia on the basis of the data. Turner (1989) argued that the dentition of the children of Mal'ta is more similar to the European *Homo sapiens sapiens*, such as the remains from Sungir' and Kostenki, than to Asiatic Upper Palaeolithic man, such as for instance of Zhoukoudian Upper Cave, or the Palaeoindians. On the other hand, however, Alexeev and Gochman (1987) believe that the incisors of the Mal'ta children are shovel-shaped which is accepted as a specific Mongoloid feature. Abramova (1995) has suggested that the different styles of female figurines could provide a clue to this matter and she has pointed out that the Buret' statuette may be taken as evidence for a Mongoloid stock population for Siberian inhabitants.

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Sergey A. Vasil'ev
Institute for the Material Culture History
18 Dvortsovaia emb.
191186 St. Petersburg
Russia

Jiří Svoboda
Bohuslav Klíma
Lenka Jarošová
Petr Škrdla

15 The Gravettian in Moravia: climate, behaviour and technological complexity

This paper suggests that the gravettian record of Moravia, with greater sedentism, elaborate resource exploitation systems, and innovations in technology and ideology, probably represents one of the early cases of a complex hunter-gatherer society. In addition, the paper aims to show to what extent an interdisciplinary approach to gravettian studies can place these systems into broader environmental and social contexts. It is probable that such a complex society would be more sensitive to the climatic deterioration around the Last Glacial Maximum.

1. Past research and new strategies

The large gravettian sites of Moravia have been excavated since 1871 (Jaroslavice), 1880 (Předmostí), 1924 (Dolní Věstonice and Petřkovice) and 1952 (Pavlov). The site of Dolní Věstonice I has been excavated almost continuously, from 1924 to 1938 by K. Absolon, from 1939 to1942 by A. Bohmers, from 1945 to 1946 by K. Žebera, from 1947 to 1952, in 1966 and 1968, and from 1971 to 1979 by B. Klíma, and in 1990 and 1993 by J. Svoboda. Pavlov I was excavated from 1952 to 1965, and in 1971 and 1972 by B. Klíma, and Pavlov II in 1966 and 1967 by the same author. Since 1985, the site of Dolní Věstonice II has been the subject of salvage excavations by B. Klíma and J. Svoboda, and since 1986 the salvage excavation has been extended to the nearby site of Milovice by M. Oliva. This extensive fieldwork yielded groundplans of dwellings, hearths and kilns, human burials, mammoth-bone deposits and other faunal remains, tools, decorative objects, the earliest ceramics and textiles hitherto known, and art objects.

As for Dolní Věstonice I, K. Absolon has published three monographs on his first field seasons: 1924, 1925, and 1926 (Absolon 1938a and b, 1945). K. Žebera published another report on his excavations, which is primarily of stratigraphic value (Knor *et al.* 1953). Subsequently, B. Klíma presented a large monograph summarising his own fieldwork between 1947-1952 (Klíma 1963a), followed by reports on the adjacent mammoth-bone deposit (Klíma 1969) and the situation in the middle zone of the site (Klíma 1981); the upper zone remains to be reconstructed and published in detail. And finally, B. Klíma published a popular synthesis summarising issues addressed until then (Klíma 1983 with further references).

Dolní Věstonice II has been presented internationally in a series of articles announcing discoveries of the human burials (Klíma 1987a; Svoboda 1987; Svoboda and Vlček 1991, etc.), the presence of a wooden industry (Klíma 1990a), and particular segments of the site (Svoboda 1990; Svoboda *et al.* 1993). These preliminary reports were completed by complex publications on this site by Svoboda ed. (1991) and Klíma (1995).

Pavlov I was hitherto known only from preliminary seasonal reports and specialised studies of the antler tools (Klíma 1955a, 1987b), the lioness carving (Klíma 1963b), the non-siliceous stone (Klíma 1984), the engraving of a palaeolithic 'map' (Klíma 1988), other plastic art (Klíma 1989), the human burial (Vlček 1961), and fauna (Musil 1959). On the other hand, Pavlov II, which is a much smaller site, has a summarising monograph (Klíma 1976). Preliminary publications on Milovice were presented by Oliva (1988, 1989). From abroad, the Moravian evidence has been summarised by Otte (1981) and Kozlowski (1986).

Faced with this situation, the Department of Paleolithic and Paleoethnology at the Institute of Archaeology, Dolní Věstonice, felt that the most urgent task would be to make a more profound and interdisciplinary analysis of the sites hitherto excavated and to place these sites into a meaningful chronological and spatial framework. In the first instance, we decided to approach the inner structuring of the Pavlov I site (Svoboda, ed. 1994, 1997); the advantage of this site is not only its size and the complexity of the excavated record (only the lithics total already about 1,000,000 pieces), but also the fact that it has been excavated systematically, and by one person using one excavation strategy (Klíma 1963c). However, the nature and the interdisciplinary character of this project showed that every topic addressed at Pavlov I, be it environment, dating, subsistence, materials, technologies or rituals, revealed in fact a new set of problems to be investigated.

In addition, Pavlov I is compared with the other sites in Moravia (Dolní Věstonice I-II, Předmostí), Silesia (Petřkovice), and Lower Austria, and with their location in the landscape. In order to control the extension of the settled zones at these sites, to review their stratigraphic sections, and to apply new methods of documentation, both geological and

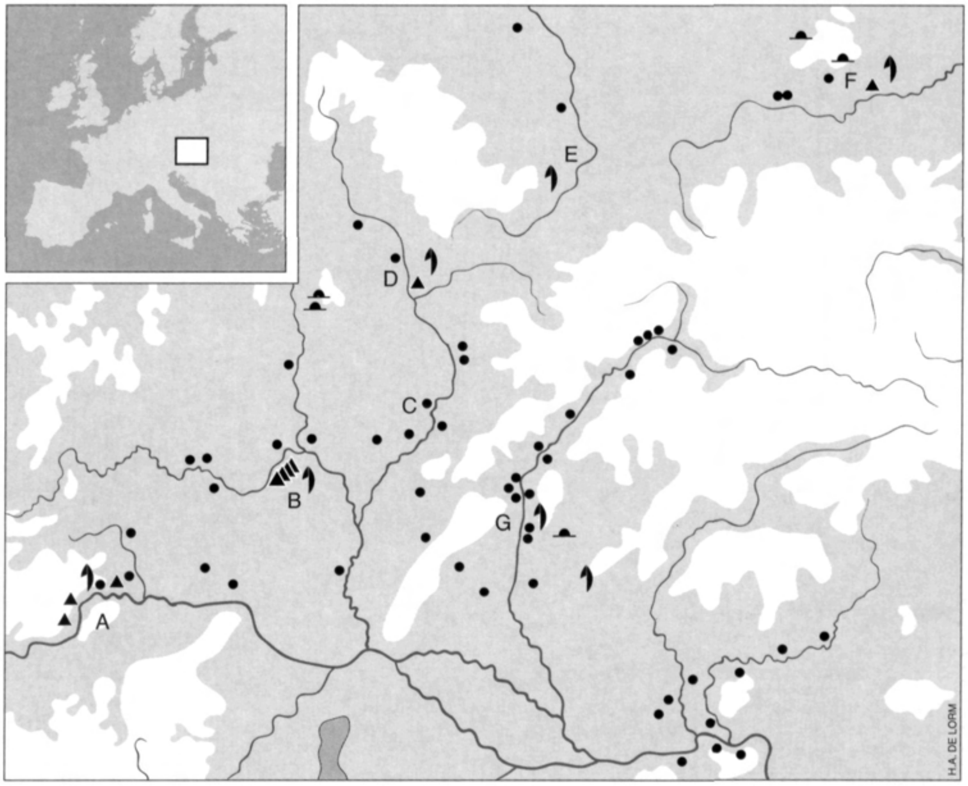

Fig. 1. Schematic map of the gravettian settlement in the Middle Danube.
Key: Triangles: Pavlovian stage. Shouldered point sign: Willendorfian-Kostenkian stage. Points: Undetermined Gravettian.
A. Danubian sites (Aggsbach, Willendorf, Krems-Wachtberg);
B. South Moravian sites (Dolní Věstonice, Pavlov, Milovice);
C. Middle Moravian sites (Kyjov, Boršice, Jarošov, Spytihněv);
D. Předmostí; E. Petřkovice;
F. Krakowian sites (Piekary, Mamutowa Cave, Spadzista);
G. Váh valley sites (Trenčianské Bohuslavice, Moravany, Radosiná Cave).
Sites in present-day Austria are located after Neugebauer-Maresch (1993), Slovakia after Bárta (1980), Hungary after Dobosi (1994), Poland after Kozlowski and Kozlowski (1977), Moravia after Svoboda *et al.* (1994). A more detailed cartographic record of these sites, on a microregional level, seems to be one of the main tasks for future research.

environmental studies and further fieldwork (excavations and surface surveys) are carried out simultanously, but now on a smaller scale than the large-scale excavations of the past. Certain aspects of this project, requiring a broader comparative background as well as specific skills and techniques, are executed in the context of international collaboration (Soffer *et al.* 1993; Soffer and Vandiver 1994; Tomášková 1994; Svoboda *et al.* 1995, 1999; West 1996; Adovasio *et al.* 1997; Trinkaus 1997; Van der Plicht 1997; Verpoorte 1997; Soffer, this volume).

2. Environmental and chronological background

2.1 Introduction

During the Last Glaciation, Central Europe represented a narrow steppic belt that provided a corridor for communication between non-glaciated regions in the west and east of the continent. As a result of the establishment of important cultural centres in Eastern Europe during the MUP, a kind of 'continental balance' seems to have been created, with an impact on the increasingly social importance of the centre.

Moravia forms a natural corridor separating the Bohemian Massif from the Carpathians, and allowing migrations of both animals and humans from the Danube valley in the southwest to the North European Plain in the northeast. This territory has a system of narrow passages connecting the plains: the Moravian Gate in the northwest, the Vyškov Gate and the Napajedla Gate in the centre, and the isolated chain of the Pavlovské Hills as a marked orientation point in the Dyje floodplains in the south. Efforts to get an overall view of gravettian settlement structures in this area (Fig. 1) are made difficult by the incompatibility (both qualitative and quantitative) between the excavated mega-sites, with hundreds of thousands of artefacts, and the mini-sites, with sometimes just artefact scatters from the surface, and by the lack of definitions of the inner structure and hierarchy of these sites.

In general, however, all recent studies of the gravettian settlement pattern demonstrate a radical difference with the other Upper Palaeolithic cultures: the Gravettians preferred the large Moravian river valleys, of the Dyje, Morava, Bečva and Odra (territorial type C or, the "Gravettian landscape", in Svoboda *et al.* 1996). These sites are at lower altitudes (200-300 m a.s.l.) than the EUP cultures, but still high enough to control the valleys. With the exception of the northernmost part (Odra valley), these territories do not provide good quality lithic raw materials. Rather, they seem to be advantageously located for the control of animal movements, and may also have offered numerous 'natural traps' in the side gorges of the valley slopes. In general, the gravettian settlement structure seems to reflect an adaptation to the optimal mammoth environments.

2.2 Pedology and sedimentology

The Gravettian corresponds stratigraphically to the time of the Stránská skála soil formation at about 30 kyr bp, and the deposition of the overlying loess, until the Last Glacial Maximum (20-18 kyr bp). The best stratigraphic sequences of the 30-20 kyr period are recorded from the multi-level sites, such as Willendorf II (Haesaerts *et al.* 1996) or Molodova V. In the large Moravian sites, under interrupted or limited loess deposition, evolved a complex of cultural horizons which are difficult to analyse (Fig. 2).

Depending on the substrate and other local conditions, the basal Stránská skála soil may typologically range from the *chernozems* and *pararendzines* (Stránská skála IIa, IIIa; Czudek *et al.* 1991), weakly developed *pararendzines* (Dolní Věstonice II; Smolíková 1991), pseudogleys (Milovice; Smolíková 1991), to lenses of humous sediments (Willendorf II; Haesaerts *et al.* 1996). The position and microstratigraphy of the cultural layers, in Moravia always lying above the Stránská skála soil, was recently published by Klíma (1994a), while Smolíková (1991) focused on the micromorphology of these layers; she shows that the matter originates from anthropogenic activities, but the matrix also includes earlier soil particles. At the end of the gravettian settlement, we observe an instability that caused the formation of tectonic fissures, sometimes quite deep (Dolní Věstonice, Petřkovice), and subsequent landsliding of whole blocks of the cultural layer (Dolní Věstonice); all these processes occurred prior to the deposition of the last loess cover. Finally, the last loess cover overlying the cultural layer was studied in detail by Klíma at Dolní Věstonice I, by Smolíková at Dolní Věstonice II and Milovice, and by Haesaerts at Willendorf. These authors observed and described several pseudogley horizons, aeolian sand, and solifluction layers within the loess, without traces of human occupation.

2.3 Palaeobotany and malacozoology

The pollen and charcoal analyses of the gravettian cultural layers show that the landscape was partly covered by wooded areas (arboreal pollen usually exceed 50%), with dominating conifers and accompanying decidous trees, including a few more demanding species (oak, beech, yew; Rybníčková and Rybníček 1992; Svobodová 1991a and b; Opravil 1994; Mason *et al.* 1994). For the upper gravettian and epigravettian period, the palaeobotanical evidence is scarcer, but the situation at Předmostí II (samples 6-7; Svobodová in Svoboda *et al.* 1994) suggests a decrease in arboreal pollen (31% – 16%) and an increase in heliophilous plants in the layers immediately following the gravettian occupation. Studies of the molluscs, in contrast, suggest markedly colder environmental conditions than the plants throughout the gravettian period (cold subarctic tundra; Kovanda 1991).

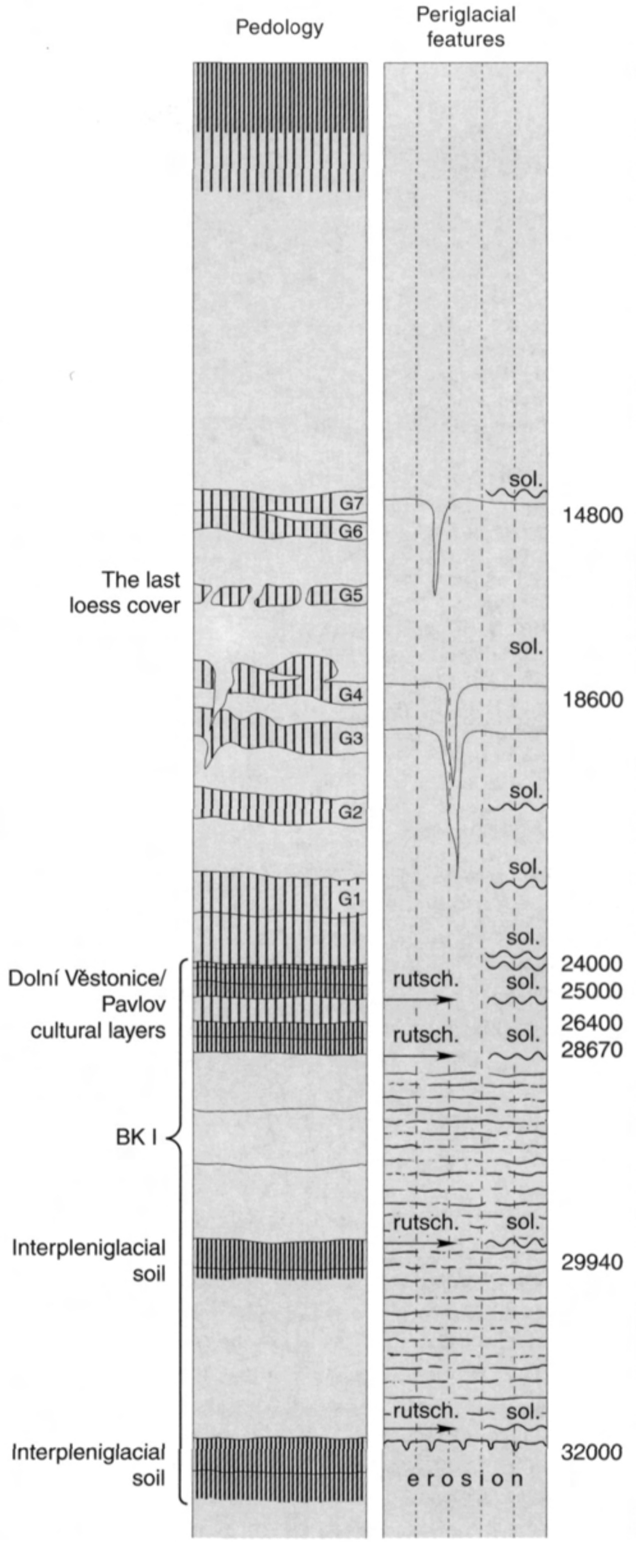

Fig. 2. Composite loess stratigraphy of the Pavlov region (adapted from Klíma 1994a and 1995). Key: G1-G7: gley horizons, BK1: pedocomplex I, sol: solifluction.

Table 1. Comparative gravettian chronology in eastern Central Europe, based on conventional ^{14}C datings.

KYR BP	GRAVETTIAN STAGE	WILLENDORF SITE II	DOLNÍ VĚSTONICE SITE I	DOLNÍ VĚSTONICE SITES II, III
20	Willendorfian-			
	kostenkian			
21				
22				
		layer 9:		
23		23 180		
		23 860		
24		24 370		site III, unit 1:
		24 910	middle and	24 560
25	Pavlovian	layer 8:	upper part:	site II, unit 1:
		24 710	25 820	25 570 – 25 740
		25 800		
26		layer 7	25 950	unit LP:
		layer 6:		26 390
		26 150		triple burial:
		26 500		26 640
		27 600		majority of units:
27		27 620	lower part:	26 900 – 27 100
			27 250	units A–C:
				27 660
28			(charcoal layers	
			without artefacts)	lower part:
		layer 5:		28 300
		27 270		
29		30 500	lower part:	29 000
			29 300	

2.4 Chronology

Archaeological approaches to the large hunter-gatherer sites may be based on a variety of assumptions. Extreme viewpoints may either explain them as an extensive, chronologically contemporaneous 'village', or alternatively, as an accumulation of a number of separate occupation events. The truth probably lies somewhere in between.

Through a lack of stratigraphic superpositions, the gravettian chronology in Moravia is still based primarily on the ^{14}C method. As noted by Pettitt (this volume), the majority of the dates older than 20,000 years may be underestimations. Our gravettian samples, mostly of charcoal, were measured in several laboratories, but the Groningen data present usually higher values, smaller deviations, and a more meaningful developmental pattern. In order to gain comparability, we based our chronological framework primarily on the Groningen data (Fig. 3; cf. Van der Plicht 1997: fig. 2). Chronological relationships between the various settlement units at the large gravettian sites, as outlined by the dates, should be correlated with the other evidence, such as spatial relationships, typology and refittings (Table 1).

On the basis of the available ^{14}C dates, it seems that Dolní Věstonice I and II were repeatedly settled between 29 and 25 kyr bp, Dolní Věstonice III at 26.2 (unit 2) and 24.5 (unit 1) kyr bp, Pavlov I between 27 and 25 kyr bp, Předmostí I between 27 and 26 kyr bp, Předmostí II around 25 kyr bp,

Table 1 continued. Comparative gravettian chronology in eastern Central Europe, based on conventional ^{14}C datings.

KYR BP	GRAVETTIAN STAGE	PAVLOV I: A, B	MIDDLE MORAVIA	PŘEDMOSTÍ I, II	MILOVICE	PETŘKOVICE	SPADZISTA SITE C2	MOLODOVA SITE V
20	Willendorfian-							
	kostenkian					20 790		
21								
22					22 100			
23								layer 7:
								23,000
24						23 370	layer III:	23,700
							24,040	
25	Pavlovian	25 020 – b	Boršice:	site II:			24,380	
		25 530 – b	25 040	25 040	25 220			
			Jarošov:					
			25 110					
			25 780					
26		26 170 – a		site I:				
		26 620 – b		26 320				
		26 650 – b						
		26 730 – b		26 870				
27								
							layer IV	
28								
								layer 9:
								28,100
29								layer 9:
								29, 650

Milovice between 25 and 22 kyr bp, Petřkovice between 23 and 21 kyr bp, and Jaroslavice, if the date of an old sample is correct, would be even later. Chronological and stratigraphical correlations suggest that the Gravettian was contemporaneous with the Upper Aurignacian. By combining these dates with the classic Willendorf II stratigraphy (Haesaerts *et al.* 1996), with spatial relationships and typology, we arrived at a broader chronological subdivision of the Gravettian in Moravia and Lower Austria and at a narrower definition of the Pavlovian as an earlier gravettian stage (Svoboda 1996a and b):

– The earliest Gravettian (Pavlovian) in the Middle Danube territory (30-27 kyr bp) is documented at Willendorf II (layer 5), Dolní Věstonice I (lower part of the site) and II (lower part of the site and certain locations in the upper part, such as units 2 and 3 of the western slope). The industries are dominated by burins, backed implements and endscrapers, burins are about twice as numerous as endscrapers, and the number of geometric microliths is usually lower, while flint dominates the raw materials.
– The evolved Gravettian (Pavlovian) stage (27-25 kyr bp) was observed in layers 6-8 at Willendorf II, at Dolní Věstonice I (middle and upper parts of the site), Dolní Věstonice II (certain settlement units), Pavlov I (all hitherto analysed materials) and Předmostí (larger part of the industry), whereas a regional separation into facies or

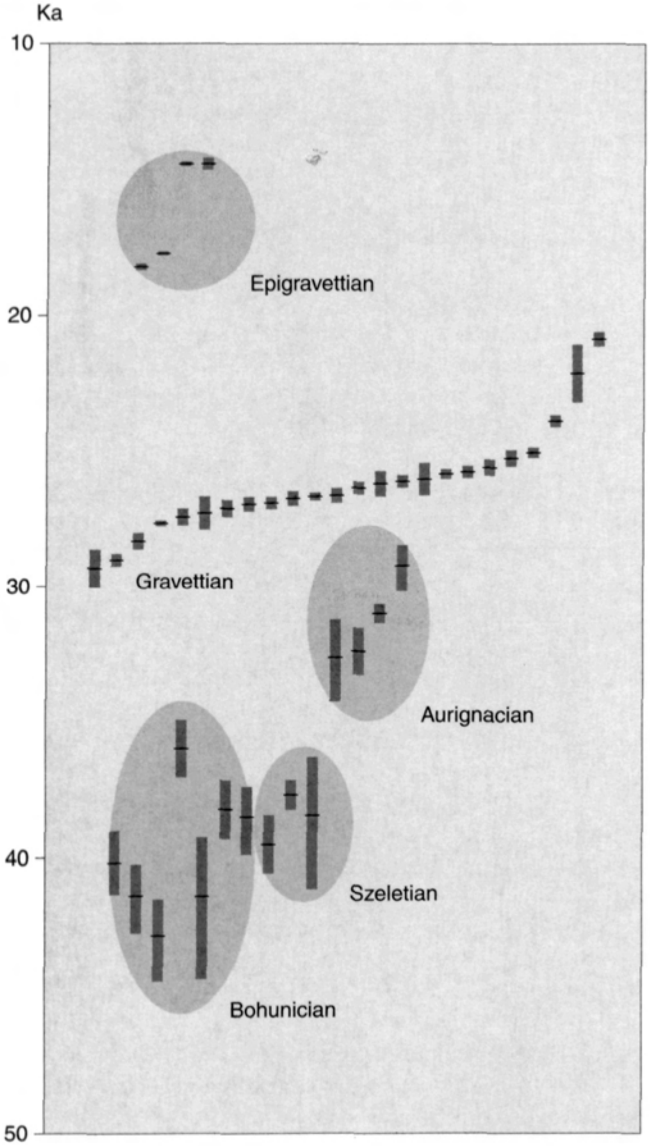

Fig. 3. Radiocarbon dates of the Upper Palaeolithic in Moravia, based on the Groningen data. From the base to the top: Bohunician, Szeletian, Aurignacian, Gravettian, Epigravettian.
The scale is given in thousands of years.

styles in typology can be observed, together with an instability in the flint/radiolarite ratio. The first facies, represented by Předmostí, Willendorf II, and Dolní Věstonice II (unit LP/ 1-4), is characterised by elaborate marginal retouch on blades and flakes, by retouched pointed blades, and by some typical sidescrapers. The second facies found predominantly at Dolní Věstonice I and II, and most characteristically at Pavlov I (1952-53), can be differentiated by a scarcity or absence of marginal retouch, and by an abundance of microliths such as crescents, trapezoids and triangles, while Dolní Věstonice is rich in denticulated microsaws. Moravia played a central role during this period.

- The Upper Gravettian (Willendorfian-Kostenkian) stage (24-20 kyr bp) is mainly represented by the sites of Willendorf I and II (layer 9) and Petřkovice Ia. Marginal, sometimes steep retouches on the artefacts and a decrease in the number of microliths recall the Předmostí style rather than the Dolní Věstonice and Pavlov style. Some of these sites (Petřkovice, Trenčianské Bohuslavice, Předmostí) also provided leaf points. However, the most important typological feature uniting these assemblages are the shouldered points of the Kostenki type (Sobczyk 1995), also indicating the emergence of relationships with Eastern Europe.
- The Epigravettian (about 18 kyr bp and later), when interpreted from a limited regional point of view, seems contradictory (a combination of gravettian and aurignacian traditions). In a broader continental perspective, again, these industries recall contemporary assemblages of the East (Kašov, Lipa, Mežirič).

3. Subsistence

3.1 Meat resources

There seems to be a relatively stable faunal composition at the large sites (Table 2; Musil 1994, 1997), with a dominance of fox, wolf, hare, and reindeer, and a surprising decrease in the number of horse remains. Some of these animals were certainly hunted for furs. The tendency to exploit smaller but more predictable food resources such as hares and birds rather than large herd animals would accord with a more sedentary regime at the large sites, and, as suggested by Soffer (this volume), the use of net hunting. However, these animals alone would probably not provide the large hunter settlements with the required quantity of protein and fat.

Along or inside some of the large sites, huge deposits of mammoth bones were accumulated, and there is still a discussion on whether these are remains of victims of organised human hunting activites (Musil 1994), or whether the settlements were specifically located adjacent to naturally occurring bone accumulations exploited as a source of raw material (Soffer 1993). In any case, mammoths would supply meat and fat in quantities that the small animals, as documented in the faunal record, obviously could not offer. There are several other, indirect, arguments that mammoths were hunted by the Gravettians (Mussi *et al.*, this volume).

After the LGM, we generally observe a return to the less predictable, larger herd animals such as horse and reindeer, and this process seems to be related to the generally higher mobility patterns of the epigravettian population. An analysis

Table 2. Pavlov I. Percentual representation of animal bones in the northwestern (excavation 1957, 1958) and southeastern (1952, 1953) parts of the site. After R. Musil (1997).

	1957 - 1958	1952 - 1953
mammoth	18,9	7,5
wolf	14,6	12,5
reindeer	15,1	10,1
horse	9,0	4,6
hare	19,2	18,5
polar fox	13,9	16,9
fox	3,2	12,7
bear	0,6	1,6
wolverine	2,3	4,4
lion	0,3	0,5
rhinoceros	0,9	-
birds	1,7	8,3
felids	-	0,7
bovids	-	0,5
red deer	0,3	0,2

of the epigravettian horse hunting site at Stránská skála IV (18 kyr bp; Svoboda 1991; West 1996), in comparison with the settlement of Grubgraben, suggests that bones were transported to settlements in a random pattern, together with meat. Heads, intensively fragmented and exploited, are relatively frequent, probably to compensate for the lack of fat in horse bodies.

3.2 Vegetational subsistence

Absence of cereals in a child's diet would prolong the lactation period, with a general impact on female fertility and with other demographic consequences. Some surprising discoveries at Dolní Věstonice II suggest, after Mason *et al.* (1994), that plant foods could have been consumed. These discoveries are fragments of charred plant tissue or amalgamations of plant fragments with mineral matter, possibly charred faeces of infants fed on finely-ground plant food. Further finds of this kind, and a correlation with an analysis of the possible grinding stones (Bosinski, this volume), may force a revision of our understanding of the Upper Palaeolithic diet.

4. Materials

Typically, the Gravettians established systems of a labour-expensive, long-distance transport of siliceous lithics, supplemented by a short-distance exploitation of the local, coarser rocks. The majority of the silicites were imported from flint sources in the north (glaciated parts of Silesia, Krakow-Czestochowa Jurassic) or from radiolarite outcrops either in the Vlára region or in the Danube area (especially Willendorf II, layers 6-8, Pavlov, 1957 area, Milovice). However, there is a considerable structuration in preferences for individual materials in the various parts of the large sites (Table 3). The Krumlovský Les cherts are important at Dolní Věstonice II, unit B, the spongolites in various sections of Dolní Věstonice I, the Krakow-Czestochowa flints at Pavlov I, lower 1956 area, etc. No correspondence between the distance of imports and frequency of use can be observed. The radiolarites are not more frequent at sites close to the outcrops (e.g., Jarošov II), and the local, Moravian outcrops of cherts and quartzites were neglected, unless they could be collected from river gravels directly below the settlements.

In order to better understand this selection, the raw materials were tested according to modern industrial norms of coarseness and cutting ability (Škrdla 1993: table 3). The materials were separated into two main groups: the siliceous rocks, more suitable to the use of force (northern flint, radiolarite and local cherts), and the others (quartz, quartzite, rock crystal, obsidian). To determine more precisely the sources, A. Přichystal (1994b: tables 1-2) examined the various kinds of siliceous rocks under a stereoscopic microscope and confirmed his observations by geochemical analyses of the trace elements. The first informative results, still based on a non-representative number of samples, suggest a comparability of the Pavlov radiolarite samples with those from the Vlára region, and only slight differences in the Pavlov flint samples compared to those from glacial sediments and the Krakow-Czestochowa Jurassic. A more detailed analysis of the local rocks, samples of ochre and Tertiary molluscs is actually in progress by A. Přichystal and Š. Hladilová.

The gravettian evidence also shows, more clearly than the other UP cultures, that these anorganic materials are widely supplemented by a range of organic materials (Klíma 1990a, 1994b, 1997; Soffer, this volume).

5. Technologies

5.1 The flint/radiolarite industries

Refittings recently shed new light on studies of Upper Palaeolithic technologies. The gravettian technology, as analysed by P. Škrdla (1997) in the radiolarite materials from Pavlov I, represents a fully developed Upper Palaeolithic blade technique. The shape of a core was formed by the removal of a series of cortical flakes and platform preparation flakes. The reduction usually starts from the narrow core face by the removal of a crested blade; subsequent blades become smaller and smaller, while the platform(s) may be rejuvenated. The residuals are cores, mostly unilateral, or various microcores; some of these were re-utilized as retouchers.

Table 3. Pavlov I. Representation of the silicite raw materials in the northwestern (excavation 1957) and southeastern (1952) parts of the site.

Pavlov I	Minimal distance (km)	n 1957	%	n 1952	%
Flint	150	7065	47,3	13015	96,5
Radiolarite (red)	80 - 100	5088	34,1	430	3,3
Radiolarite (green)	100	2420	16,2	undetermined	
Moravian cherts	0	51	0,3	20	0,2
Obsidian	360	2	-	0	0
Rock crystal	80	2	-	0	0
Burnt in fire	-	305	2,1	undetermined	
Total	-	14933	100	13485	100

Use-wear was hitherto analysed on materials from Dolní Věstonice II (Tomášková 1991), Pavlov I (Tomášková 1994), and Willendorf II. Damage observed on the tool edges under the medium magnification used (75-200 x) could be best described in the following terms:

- polish (varying intensity, appearance, and extent; most common in woodworking),
- rounding (consistent loss of a sharp edge; varying appearance depending on the worked material),
- striation (appearance of scratches and grooves; pronounced with dry and frozen materials),
- microflaking (various forms of crushing, nibbling, step and hinge fractures; common in bone work).

Results obtained in an experimental study enabled a broad separation of the worked materials into four groups:

1. dry, coarse, hard material (e.g. shell, frozen, dry meat and hide),
2. soft resistant material (e.g. wood, tough roots),
3. soft material (e.g. plant, fresh hide, fat),
4. fresh tough material (e.g. bone, antler, meat).

Overall, on the basis of the use-wear study at Pavlov I, it may be proposed that as a whole a variety of activities could have occurred at the site. Hard, possibly dry, frozen, as well as soft, fresh, and tough materials could have been processed here. Yet, it appears that the area around two of the hearths served more for working of soft and fresh material. The evidence gathered from the material located near the other hearths seems to show a balanced mix of activities associated with them. In addition, special attention has been paid to stone stab-like tools and to the effect of impacts creating, in fact, burin-like patterns on their extremities (Škrdla 1995).

The epigravettian technology is more variable, demonstrating a change towards flake and microblade technologies. A strange technological feature recognised recently represents the wedge-shaped microblade cores from several Moravian and Silesian sites (Svoboda 1995a), recalling morphologically the specimens used by the same time in North Asia.

5.2 Coarser lithics: the heavy industries

The coarser materials were analysed as to morphology (which was quite simple: pebbles, fragments, cores, flakes, plaques), raw materials (which are rather local: limestones, sandstones, metamorphites, quartz, quartzite), and traces of activities. The evidence of activities can be separated into traces of ochre, abrasion (striations and polish), and pounding and grinding marks (active and passive). It is through a combination of the morphological and traceological analyses that terms such as 'hammerstone', 'retoucher', 'grindstone', 'polishing stone' and others should be developed. Some of the objects have clearly served several purposes. Microscopic observations show, in most of the hammerstones, that pounding marks are superposed over the ochre coverage, i.e., the pounding activity was posterior to the ochre grinding. Generally, it seems that the hammerstone was the last stage in the life´s history of certain implements (some flint and radiolarite cores ended in the same way).

5.3 Grinding stone

Apart from pebbles showing ground surfaces created during use, Klíma discovered a series of intentionally ground pebbles and their fragments in Pavlov I (Škrdla 1997). Pebbles of this attractive, whitish material with mosaic-like red colouration were collected in the broader vicinity of the site (minimum distance, at Brod nad Dyjí, is 7 km). The weathered original surface of the discoid, circular or ovoid pebbles was ground, probably by using sandstone plaques and thus creating characteristic striations; some pieces were further polished. The use-wear traces (impact cones and scratches) show that the artefacts were used as retouchers. Analogies are observed as far as Kostenki IV-Alexandrovka.

Finally, several gravettian sites (Pavlov I, Předmostí, Brno II and others) yielded large and characteristically perforated

Fig. 4. The typical curved-line style of Pavlov I, here applied on ivory headbands.

discs ground from siltstone plaques; enlightening their function seems an important task for future studies.

5.4 Bone and ivory

New presentations of the bone industry from Pavlov I, 1952-53 area (Klíma 1994b), and 1957 area (Klíma 1997), show that it is composed of finished and unfinished artefacts of various animal bones, antler and ivory. Not only for their number and good state of preservation, but especially for the richness in forms and types, these artefacts are typical, especially for the pavlovian stage of the Gravettian. An additional characteristic is supplied by the decorative objects and the art, carved most frequently of ivory: the elaborate headbands (Fig. 4), relief pendants, and further anthropomorphic and zoomorphic carvings. They prove a high degree of mastery in working this noble and precious material. Some of the tools yield evidence of the applied technological procedures, i.e., the mode of antler chipping differs from the later UP cultures.

The bone tools were mostly found scattered around the hearths (Klíma 1994b). Among the exceptions are a concentration of antler tools which, however, does not represent a workshop area, and several concentrations of pendants, obviously the remains of necklaces. Actually, the discovery of textile imprints in clay will probably introduce a new perspective on the bone tool interpretation: it seems that certain characteristic tool forms could have served in textile fabrication.

5.5 Processing ochre

At Dolní Věstonice I, plaques and grinding stones with visible traces of ochre have been recorded since the times of Absolon (1938a: fig. 54; 1938b: figs 137-139), while the ochre lumps were later examined (Klíma 1963: 179; Přichystal 1994a: 48; Vandiver 1997). Further details about the spatial distribution of ochre and the tools for its processing, with reference to the palynological evidence for use of water as a medium, and the spatial relationship to the human burial at Dolní Věstonice II, were given by Svoboda (ed., 1991: 50), whereas an experimental study of the colour variability was carried out by Šedo (not published).

5.6 Ceramics

The fact that baked clay figurines were produced in the Upper Palaeolithic at Dolní Věstonice I was first recorded by H. Freising and K. Absolon as early as the 1920's. Later, Klíma added another large collection from Pavlov I; smaller samples exist from Dolní Věstonice II, Pavlov II, Předmostí, Petřkovice, and, most recently, Ch. Neugebauer-Maresch (1995) announced zoomorphic pieces from Krems-Wachtberg in Lower Austria.

The results achieved by physico-chemical studies by Soffer *et al.* (1993) and Soffer and Vandiver (1994) clarify certain aspects of the production and utilisation of these ceramics. The raw material was local loess, generally fired to temperatures between 500-800°C. These temperatures correspond to the results of analyses of temperatures in some of the hearths. Ceramics could have been used for a variety of practical and non-practical uses (Soffer, this volume). Certain deformations observed in the shape of the figurines can be explained as the result of thermal shock. Effects of such a rapid temperature change appear repeatedly, showing that this approach leading to destruction was not accidental, but rather intentional, and possibly ritual.

5.7 Textiles

In July 1996, O. Soffer, J. Adovasio and P. Vandiver confirmed an earlier assumption (Adovasio *et al.* 1996), that imprints observed on certain lumps of fired clay are from textiles, most probably from *Urtica* fibres (Adovasio *et al.* 1997; Soffer, this volume). Naturally, this issue will change our understanding of palaeolithic lifestyles in several aspects: first, this technology requires stability of settlement and a good knowledge of vegetational resources; second, further activities such as basketry, net weaving and trap making should be implied, and third, it may help in the interpretation of certain bone tools and so-called pendants and weights (some of which were interpreted as 'anthropomorphs' in the past) that may have been useful in net weaving and in stabilising the weavers' frames.

6. Rituals

Evidence of rituals is difficult to excavate, demonstrate, and, sometimes, to separate from the evidence of practical activities. Attention should be paid to technologies and contextual data on objects such as the fragments of ceramic figurines, ochre distribution, and human burials. This kind of evidence was usually discovered in the centres of the settled areas, especially in large sites with intensive reoccupations. This stresses the social functions of the expected rituals, performed in living places and in places of aggregation.

Studies of the ceramics document the spatial relationship of the production and damage of the figurines, all happening around some of the central hearths at Dolní Věstonice and Pavlov (Soffer *et al.* 1993; Soffer and Vandiver 1994). The studies of ochre are based on both the evidence from earlier excavations at Pavlov I (concentration of grind stones and ochre pieces within the 1957 area), and new data from the field. At Petřkovice, we discovered surfaces truly plastered with red ochre in the central part of site Ia. Due to unfavourable conditions for organic preservation at this site, we are not able to explain this situation using full contextual data, but samples of both the ochre and the sediment are further examined.

Hypotheses on burial rituals are derived from contextual data based, among others, on reconstructions of the original terrain situations (Klíma 1987a, 1990c, 1991; Svoboda 1987; Svoboda and Vlček 1991; Oliva 1996, this volume), from examinations of injuries on bones (Vlček, ed. 1993; Vlček 1995), and from the evidence of postmortem manipulations of the human remains (i.e., skulls arranged as 'bowls' at Dolní Věstonice). Therefore, further studies of this kind will also require a more integrated collaboration with physical anthropology.

7. Symbolism

Forms, whatever individual meaning each may have possessed, can only exist in defined space and time. In Moravia, their co-appearence at a single settlement, or group of related settlements, seems not accidental, and it is suggested that an integrated awareness of space and time, group identity, memory, epics and life and death concepts lay behind these objects and actions. Part of the evidence also refers to the concept of individual identity and rituals. This symbolism may be correlated with other aspects of the complex gravettian archaeological record. In the light of this, we propose that symbolic behaviour also had informative and adaptive significance (cf. Svoboda 1995b, 1997).

8. Physical anthropology

The series of human skeletons from Moravian gravettian sites, together with the Italian series, represent the earliest relatively complete sample of early modern human remains available today (Figs 5-6). Formerly, anthropological research focused on primary morphological description, demography, palaeopathological diagnosis and interpretation (Vlček 1991, 1995; Jelínek 1992; Vlček, ed. 1993), including broader comparative studies with the other Moravian materials (Vlček 1994). Future research will address functional analysis of these remains, especially the postcranial remains, with respect to adaptive tendencies within the early modern population (Trinkaus 1997; Trinkaus and Jelínek 1997).

9. Case studies: microregions and sites

9.1 Approaches to site analysis

Analysis of the settled areas shows that they are usually composed of various 'settlement units', each with a central hearth or hearths, with pits in the surrounding floors, and some of these in shallow depressions and/or with larger objects along the external margins. Their relationships (chronological, seasonal, functional) are expected to be revealed through an analysis (Table 4). Serious limitations of the spatial analysis of earlier excavated gravettian sites is given by the nature of the primary data on the location of the objects. At Dolní Věstonice I and II and Pavlov I, the position of the artefacts was mostly recorded only in square metres, but some recent results achieved with this coarse grid recovery method (Svoboda *et al.* 1993; Svoboda, ed. 1994) are encouraging, and allow further applications of the Surfer

Fig. 5. The triple burial from Dolní Věstonice II (1986 excavations).

programme to artefact density patterns (Jarošová 1997). Since 1990, the position of each piece is being recorded two-dimensionally (Dolní Věstonice I and III, Petřkovice) or three-dimensionally (Předmostí, Jarošov) and stored in a database file. This enables us to analyse more precisely the distribution of raw materials, tool types, and refittings.

In the winter of 1996, in an effort to understand the dynamics lying behind the static archaeological record, we examined the ethnoarchaeological evidence from the Yamana sites of Tierra del Fuego, thanks to collaboration with the CADIC, Ushuhaia, and the Universidad Autonoma of Barcelona (Svoboda 1996c). The Fuegian sites, as visible on the surface today, are composed of networks of circular settlement units with a diameter of 3-3.5 m, each encircled by shell middens accumulated over longer time spans. This circular structure resulted from the repeated clearing of hearths and other objects, accumulated in the centre, towards the periphery. The stratigraphy and chronology of the middens, composed of shells, charcoal, bones and artefacts interstratified with sterile humous layers, document differences in the range of thousands of years among the features, or, sometimes, among occupations of the same feature. Against the Fuegian evidence, where objects have accumulated as refuse in the periphery, there is the teepee-rings case from the North American Plains, where larger objects evidently formed the base of the structures. Both models are evaluated in interpreting the gravettian sites.

Fig. 6. The single male burial from Dolní Věstonice II (1987 excavations).

The experiment, as another kind of archaeological analogy, was recently tested in the frame of two film productions and two museum expositions, which provided several opportunities to reconstruct gravettian dwellings. In some of these cases, we also reconstructed the individual activities that took place inside these settlements (ceramic production by M. Lázničková, textile production by M. Buòatová, use of ochre by O. Šedo; cf. the Conference of Experiments and Reconstructions in Archaeology, Brno, 1998).

9.2 Recent regional surveys

- The Dolní Věstonice-Pavlov area. The intensive surface surveys of the Dolní Věstonice-Pavlov area, continuing since the times of Absolon and Klíma, help to place the large excavated sites in a broader regional context. From east to west, we actually surveyed artefact scatters at Bulhary, to the east of Pavlov (site Pavlov III), in the surroundings of the trenches at Dolní Věstonice III, and two smaller locations of bones and lithics above the site of Dolní Věstonice II (sites IIa and IIb). As in other microregions in Moravia, it appears that the almost continuous chain of gravettian sites is limited by the altitudinal zone of 200-300 m a.s.l., while the only earlier (EUP) site, in the uppermost part of the site of Dolní Věstonice III, lies higher.
- The Middle Morava Basin. This valley is important as a connecting link between the Dolní Věstonice-Pavlov area

Table 4. Hierarchy of main gravettian sites of South Moravia.

CENTRAL AND LARGE SETTLEMENTS	LARGE-SIZED	MIDDLE-SIZED	MAMMOTH BONE DEPOSITS
Dolní Věstonice I	Dolní Věstonice II	Dolní Věstonice III	Dolní Věstonice I
Pavlov I		Pavlov II	Dolní Věstonice II
		Milovice I	Milovice I

and Předmostí. Several important gravettian sites in the area, already studied by Klíma (Boršice) and Valoch (Jarošov), are re-examined by new surveys and smaller excavations (Škrdla and Musil n.d.).

9.3 RECENT EXCAVATIONS (1991-1997)

- Dolní Věstonice I. A series of control trenches along the central parts of the site of Dolní Věstonice I was opened in the summer of 1990. In the lower zone of the site, two superimposed layers of charcoal deposits yielded relatively early dates (29.3 +0.75 -0.69 kyr bp, GrN 18187, and 27.25 +0.59 -0.55 kyr bp, GrN 18188), while the cultural layer in the upper zone was more recent (25.95 +0.63 -0.589 kyr bp, GrN 18189).The following excavation in 1993 opened a larger area in the upper zone of the site, showing postdepositional alterations in the relief of the cultural layer, structured along vertical fissures. In collaboration with P. Haesaerts, the opening of geological sections continued in 1994.
- Dolní Věstonice II. The central parts of this site were already excavated and are now destroyed by industrial loess exploitation. In 1991, a marginal area in the uppermost part of the site was presented to the UISPP Congress excursion. Various geological sections at both sites, Dolní Věstonice I and II, are continuously sampled and studied from a chronological, sedimentological and environmental point of view.
- Dolní Věstonice III. A smaller site ('Rajny'), discovered by Klíma in 1969, was opened to excavation and surface surveys in 1993-1995 (Škrdla *et al.* 1996). Unit 1 of this site yielded a hearth encircled by an accumulation of bones, artefacts, Dentalia shells and ochre, and is important for its relatively late ^{14}C date (24.56 +0.66 -0.61 kyr bp, GrN 20392), making it the most recent settlement within the Dolní Věstonice-Pavlov area. Unit 2, higher on the slope, shows superposition of two Upper Palaeolithic layers. The upper layer is typically Gravettian, with a dominance of northern flint, and the lower layer, formed by redeposited infilling of a shallow gully, shows a predominance of Moravian cherts; however, dating charcoal dispersed throughout the two layers (26.2 +1.1 -0.97 kyr bp and 26.16 +0.77 -0.7 kyr bp, GrN 22306-7) did not help to identify a chronological difference.
- Předmostí II. This site is of prime importance because of its location at the southern entrance of the Moravian Gate (Absolon and Klíma 1977; Klíma 1990b). New fieldwork was prepared by prior stratigraphic studies, and carried out systematically, and over a larger area in 1992 (Svoboda *et al.* 1994). The stratigraphy shows a sequence of two Middle Palaeolithic layers in the last interglacial sediments (dated by TL between 145 and 90 kyr bp, by M. Frechen), followed by a gravettian layer in Würmian loess sediments (dated by ^{14}C to 25.04 ± 0.32 kyr bp, OxA 5971). Environmental studies of the section were carried out by V. Ložek in malacozoology and by H. Svobodová and E. Opravil in palaeobotany. In the framework of Czech archaeology, the excavation was important for application of more precise methods of three-dimensional recording of all recovered objects, and studying their spatial and stratigraphical relationships by refittings.
- Petřkovice I. This site controls the northern entrance of the Moravian Gate. Our 1994-1995 excavation (Jarošová *et al.* 1996) completed the area previously excavated by Klíma (1955b), first in the central parts of the site (Ia, Ib), and then expanded to adjacent areas (Ic). New dates (20.79 ± 0.27 kyr bp, GrN 19540; 23.37 ± 0.16 kyr bp, GrA 891) and typological reconsiderations showed that the most important part of the site, location Ia, belongs to a more recent Gravettian than was previously expected (Willendorfian-Kostenkian stage). In the other parts, however, the typological features are different and may correspond to another stage of the gravettian occupation.
- Jarošov II. Another site controlling the Middle Morava valley, was previously known as a deposit of animal bones only. New joint surveys, followed by a systematic excavation by Škrdla in 1996-97, showed that the structure of this site is more complex than we expected, and included a related settlement area. In addition, the site differs from most of the large sites by the dominance of reindeer in the fauna (Škrdla and Musil, n.d.).
- Grubgraben. The most important epigravettian settlement in the Lower Austrian/Moravian territory (about 18 kyr

bp) was recently excavated by F. Brandtner; in 1993-1994, this fieldwork was co-directed by Klíma (Brandtner and Klíma 1995).

9.4 EXAMPLES OF SITE ANALYSES

- Pavlov I. After Klíma (1963c), the settled area of this site may be separated into two chronologically not contemporaneous parts. So far, we have analysed two segments from both parts: the southeast, the 1952-53 area and the northwest, the 1957-58 area (Svoboda, ed. 1994, 1997). Almost all the radiolarites of this site have already been refitted and their distribution pattern shows that the 1957 area was a centre of radiolarite production within this site. Even if the database is limited, due to the coarse grid recovery, the picture (Škrdla 1997) documents the pattern of radiolarite distribution and the links between the two main parts of the site.
  The 1953 area was examined on faunal distribution, use-wear distribution and lithic typology. In the centre, outlines of a central structure are rougly delimited by larger objects, and, more clearly, by a slight depression along the northern margin. The artefact distribution accords with the shape of the feature, it respects the northern outline, but continues to reach maximum densities at the western margin. The faunal distribution does not respect the feature at all, almost all species concentrate to the west of it, and some to the south. It seems that the western part of the 1953 area was a zone of concentrated activities. If we accept the central feature as a dwelling, the western zone would represent an adjacent activity area, most probably around an entrance.
  Analysis of the 1957 area revealed a male burial and two settlement units nearby, each partly correlated with an area of increased artefact density (Jarošová 1997). One of the features is more precisely correlated with an important accumulation of baked clay fragments and figurines, some of which suggest that the presumed hut was burnt. There are several further indications, including the typology, suggesting that the two features are not contemporaneous.
- Dolní Věstonice II. On the western slope of this site, three settlement units were distinguished, each with a central hearth and an artefact concentration around it (Svoboda, ed. 1991: figs 2 and 23). The ^{14}C dates, spatial relationships, refittings and typology suggest that units 2 and 3 may be contemporaneous (*c*. 27 kyr bp), and that unit 1, including the human burial DV XVI, is more recent (*c*. 25.5 kyr bp). A more detailed analysis of the nearby unit 4 (also about 27 kyr bp, Svoboda *et al*. 1993) shows that in this particular case, the position of the hearths in relation to the central artefact concentration is clearly peripheral. One of these hearths was surrounded by Tertiary shells and ochre. The microliths dominate in the centre of the artefact concentration, and in the periphery we observe an increase in larger objects, of radiolarite, and burins.

9.5 WITHIN-SITE TYPOLOGICAL VARIABILITY

Examples from Dolní Věstonice II, Petřkovice I and other analysed sites document a considerable variability, both qualitative and quantitative, on the one site-level. At Pavlov I, for example, a comparison of the typological structure of an assemblage from the southeastern (1952-3) part and from the northwestern (1957) part demonstrates that the 1952-3 part has a higher number of groups of endscrapers/burins and backed implements. The northwestern part, on the other hand, is rich in the other microliths, especially crescents, laterally retouched implements, such as blades and sidescrapers, and chisels. Taking into account that the 1952-3 sample is predominantly made of flint, while the 1957 sample is mostly of radiolarite, some of the differences between the two parts of the site may also be related to a pattern of raw material preferences for the various tool types.

9.6 DURATION OF OCCUPATION AND SEASONALITY

The macrochronological studies demonstrate that the large Moravian sites were settled repeatedly during longer time spans. A more detailed insight (microchronology), however, concerns the duration of the single occupations recorded. A number of arguments would suggest that the occupations recorded in the analysed parts of Pavlov I and Dolní Věstonice I may be of longer duration than Pavlov II and Dolní Věstonice II: the presumed dwellings at Pavlov I and Dolní Věstonice I are more frequently semisubterranean and sometimes include remains of marginal enclosures, while those at Dolní Věstonice II are rather light surface structures; Pavlov I and Dolní Věstonice I have thick ashy deposits, with concentrations of art and decorative objects, and Pavlov I has a possible storage pit; Dolní Věstonice II and Pavlov II lack representational art, the production of fired clay was limited, and the ash deposits were smaller and thinner; the lithic production at Pavlov I suggests a generally higher intensity of raw material use (Svoboda, ed. 1994), as well as of use-wear (Tomášková 1991, 1994). Basing himself on the amount of hunted game at Pavlov I, 1952-53 area, Musil (1994) estimated the length of occupation of this spot to be one or two years, or one year with two winters.

The evidence on seasonality is still scarce and the various indications suggest rather a year-round stay at one place than seasonally structured movements between sites. Winter occupation is suggested for Pavlov I by Musil (1994), on the basis of the quantity of animals hunted for furs (wolves, foxes) and by Tomášková (1994), who observed traces of work with frozen and dry materials near some of the hearths. Dolní Věstonice II, a site expected to have a shorter occupation, also has a good proportion of foxes and Opravil (1994) confirmed a winter occupation on the basis of tree rings preserved in the wood from the vicinity of the triple burial. In favour of an occupation in a more temperate season would also be the location of activity areas in front of the presumed entrances of certain dwellings (Pavlov I – 1952-3; Dolní Věstonice II – unit 3). The new evidence of weaving also suggests that humans were present in the area in times when the *Urtica* fibers were available, and that they were sedentary enough to be able to process them on the spot. Generally, this evidence rather suggests settlement stability within the region.

10. Coping with deteriorating climate

From the point of view of behaviour, the gravettian biocultural system demonstrates an optimal and dynamic combination of settlement stability with a long-distance exploitation of an extensive territory, as documented by the typical site location strategies along the interconnecting rivers, long-distance lithic transport, and probably, hunting of the largest mammals of that time offering an important supply of fat – the mammoths. A number of progressive techniques has been involved in order to make this system as efficient as possible (ceramic production, the first textiles and basketry, grinding stones, use of coal for heating; cf. Soffer, this volume). In addition, the efficiency of the gravettian adaptation was supported psychologically, by rituals performed in places of aggregation (ceramic production, burials; Soffer 1997; Svoboda 1997). This system operated in a social climate involving the presence of another population in the same region (the aurignacoid line), but using different settlement and lithic exploitation strategies. In this light, we propose to see the gravettian system as an early example of a complex hunter-gatherer society (Yesner 1994; Arnold 1996). Theoretically, such a system would be more sensitive to the environmental deterioration at the end of the period.

While the settlement pattern suggests stability during the earlier Gravettian (Pavlovian), the long-distance exploitation network became a solid pre-adaptation for population movements before the LGM. The archaeological record suggests a shift of civilisation centres towards Eastern Europe during the Upper Gravettian (Willendorfian-Kostenkian stage; Soffer 1987; Svoboda 1996a). After the LGM, during the Epigravettian, we observe the emergence of other strategies in animal exploitation (West 1996), together with a more variable selection of the siliceous sources, a decadence in art, and we may presume either a combination of group mobility with intergroup exchange, or random movements of groups across eastern Central Europe. It seems that Moravia, after 20 kyr bp, played the role of a western periphery of larger, Eastern European cultural units.

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Jiří Svoboda
Bohuslav Klíma
Lenka Jarošová
Petr Škrdla
Department of Paleolithic and Paleoethnology
Institute of Archaeology
AS Dolní Věstonice
Czech Republic

Martin Oliva

16 Some thoughts on pavlovian adaptations and their alternatives

The Pavlovian, an exceptionally advanced variant of the Gravettian in Moravia, owes its name to the existence of several unusual phenomena: the strict concentration of settlement areas in broad river valleys, the huge deposits of mammoth bones, the almost exclusive utilisation of imported raw materials in the lithic industry, the considerable variability of the bone industry, the flourishing of art, and the concentration of burials. The cause behind such a cultural development has been seen in the psychosocial consequences of the hunting of mammoths, the most prestigious hunting game. Ecological conditions merely permitted this adaptation, they did not condition it. Around 22,000 years ago the Pavlovian was succeeded by an entirely different cultural system (Epiaurignacian, Epigravettian), which took up from local EUP adaptations. This occurred during the continual cooling of the climate and the expansion of the cold steppes.

1. Introduction

The most numerous and most structured evidence of the gravettian (pavlovian) occupations has been observed in Moravia, in the eastern part of the Czech Republic. The Moravian Gate and the broad river valleys form a privileged north-south corridor between the North European Plain and the Danube valley. Towards the West and East, however, Moravia is relatively enclosed: it is separated from Bohemia by the Czech-Moravian Highlands and from Slovakia by the western part of the Carpathians. These geographical conditions have favoured the link-up of the local cultural system both with the settlement areas in southern Poland with their rich flint sources, and with the gravettian sites in Lower Austria which lie again along the East-West corridor along the Danube.

Moravia was already densely settled in the EUP (szeletian, bohunician, aurignacian, and Míškovice type), from which approximately 300 sites are known. The hitherto insufficient evidence (mostly surface sites) shows that horse predominated in the catch. With the advance of the continental ice sheet after 29 kyr, the climate deteriorated, the vegetation impoverished, and game hunting became less predictable due to its greater mobility. Nevertheless, the megafaunal populations such as mammoths and woolly rhinos did survive and perhaps also increased, at least seasonally. The natural faunal composition is unfortunately not known, since no thanatocaenosis not influenced by man has been preserved. A whole series of other animals (reindeer, horse, rodents, carnivores, birds) is documented from the gravettian sites which, in locations where no mammoth-bone dumps have been investigated, can also prevail in numbers (Pavlov I; Musil 1959, 1994). Even though accurate archaeozoological studies in the Pavlovian are not available (the papers by Musil are aimed mainly at taxonomic questions), it is clear that in the represented biomass the mammoth always predominates. This situation, documented in the entire pavlovian time span from 28 to 22 kyr, does not have an analogy in other gravettian provinces. About the way of life and seasonal migrations of mammoth herds we know very little. According to the studies of Vereschagin and Barishnikov (1982), it appears that the mammoths were moving above all in the broad river valleys and also in lacustrine environments, so that the river beds (but also the Danube valley) could have belonged to their preferred habitat.

Mass mammoth hunting was, of course, only one of the subsistence possibilities and thus a matter of a culturally determined choice. There is no doubt that this was the most exacting alternative, with a huge risk to the life of the hunter. We do not know exactly to what extent the mammoth herds were migratory (and their arrival eventually predictable), but a successful exploitation was dependent on cooperation and perhaps also on seasonal aggregation of several social units. This required the elaboration of social mechanisms which would guarantee communication between more or less distant groups, as well as a spirit of cooperation, a sharing of prey, and a sufficient safety network in seasons of want. In this sense mammoth hunting is comparable with whaling in some subrecent foraging communities.

The cause of the specialised mammoth hunt is rationally not an easily solvable question. One can speculate about the specific natural conditions, the considerable role of the previous long-term settlement in the EUP (cf. Gamble 1993), and so on. The mammoth hunt evoked a considerable increase in the prestigious and competitive aspects between individuals and in the social complexity at both intra and intergroup levels. Into this model fit well the particularities of the Moravian Gravettian which will be discussed in the following section.

2. The settlement pattern

The Moravian gravettian sites differ considerably in the size, quantity and quality of the evidence yielded – from megasites such as Předmostí, Dolní Věstonice I, Pavlov I and Petřkovice I with all their manifestations of material and spiritual life, via small concentrations of some lithics and bones, to isolated finds of stone implements. Regardless of the size and contents of the assemblages (which indicate a diversified function of the sites), nearly everything comes from the borders of the broad valleys of the Dyje, Morava, Bečva and Odra rivers (Fig. 1). No sites are located in the areas of the densest EUP settlement, such as on the slopes of the Krumlovský les, Drahany and Chřiby uplands. With the exception of several gravettoid artefacts from the unclear stratigraphic position in the Kůlna cave, with relatively recent radiometric dates of about 23-22 kyr (Valoch 1988: 47), in general traces of the Gravettian are missing in caves and in the Moravian Karst. This differs greatly from the land use in southern Germany where the richest gravettian collections originate from caves. This documents a lack of interest in the supplementary (i.e., non-mammoth) food sources which these areas, distant from the large river valleys, could have provided.

The pavlovian hunters were narrowly adapted to food sources near rivers which carried a degree of risk.

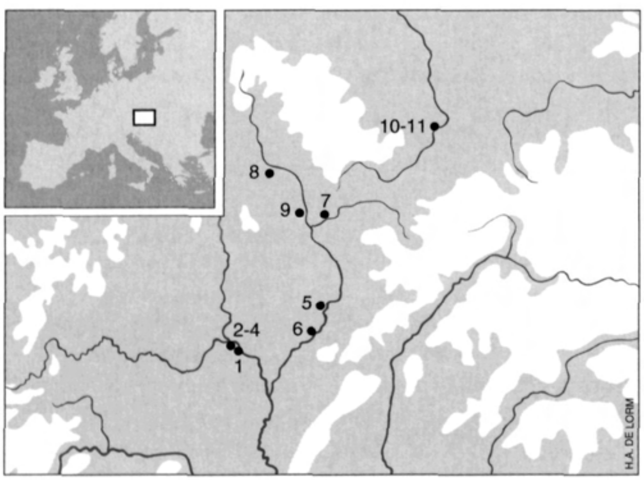


Fig. 1. List of sites mentioned on the map
Southern Moravia (Pavlov Hills area): 1. Milovice I; 2. Pavlov I; 3. Pavlov II; 4. Dolní Věstonice I.
Eastern Moravia: 5. Napajedla I; 6. Boršice I.
Middle Moravia: 7. Předmostí; 8. Mladec II; 9. Blatec.
Northern Moravia (Silesia): 10. Petřkovice I; 11. Petřkovice II.

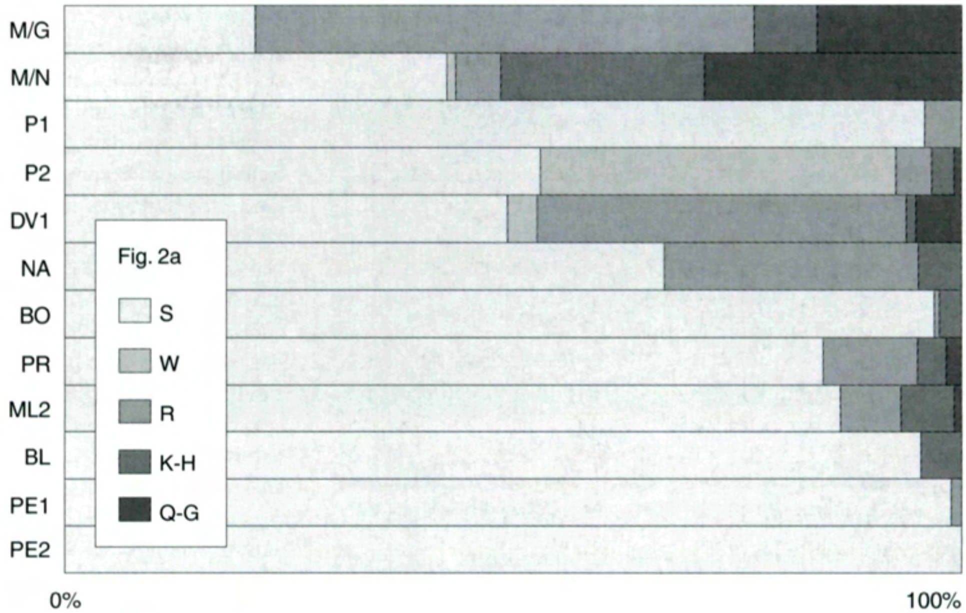
Archaeozoological studies of the fauna from Dolní Věstonice I have yielded evidence of the extensive use of smaller animals, especially the habitual consumption of carnivores and fur bearers, which probably indicates seasonal food stress (Soffer 1993: 38). To prevent such a stress, the elaboration of extensive information and alliance networks was necessary.

3. Raw material economy and lithic industries

The best evidence of interregional contacts in the archaeological record is provided by the presence of distant raw materials. The percentage of rocks utilised in the pavlovian sites is presented in figure 2. Regardless of the geographical position, erratic flint of Silesian origin always predominates (the only exception is Milovice I/G). It is true that this material exhibits, together with radiolarite, better properties than the siliceous rocks from the nearer outcrops. Its imports have in this sense a functional significance. However, for the majority of tasks performed with lithic tools a superior quality was not necessary, so that the energy expenditure linked with the procurement of these distant raw materials was not balanced by a proportional increase in their technical advantages.

In contrast to e.g. the Rhineland or southern Germany (Scheer 1993; Floss 1994), the handling of lithic raw materials was absolutely 'uneconomic' (Figs 3 and 4). Not only were the nearer sources exploited to a minimum extent (cherts from the Svitava valley, Krumlovský les and Stránská skála, dominant during the EUP), but there is also no difference in the curves of the representation of the individual raw material types between cores + debitage and retouched tools. In both cases erratic flint has the highest representation, irrespective of the distance to its sources. With a growing distance from the presumed outcrops, the treatment of the raw material is not becoming more sophisticated and not even the absolute quantity is reduced. The most distant sites along the slopes of the Pavlov Hills belong to the richest ones and the mass influx of nordic flint continues right into Lower Austria (it predominates in Willendorf II/levels 5, 6 and 9; Kozlowski 1987: 72). The imported raw material was thus commonly used, other materials were not envisaged.

How can this be explained? In the case of specialised direct procurement (expeditions undertaken above all for the purpose of procuring raw materials), the raw material would have to be treated in a more economic way. Another question is, of course, the procurement 'embedded' in other activities, i.e. gathering during seasonal migrations or hunting trips. Here, we would expect a higher representation of other suitable raw materials (as in the German Gravettian) and a higher variability in accordance with the locality of the outcrops. The latter is, however, minimal. The procurement



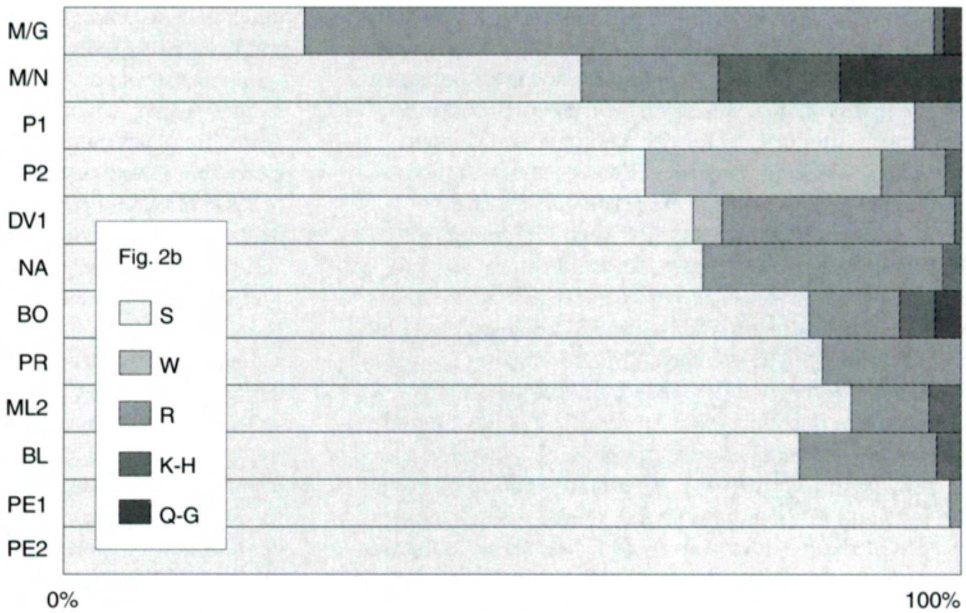


Fig. 2 a and b. Raw material composition of cores and debitage (a) and retouched tools (b). S=flint, W=Cracovian Jurassic chert, R=radiolarite, K-H= Moravian cherts, Q-G= local coarse materials (quartz, quartzite, limestone).

List of mentioned sites:

M/G Milovice I, zone G
M/N Milovice I, northern zones
P1 Pavlov I
P2 Pavlov II
DV1 Dolní Věstonice I, mammoth bone deposit
NA Napajedla I
BO Boršice (coll. Hrubý)
PŘ Předmostí (coll. Wankel)
ML2 Mladec II
BL Blatec
PE1 Petřkovice I (coll. Folprecht)
PE2 Petřkovice II

of the raw materials was thus in some way established, and perhaps generated by the inhabitants of the exploitation areas. At the other end of these chains stood the local demand. The exact mechanisms of the raw material distribution are, however, unclear. But technological reasons played only a secondary role and apparently served only as a pretext for maintaining a long-distance social network (Féblot-Augustins and Perlès 1992: 201, 205). The sketched system naturally assumes a certain geographical knowledge of the course of the river valleys and the location of the major occupation areas, where the largest sites apparently played the role of aggregation sites. At several sites we come across even more distant imports: at Dolní Věstonice I, Pavlov I, Milovice I/G, Předmostí and Napajedla, obsidians from eastern Slovakia or northeastern Hungary have been found (a distance of approximately 380-400 km). The most distant contact could be represented by the endscraper made very probably of Bergerac flint in the Absolon collection

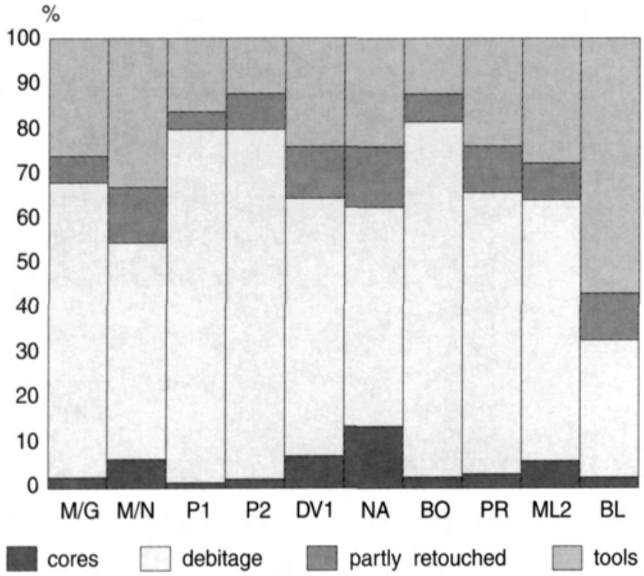


Fig. 3. Major classes of chipped industry (debris not included). (for abbreviations see Fig. 2)

from Dolní Věstonice I (according to the expert opinion of A. Přichystal, the piece is different from all the known specimens from Central Europe and manifests neither macroscopic nor microscopic differences from the above mentioned French raw material). A highly distinctive distributional pattern shows the flint (chert) from the Kraków-Czestochowa Jurassic formation employed only on sites along the slopes of the Pavlov Hills, i.e. at the most distant end of Moravia (more than 250 km away). It is most frequent in Pavlov II (perhaps 30%), in Pavlov I (excavation 1952-53) it amounts to less than 10% (Přichystal pers. comm.), it is relatively plentiful in certain units of Dolní Věstonice I and it has also appeared in Milovice I/G and I/North. Surprisingly, it also appears in the form of less exploited cores, preparation flakes (many with cortex) and crested blades. In other parts of Moravia, closer to the flint sources, it is practically absent. This also testifies in favour of more complicated ways of raw material distribution than a mere gathering during the movements of the group. The only site where nordic flint does not predominate is Milovice I/G (flint 20%, radiolarite 55%). A lack of cores, a profusion of retouch spalls, a very high frequency of backed points (Fig. 5), as well as the limited size of the living floor with a hut foundation of mammoth bones (which gives the impression of rapid construction from material at hand; Fig. 6), and no hint of art objects allows us to speculate about a temporary hunting camp. A correspondence with the pavlovian homebases along the slopes of the Pavlov Hills seems to be questionable. Milovice I/G could be an auxiliary camp of Pavlov I (only 3 km away), if there would be a technological and typological agreement with radiolarite implements from this site (prevailing in the NW sector). Differences in the overall representation of the raw materials would not be so important, since the task specific group could have taken with it blanks from the raw material which was at hand from the last acquisition. But in Milovice there are materials which so far have not been reported from Pavlov (5 pieces of limnosilicite from Central Slovakia, 1 piece of basalt, graphite, etc.), and also the radiometric dates are younger (25-23 kyr; Oliva 1988).

On the other hand there are in Milovice marked resemblances with some sites in Lower Austria. Some of these sites could possibly also have been extraction camps (Stillfried, Grub), but others are more residential sites (Aggsbach A, B). Radiolarite also prevails in Stillfried and Aggsbach, and small backed points and *fléchettes* with a supplementary ventral retouch dominate in the tool kit (Felgenhauer 1951, 1980; Otte 1981). On the other hand, Kostenki knives and microdenticulates are missing, which are typical for the Pavlovian. The large amount of microgravette points, the presence of small shouldered points and blades, and tools with steep bilateral retouches or inverse supplementary retouches indicate certain links with the Mediterranean province of the Gravettian (Oliva 1999). Apart from that, the typological variability in the Moravian Gravettian is not very large. We could consider a separation of the middle Moravian group (Předmostí, Mladeč II, Blatec) with a more than average representation of Kostenki knives and of blade and flake points with a marked lateral retouch. The latter ones also frequently appear in Petřkovice (Klíma 1955), whereas the backed implements appear rather sporadically on all the above mentioned sites (regardless of the date of the excavation).

The shouldered points are always only isolated (Předmostí, Valoch 1981: fig. 1:25; Milovice, fig. 6; Dolní Věstonice II, Klíma 1995: fig. 100:14; Petřkovice I, Klíma 1955: figs 13:34, 41; Jarošová *et al.* 1996, fig. 8:1-2), so that it would be speculative to construct out of these the *fossile directeur* of the late 'Kostenkian' phase. Although in surrounding regions they prevailingly appear in late assemblages, in Moravia they occur in various collections of different dates. Unit B in Dolní Věstonice II is the oldest ensemble of the Moravian Gravettian known so far (GrN dates round 27 kyr bp; Klíma 1995: 53), while Milovice G belongs to the middle phase (GrN-14824: 25,220 ± 280 bp; GrN-22105: 25,570 ± 170 bp) and Petřkovice to a later phase (two dates of about 23 and 21 kyr bp; Svoboda *et al.* 1995: 283). Likewise, the new GrN and GrA dates from Willendorf II/9 of between 25 and 23 kyr bp (Damblon *et al.* 1996: 183) are older than the majority of sites with *pointes à cran allongé* (Kraków, Moravany, Nitra, East European sites), which are lacking in Moravia.

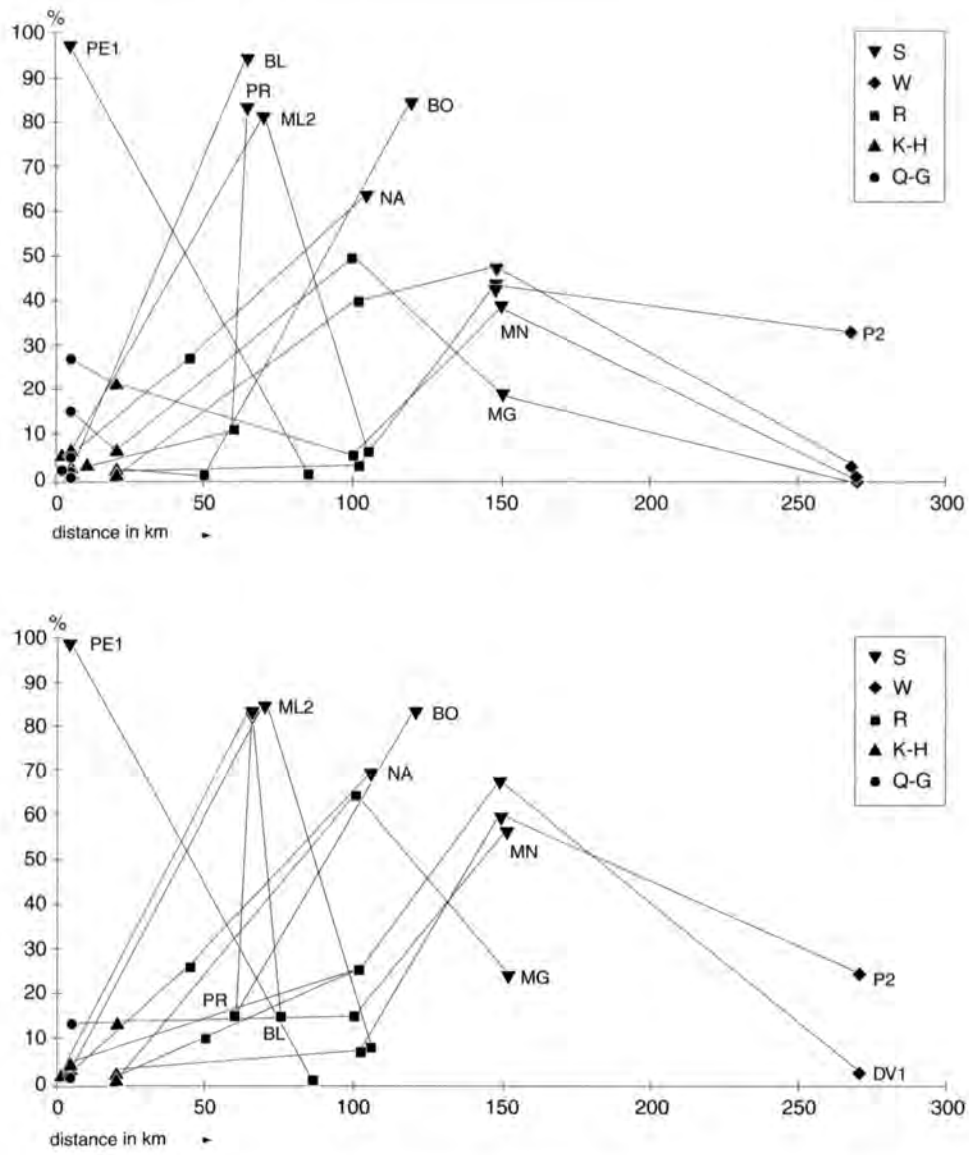


Fig. 4 a and b. Percentage of raw materials (cores and debitage (a) and retouched tools (b)) plotted against distance between site and source (for abbreviations see Fig. 2).

The only direct superposition of several gravettian layers in Central Europe has been documented in Willendorf II, and several authors have tried to use it for the elaboration of a unidirectional periodisation (Otte 1991; Svoboda 1994). These efforts, however, neglect the possibility of regional differences and manifestations of various activities in the typology. To fit into this unidirectional model, quite small sites are further sectioned into even smaller units according to differences in radiometric dates (Dolní Věstonice II), while the megasites, such as Petřkovice I, are treated as one single unit, or *ad libitum* sectioned into several phases (Předmostí). New excavations by J. Svoboda and L. Jarošová at Petřkovice I have indeed shown that the site probably involves different stages of occupation (Jarošová *et al.* 1996). The presented periodisation (Svoboda 1994; Svoboda ed. 1994) is definitely one of the possibilities, although probably not the only one, and the discovery of any further sufficiently articulated cultural stratigraphy can lead to radical modifications.

The proportion of backed microdenticulates is highly variable (mostly in Dolní Věstonice I), but they come from all the areas (Dolní Věstonice II and Pavlov 9 along the

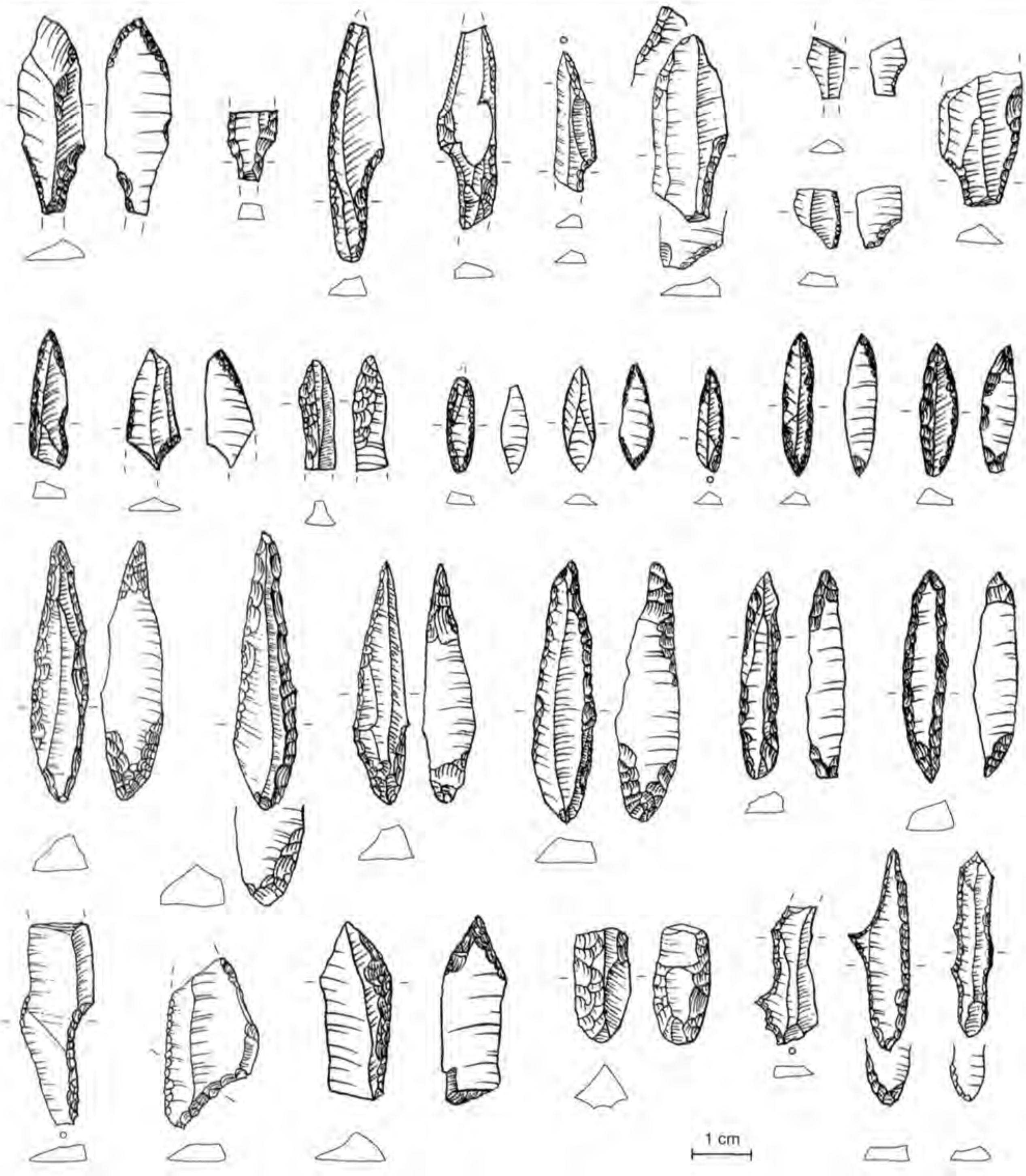


Fig. 5. Industry from Milovice I, section G. (drawing T. Buganská)

Fig. 6. Milovice I/G, foundation of the mammoth-bone hut.

slopes of the Pavlov Hills, Napajedla I and III and Boršice I near the Morava valley, Předmostí and Petřkovice in North Moravia). Certain collections contain bifacial leaf points of a quite szeletian appearance (Předmostí, Petřkovice I, Dolní Věstonice I, Pavlov I, Milovice I/North). Specimen from Dolní Věstonice I (Absolon 1938: 53) and Milovice (Oliva 1989: 268) are slightly altered, so that it is probable that these are collected pieces of older (szeletian?) origin. Some leaf points from Předmostí were without doubt found in the lower layer.

4. Decorative objects

Disregarding numerous personal adornments, real works of art are known only from four large sites (Klíma 1987a; Oliva 1995; Svoboda 1995): Dolní Věstonice I, Pavlov I, Předmostí and Petřkovice I (only two haematite female figurines, no bones were preserved). As a whole they fit well into the art framework of the eastern part of the Gravettian but the individual sites have their own specificities: statuettes of pregnant women of mammoth metapodia at Předmostí, flat animal reliefs in Pavlov, hyper-stylised female figurines at Dolní Věstonice, and numerous ceramic objects at the last two stations. On the last three sites there are also abstract geometric motifs.

Out of the entire spectrum of gravettian art, only a certain segment has thus always been implemented. The closest analogy of the female figurines and mammoth sculpture from Předmostí can be found as far away as Avdeevo on the Russian Plain. One can see in this regional diversity and interregional identity a strengthening of stylistic means of social adaptation. From our point of view it is also important what is lacking in pavlovian art, even though the means for it existed: engravings of animals, carvings in antler, applications of geometric ornaments on animal sculptures, though the large polished surfaces on the figurative reliefs from Pavlov are well suited to the application of some motifs.

The geometric motifs only supplement the hyper-stylised female statuettes from Dolní Věstonice but they depict no anatomical details. The only two figurative engravings come from Předmostí and represent strongly abstracted women, whereby the internal ornamention is again abstract, non-anatomical.

Gravettian art was thus subjected to a severe canon, into which probably not everyone was initiated (Oliva 1995). In the Pavlovian, ornamental features on weapons (e.g., cylindrical ivory points) are also missing, and they are rather scarce and vague on objects of everyday use (the ornaments were curiously most elaborate on the miniature and hardly functional antler adzes; Klíma 1987b: figs 30-33).

These peculiar limitations of gravettian art become prominent especially in comparison with magdalenian art, where the combinations of raw materials, genres, motifs and techniques are much freer.

5. Burials and mammoth bone accumulations

The complex social relations in the Pavlovian are also manifested in burials. From Moravia are known from 5-6 findspots (Předmostí, Dolní Věstonice I and II, Pavlov I, Brno II and III?) seven (or maybe eight?) inhumations with some thirty individuals. For some of these there now are indications that we are dealing with secondary depositions of whole bodies (Dolní Věstonice I, grave 3) or only partial ones (Předmostí – 'mass grave' of 18 humans (Oliva 1997), Pavlov I and maybe Brno II). From the point of social status, the Brno II burial occupies a special position which is currently being reconsidered (Oliva 1996, this volume). Here was inhumed in the bed of the Svitava river an adult man (40-50 years old), suffering from chronic painful osteomyelitis (this is the first evidence of this disease in the Palaeolithic). He was accompanied by numerous grave goods and no practical function can be assigned to any of these: 2 perforated discs of soft stone, 14 tablets made of different raw materials (stone, bone, ivory, mammoth mollars split perpendicularly to the lamellae), an ivory human figure in the form of a marionette with an opening in the axis and traces of wear and reparations (this is the only male sculpture in the Gravettian and the only sculpture in a palaeolithic grave), a drumstick (?) of reindeer antler, several hundreds of fossil molluscs of one species (*Dentalium badense*), many large bones of mammoth, rhinoceros, etc. The majority of the tablets has on the edge very fine and hardly visible incisions. These objects lack any modification which would allow suspension or attachment, so that they could not serve as personal adornment. All these items remind us almost too conspicuously of the requisites of Siberian shamans. This extraordinary burial testifies to the existence of individuals with an exceptional status in the ritual sphere.

The presence of bones of large hunting game in the vicinity of the grave might not be fortuitous. Large mammoth bone dumps appear in moist depressions in the vicinity of gravettian sites (Předmostí, Dolní Věstonice I and II, Milovice, Spytihněv). The majority of the bones certainly represents kitchen debris, some could have been brought in from nearby kill sites or natural deposits (Soffer 1993: 40). The presence of voluminous, heavy and almost no meat bearing bones such as pelvises, scapulae, mandibles, skulls, tusks and isolated molars is a reminder of the ritual behaviour of subrecent hunters, tending to the preservation of the maximum number of bones of the most important or the most prestigious hunting game (Oliva 1996, 1997 with further references).

6. Adaptation?

In all the above mentioned phenomena some kind of adaptation can be observed but this adaptation was rather of a social and psychic than a technological nature. Technology and lithic implements were in the entire Gravettian similar, regardless of the fact whether hunting went on for mammoth as in the Pavlovian and on the Russian Plain, or for smaller game as in western and southern Europe. All other things, considered as typical for this civilisation, epitomise in fact only the societies of mammoth hunters: a concentration of nearly all sites in river valleys, a high degree of site hierarchy (the existence of 'megasites' in Moravia and eastern Europe), a constant predominance of imported raw materials, long-term dwellings, depositions of mammoth bones, complex burials, and a profusion of art. Thus these phenomena did not function as adaptations to climatic conditions, which were the same in Moravia and Germany.

On the other hand, the climate on the North European Plain and in the Mediterranean was certainly different – and nevertheless the basic technology and typology is the same. Thus not even these have manifested an excessive environmental sensibility. If, in addition, we widen the angle of our view, then the analogous deterioration of climatic conditions in North America has introduced completely different ways of adaptation (Soffer and Praslov 1993), perhaps due to the differences in the previous settlement system (Gamble 1993).

The Pavlovian has implemented a very specific method of exploitation of a certain component of the environment. Its subsistence strategy, centred around mammoth hunting, required the creation of a social network to cope with the unpredictability of nutritional sources, and the creation of ritualised behaviour to guarantee the peaceful sharing of prey, hunting territories, prestigious items, etc.

Prior to 20 kyr, this system was exhausted. At this time there emerge other subsistence strategies which link up – as regards both technology and land use – with the Aurignacian and perhaps also the Szeletian. The epiaurignacian occupation was undoubtedly more dense than the current number of radiometric dates suggests. There are even some hints that the Aurignacian coexisted with the apogee of the pavlovian culture (aurignacian levels in the loess overlying the middle Würm sediments at Brno-Stránská skála, Vedrovice Ia, radiometric dates of 20 or 25 kyr from Alberndorf, etc.). The only dated epiaurignacian sites in Central Europe are Langmannersdorf (21-20 kyr; Hahn 1977), Bockstein-Törle VI (20 kyr; Hahn 1977) and Brno-Stránská skála IV (18 kyr; Svoboda 1991).

Its elements (transverse and polyhedric burins on broad laminar flakes, often with tertiary readjustment of the working edge, extremely narrow nosed scrapers on thick flakes) can be followed also in the contemporary 'epigravettian' sites in Bohemia (Stadice), Southern Poland (Spadzista C2/II, Piekary) and Lower Austria (Grubgraben). From a technological and typological point of view, a series of very large and rich findspots on the eastern slopes of the Drahany Upland (Určice, Slatinice, Ondratice II, Seloutky), in the Chřiby Highlands (Lhotka, Karolín), and on the borders of the Brno basin (Brno-Kohoutovice, Jundrov) belongs to the Epiaurignacian, all in the classic areas of EUP settlement. This is taking place under a constant worsening of the climate, to which – in accordance with prevailing opinions – the gravettian technology and subsistence strategy would have been the very best adaptation.[1]

note

The gravettian research project originated in the Anthropos Institute (Moravian Museum) in connection with the preparation of a publication on our excavations at Milovice (1986-1991). Within the framework of this programme, all the accessible assemblages of the Moravian Gravettian were studied (i.e. all with the exception of Pavlov I, Dolní Věstonice II-III and new collections from Petřkovice I) from the point of view of lithic raw materials, technology, typology, metrics and the dynamics of reduction sequences. For the first time each item of the lithic industry was classified in all the above mentioned systems and all were mutually interconnected. A. Přichystal, head of the Department of Geology at Masaryk University, assisted in the determination of raw materials. With him we checked all the samples of lithics which were conspicuous in their appearance or by the unexpected position in the reduction sequences (e.g. cortical flakes or unexhausted cores from distant raw materials), so that all the critical results are supported by expert analysis.

The outcomes are partly in press, but the major part is still in the computer. The presented preliminary synthesis originated above all from the need to present the most important results at the 1995 Pavlov workshop.

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Martin Oliva
Moravské Zemske Muzeum
Zelný Trh 6
65937 Brno
Czech Republic

Viola Dobosi

17 Interior parts of the Carpathian Basin between 30,000 and 20,000 bp

An ecological reconstruction of the MUP period in the Carpathian basin was recently complemented by a number of new scientific results from geomorphology, malacology, vertebrate palaeontology, palynology, radiocarbon dating and anthracology. In the history of the Hungarian Upper Palaeolithic, the MUP refers to the older blade industry of the Gravettian complex/Pavlovian. This period is represented by 11 sites, some of which are large permanent settlements with a varied lithic inventory, some are temporary hunting camps or workshops, located on or near the raw material sources with a specialised tool kit. Their cultural relations are mainly determined by the geomorphological features of the region. There is a typologically confirmed connection leading towards the northwest, the gravettian core areas, probably to the north of the Danube. Western connections are demonstrated by the presence of rock crystal from Alpine sources. We have no information on the use of southern routes. To the east and the north, the chain of mountains separated the population of the interior parts of the basin from cultural centres east of the Carpathians.

1. Introduction

The absolute chronological frames embrace an unevenly documented but eventful period within the Hungarian Upper Palaeolithic. Archaeological interaction, i.e. parallel features between the EUP – MUP and the MUP – LUP, as well as the palaeo-ecological rhythm, only partly overlap these chronological frames. The artificial frames of the period 30-20 kyr bp therefore include a possibly still existing Aurignacian II (EUP), as well as the beginning of the LUP (Ságvárian) within the study area.The absolute chronological data, complemented by sedimentological arguments, mainly seem to support the observation that the settlement history of the Hungarian Upper Palaeolithic is characterised by a certain discontinuity, closely related to ecological phenomena.

Upper Palaeolithic groups appeared in significant numbers in the interior parts of the Carpathian Basin during the interstadials of the last third of the Würm glaciation. Geological studies, sediment analyses, the investigation of the malacofauna, palaeobotanical remains and the vertebrate macrofossils, as well as radiocarbon dating of archaeological sites and loess sequences, confirm this statement. The speed of the infiltration of a culture within a major population unit or the duration of the active periods of the settlements cannot be ascertained with acceptable accuracy as yet, as the absolute chronological dates give only a coarse indication of the history of events.

As this volume focuses on the period 30-20 kyr, most of the aurignacian evidence is of little relevance for this paper, from both a chronological and an archaeological point of view. Our ^{14}C dates indicate, however, the presence of the Aurignacian II as late as 30 kyr bp (GrN 1935 30,710 ± 600 bp; Vértes and de Vries 1959: 195), and identified for the first time in the upper cultural horizon of the Istállóskõ cave by László Vértes (Olschevien). Absolute chronological dates of *c.* 31 kyr, with rather generous margins of error, indicate that the aurignacian II industry with polished bone points (though not split-based ones) was contemporary with the first settlement wave of gravettian people in Hungary at the lower margin of the given time span.

Analysis of the archaeological material of the early gravettian technocomplex revealed some archaic features in the technological and typological character which could be attributed to aurignacoid influences. However, this interaction conflicts with our current ideas on the aurignacian culture: proceeding from the Near East to the Far West, from the Levantian coast to the Atlantic coast, and stopping for a geologically short while in the Bükk caves in the north Hungarian Mid-Mountains. They came there in direct competition with the contemporary szeletian population – this contemporaneity is stratigraphically proven – so the Aurignacian was a short but enigmatic episode in the history of the Hungarian Upper Palaeolithic. It is less probable that the technical innovations appearing in the earlier Gravettian would come from these short-time 'guests'.

The last third of the Würm period, having three phases in the Carpathian Basin, is associated with the gravettian cultures *sensu lato*. On the basis of chronology and techno-typological features, this large cultural entity can be subdivided into three smaller ones, each with a local facies. This also means that with almost identical ecological conditions, similar ways of life and similar key finds (Gravette points), the sites can be assigned to three cultural phyla and represent two different technological traditions. The two chronological horizons of the leptolithic/blade tradition are:

- older blade industries, suggested terminology: Pavlovian/Gravettian (Bodrogkeresztur, Megyaszó, Hont, Püspökhatvan)
- younger blade industries, suggested terminology: Epigravettian (Danube bend, Jazygia).

A special industry, the Ságvárian, with a preferential use of pebbles as raw material is partly contemporary with the younger blade phylum. The term Ságvárian was suggested for Hungarian sites (Ságvár, Madaras, Mogyorósbánya). This phylum also represents the transition between the MUP and the LUP, and its most completely documented site, Mogyorósbánya, has a ^{14}C date of 19,930 ± 300 bp (Deb 1169; Dobosi and Hertelendi 1993: 141).

The absolute chronological position of the Ságvárian practically coincides with the date of the cold maximum of the Würm glaciation for the west of the Carpathians. The various phases of the Late Glacial climatic history in the Carpathian Basin and its relation to other regions in Europe cannot be reconstructed with the necessary accuracy. It seems that the climatic oscillations during the middle of the Würm III followed each other quite fast, and in spite of their short duration, they were characteristic enough to cause significant changes, for example in the malacofauna. In Western and Central Europe, the cold maximum of the Würm glaciation occurred around 20 kyr, between the Tursac and Laugerie interstadials, but in the Carpathian Basin it occurred one phase later. István Vörös calculated an average July temperature on the basis of Würm cave sediment fauna lists. The coldest phase of the Late Würm, with an average July temperature of 12.6° C was ascertained for the period between the Laugerie and Lascaux interstadials. This phase is contemporary with the formation of the one metre thick loess separating the two cultural layers of the Ságváre pebble gravettian site (Dobosi and Vörös 1987: 58). There are data indicating that by the end of the Ice Age there is another cold peak with an almost equally cold maximum in the Carpathian Basin.

On the other hand, the open air settlements of the older blade industries (Pavlovian/Gravettian), that is, the first wave of the Gravettian, are known only from the beginning of this period, the Würm 2/3 interstadial. The archaeological material recovered from the Late Glacial sediments of the caves can partly be allocated to the open air settlements as special temporary shelters with special, asymmetrical or specialised assemblages. The rest is composed of small insignificant assemblages, no more than 'background noise', and too small for an adequate archaeological cultural classification.

2. Geology

The most varied and thoroughly studied loess profile is situated in the Mende brickyards. The period at stake here is represented in this section by 10 metres of sediment. Sedimentological studies of the section were performed, using various methods, complemented by ^{14}C dates and TL dates in more recent times (Pécsi 1993: 228). While the latter method yielded contradictory data for earlier periods of the Pleistocene, the differences of the two dating methods, however, are within reasonable margins of error for the last third of the Würm period.

The sequence of the loess profile of the Mende brickyards is as follows:

- Würm 2/3 interstadial: double soil horizon:
- Mende Upper II: developed soil, steppe forest with groves, with charcoal remains, dated at 40 kyr
- intermittent loess (calculated data)
- Mende Upper I: steppe soil, cold steppe taiga, grove-forests, dated at 29,800 ± 600 bp (Mo 422) (Both soils are of *chernozem* type)
- Würm 3 stadial: sandy and typical loess alternating with formation and filling of 'dells' (small valleys).

The *c.* 8 m thick loess and loess-like sediments of the Würm 3 are dissected by two soil levels:

- h2: loessy humus, arctic embryonal soil, dated at 20,520 ± 290 bp (Hv 2591) and 21,740 ± 320 bp (Hv 4189)
- h1: loessy humus, embryonal soil, grove-forest, dated at 16,750 ± 400 bp (Hv 1655)

The Würm sediment sequence is overlain by sandy loess.

In the Middle Danube basin, seemingly less stratified loess slope sediments were formed than west of our area. The formation of double soil horizons is a special feature of the Würmian sedimentation in our region, and for the study period they can be observed in the Mende Upper 1-2 forest steppe soils and the Late Würm embryonal soil h1 and 2 levels (Pécsi 1993: 225).

On the basis of the collation of sedimentological, faunal and archaeological data, the author suggested the use of the term Ságvárian period for the time span 20 to 16 kyr bp (Dobosi and Vörös 1987, tab. 8), a period which corresponds to the h1 and h2 embryonal soil layers (i.e. two short interstadial phases) and the generally one metre thick loess separating them. At the same time, this is the period of the Ságvárian pebble-gravettian culture.

3. Ecology

3.1 Fauna

3.1.1 Malacofauna

As a result of the investigation of loess profiles, the terrestrial molluscan fauna of the Carpathian Basin is well known and parallels other data on climatic history. The malacofauna of the relevant period is as follows (Sümegi-Krolopp 1995: 136-137):

- Würm 2/3 interstadial: species preferring a mild climate dominate. A typical species of the *Catinella arenaria* subzone is *Granaria frumentum*.

- By the end of the soil formation/interstadial we suddenly find species indicating extreme dry conditions, such as *Pupilla triplicata*.
- These are followed by cold resistant mezophylous species: the subzone *Vallonia tenuilabris* indicates for the period between 25-22 kyr definitely cold continental steppe conditions.
- Around 22-20 kyr, a relatively milder and wetter climatic phase can be hypothesised, with a resistant mesophylous malacofauna, identified by Sümegi and Krolopp at the level of the hl embryonal soil.
- The Würm cold maximum is characterised by the fauna of the *Columella columella* zone.

3.1.2 Vertebrate fauna

We have no data on rodents and amphibian-reptilian fauna for open air sites. Avifauna is known only from the younger settlements (*Lagopus* eggshell fragments). The large mammalian fauna is less responsive to climatic changes and is thus less suitable for an outline of the climatic history.

For open air sites, the list of hunted animals consists of 11 different species: hare, fox, lion, wild boar, mammoth, woolly rhinoceros, horse, elk, reindeer, red deer, and bison.

As the palaeolithic settlements seem to be concentrated around the Würm 2/3 interstadial, this faunal list comprising both forestal and steppe elements can be considered typical for this interstadial. The palaeontological equivalent of the period is the Istállóskõ faunal phase, found in greatest variety in the aurignacian II layers of the Istállóskõ cave. The archaeological material of this unit still belongs to the EUP, and thus falls outside our scope here. The fauna, however, is independent of the cultural classification of human communities living in the same environment. We can therefore complete the faunal list of the open air (gravettian) settlements with the following species: *Bos*, *Capra* and *Rupicapra* among the herbivores, and *Canis*, *Crocuta*, *Felis* and *Lynx* among the carnivores (Vörös 1982: 46, 1984: 19).

The general trend observable in the changes of the fauna indicates that the number of pachydermata (rhinoceros, mammoth) gradually decreases, while that of the steppe herd animals (horse, reindeer) increases.

At least two species of *Equus* were recognised in the fauna, *E. germanicus* and a smaller horse, noted as *Equus* II. So far, this species was regarded as an index fossil for the period ending with the Early Würm (Dobosi *et al.* 1988: 34).

3.2 Flora

3.2.1 Charcoal remains

Anthracology, i.e. the study of charred plant remains, used to play a major role in Hungarian palaeolithic research. In the last three decades, however, this important discipline has not been continued. Since the publications of J. Stieber, there have been no further studies of this type of material. Recently, however, a young specialist at Debrecen University has started some activities in this field, but the results of these studies have been published only partially, and the research was partly performed on material younger than 20 kyr.

Stieber's results were published in 1967. He reconstructed the Würmian vegetation within the framework of the Milankovic-Bacsák chronological system, which has been updated several times since.

From the upper cultural horizon of the Istállóskõ cave, charcoal remains of *Ulmus*, *Sorbus*, *Quercus*, *Pinus* and *Picea* were identified (Stieber 1967: tab. I). This flora composition indicates an interstadial mixed deciduous forest, with some pine. As mentioned above in the palaeontological record, this period corresponds to the Würm 2/3 interstadial. Data concerning the second half of the 30-20 kyr period, the stadial, are missing.

On the basis of the charcoal finds from the Epipalaeolithic sites, it seems certain that during the Late Würm there always was some arboreal vegetation in the central parts of the Carpathian Basin, at least in the form of riparian gallery forests.

3.2.2 Pollen

The interpretation of palynological data is also problematical. The borehole studies of the Alföld (Great Hungarian Plains) resulted only in an overall picture of the Late Würm, without a detailed species list. In the sediments of the open air settlements of the Gravettian/Pavlovian, there is little chance for pollen to survive. The general scarcity of pollen extends over the Würm 2/3 interstadial as well. Apart from the species-rich NAP component (Chenopodiaceae, Gramineae, *Polygonum*), we have some deciduous remains (only *Alnus* and *Corylus*), and from conifers the usual *Picea* and *Pinus*. With the gradual deterioration of the climate, the increase in aridity, and the fall in the average temperature, the flora became even more meagre (Járai-Komlódi 1966: tab. I). The palynological evaluation of the Mende brickyards profile is unfortunately not very informative: lots of *Artemisia*, and a few arboreal species preferring a warmer climate, as well as Gramineae (Pécsi 1993: fig. 52).

4. Archaeology

The Pavlovian phylum of the gravettian entity in Hungary is known from 11 sites: Bodrogkeresztur (Vértes 1966), Korlát (Simán 1995), Hidasnémeti (Simán 1989), Megyaszó (Dobosi and Simán 1996), Sajószentpéter (Ringer 1993), Mátraháza (Biró 1984), Verseg (Dobosi 1991), Püspökhatvan (Csongrádi-Balogh and Dobosi 1995), Romhány (Simán 1993), Hont/Parassa (Gábori 1957), and Nadap (Dobosi *et al.* 1988). The sites are mentioned here in a more or less east-west

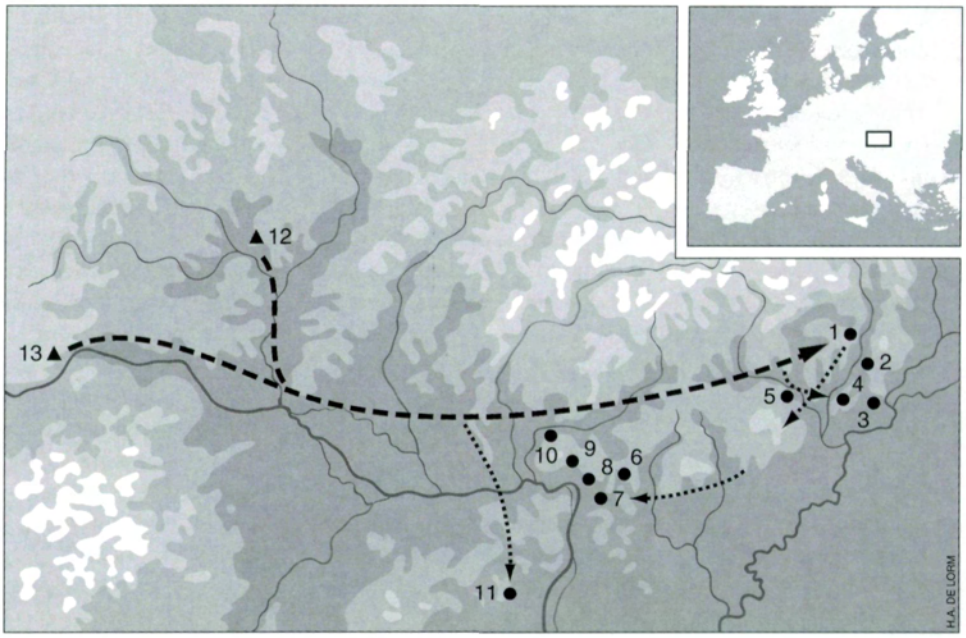

Fig. 1. Sites mentioned in the text: 1. Hidasnémeti; 2. Korlát; 3. Bodrogkeresztur; 4. Megyaszó; 5. Sajószentpéter; 6. Mátraháza; 7. Verseg; 8. Püspökhatvan; 9. Romhány; 10. Hont; 11. Nadap; 12. Dolní Věstonice; 13. Willendorf. dashed line: main route; dotted line: auxiliary route.

direction. The quantity and quality of information on these sites is unfortunately very uneven.

Some of the sites were authenticated by excavations (Bodrogkeresztur, Korlát, Hidasnémeti, Megyaszó, Verseg, Püspökhatvan, and Nadap), though we can never speak of the complete recovery of an undisturbed settlement. Some sites are known only from stray surface finds (Romhány), some are in reworked sediments (Mátraháza), and there are some where excavation is currently in progress (Hont/Parassa). Finally, there are some sites where the scientific elaboration (geomorphological position) is advanced, but the archaeological information is limited to the description of just a few artefacts (for instance, Sajószentpéter).

As for settlement function, we can distinguish temporary hunting camps (Hidasnémeti, Verseg, Nadap), longer term settlements (Bodrogkeresztur, Megyaszó), and workshop sites on raw material occurrences (Korlát, Mátraháza, Püspökhatvan).

The function of the settlement, the selection of the location (topography) and the set of tools (proportions or asymmetry of the type list) is interrelated, and the discovery of evident connections can offer a chance for prospecting and identifying new sites and classifying surface materials.

4.1 Topography

The sites are located in the northern part of Hungary in a mid-mountain environment. This phenomenon is not surprising for the workshop settlements, as the selection of the location (in all known cases so far) is connected to hydrothermal silices. Among the Alföld sites, none belongs to this chronological horizon. The term 'mid-mountain environment', however, is misleading to some extent.

These settlements are located in the generally not very high Hungarian Mid-Mountain range (average peaks at 7-800 m, highest peak at 1010 m) at lower elevations, thus the absolute height of the sites corresponds mainly to the hill category. These hills, at the same time, are connected to the mountain ranges, thus the characteristic way of life is certainly a mountainous type of existence and the surface relief forms also indicate mountains rather than hills.

In the selection of the location of settlements, the primary function of the settlement was decisive, but in the case of some sites, the topographical position was favoured for several reasons. Most suitable for living were obviously settlements for permanent residence, though in Hungary so-called residential settlements, such as Willlendorf, Pavlov, etc. near the border region of the Carpathian Basin, are still missing. On the basis of the horizontal extent and the size and quality of the finds, Bodrogkeresztur and Megyaszó can be assigned to the category of permanent settlements, though these settlements were disturbed by modern activities. Both settlement areas were chosen with a good strategic sense, in a protected, central place with an excellent view and various natural resources. Bodrogkeresztur is located on a protruding plateau of the hilly region adjoining the southern part of the Tokaj Mountains, which are very rich in raw materials. The Henye hill, on which the site lies, is protected from the north by the Tokaj-Presov mountain range, from the southeast by the Kopasz-hegy ('Bald Mountain') of Tokaj, and from the southwest by the outer row of hills.

The immediate environment is rather diverse, and consists of a mid-mountain type of environment (Tokaj Mountains), a marshy one (Bodrog and Tisza floodplain region, Takta plains), as well as of lowland biotope (starting at 1-2 km south of the site). The variety of resources is also reflected in the fauna of the settlement.

Megyaszó is separated by the ridges of the Southern Tokaj from Bodrogkeresztur, some 20-22 km as the crow flies. It lies on a hilltop separated from the surroundings by steep valleys. The situation is very similar to Bodrogkeresztur, but on a smaller scale. The local hydrothermal raw material source is only a few hundred metres from the settlement; however, this type of raw material was not very popular on the site. Good quality Tokaj sources, at the same time, are less then 10 km away in the Tokaj region. The site is protected (from the Lowlands, and from the northwesterly winds. The 'Bald Mountain' is substituted here by the Nagyrépás), and located at a meeting point of different ecological niches (Tisza river substituted by the Hernád, Bodrog river by the Gilip, and even the margin of the Alföld is near, beyond one row of hills). Likewise, the site overlooks the wide north-south corridor leading towards the Alföld along the southeastern corner of the mountains.

Sajószentpéter (Á. Ringer pers. comm.) probably belongs to the category of permanent settlements, but has so far not been published.

As for Hont, the topography of these sites in the area is suitable for permanent settlements and temporary hunting camps. The study of the chain of settlements can offer much new information on function, contemporaneity and settlement structure.

Some sites were classified as temporary hunting camps on the basis of the scarcity of finds and the small extent of settlement features rather than the type spectrum or the extremely rich fauna. The selection of the location was, most probably, directed by strictly utilitarian notions. In the case of the two sites defined as hunting camps, the common factors are the marginal position facing the plains and the proximity of fresh water.

Nadap and Verseg with their variable and relatively rich palaeontological material and, for Nadap, the basically long-distance raw materials in the lithic industry, correspond to the category delineated by K. Simán as "temporary camp, in sharp contrast to the environment" (Simán 1983: 65).

On the basis of some typical artefacts, the site of Romhány was classified chronologically in the same category. At first sight, the site seems to be an ideal hunting camp; however, the interpretation should be checked by excavations.

The topography of the workshop sites seems evident. In the case of Püspökhatvan and Korlát, the raw material was formed as a result of hydrothermal processes following Miocene volcanic activity. The resulting silices can be observed in thick banks even today, and are still used (e.g., around Boldogkõváralja and Korlát the blocks of hydroquartzite are used for making terraces against erosion in the vineyards). In the case of Mátraháza, the primary source is not known. At Hidasnémeti, the workshop function is not very clear, but on the basis of the typological composition, it was published as a workshop (Simán 1983: 64). With respect to all workshop sites, however, we must admit that we have no information as yet on the contemporary permanent (?) settlements where the artefacts prepared in the known workshop sites were transported to and used. The Püspökhatvan/Cserhát hydroquartzite may occur in the Alföld palaeolithic sites, but these settlements are chronologically one phase younger, i.e. of Epipalaeolithic age.

4.2 Raw material acquisition

The raw materials present in the gravettian sites are fairly varied. Tracing the raw materials of known geological sources, we can observe that the bulk of the MUP sites was using local or regional raw materials. These two categories are understood as defined in the 'Lithotheca catalogue' (Biró and Dobosi 1991: 8), with 'local' referring to rocks at a day's walking distance from a site, and 'regional' used as a flexible term to indicate material available at distances intermediate between 'local' and 'long distance'.

The ratio of certain raw materials can vary considerably from site to site, but some dominant raw materials can be found in nearly all sites.

Due to favourable geological factors, the territory of Hungary abounds in postvolcanic, hydrothermal and sedimentary silices (Biró 1988). In the palaeolithic period, the resources are complemented with raw materials from within and outside the Carpathian arch, serving practically all dimensional and qualitative needs. Raw materials generally known and used throughout the Upper Palaeolithic were:

- obsidian: occurring at several places within the Tokaj-Presov Mountains in the form of nodules. In the study period (the MUP), the largest transport distance is recorded at Hont (surface find), 170-180 km west of the sources. The importance of this material is demonstrated by the fact that it was also found at Püspökhatvan, a workshop site with local raw material utilisation well exceeding 95%, 150 km from the obsidian sources.
- 'Szeletian' felsitic porphyry: the characteristic, easily identifiable laminar ash-grey raw material typical of the szeletian culture. Its geological occurrence is well known in the eastern parts of the Bükk Mountains. Among the settlements studied, this material was identified at Megyaszó and Bodrogkeresztur, 30-40 km from the source area.

- Hydrothermal silices: in the study period, we have information about two raw material exploitation/workshop sites, both on hydrothermal banks of silices: Korlát and Püspökhatvan. The importance of local raw materials at these sites exceeds 90%. Their distribution at other contemporary sites is difficult to follow, as most of the sites of the period are located in the northern part of the country, which is fairly rich in local hydrothermal raw materials. Mátraháza was located on a local secondary raw material accumulation as an *ad hoc* workshop; the distribution of the raw material processed here (opal) is unknown.
- Radiolarite: primary occurrences are known from the Mesozoic sequences of the Transdanubian Mid-Mountain range and the Mesozoic of the north Hungarian Mid-Mountains. Radiolarite pebbles can also be collected from Palaeozoic radiolarites, e.g., in the stream beds on the southern slopes of the Bükk Mountains. Colour variations and radiolaria content can serve as identification characteristics. Due to the variety of sources, Carpathian radiolarites (from the Vág/Vah and Hernád/Hornad valleys) play an important role as well. Carpathian (Vah valley) radiolarite was found in large quantities at the Transdanubian horse hunters camp of Nadap, which is remarkable as radiolarite sources were present close to this site. Yet radiolarite was imported over a distance of 180 km as the crow flies.
- Erratic flint: according to generally accepted opinion, this term stands for silex nodules and pebbles transported by ice. The nearest occurrence is in the Riss moraines around the Moravian Gate, the upper reaches of the Odra river. As erratic flint can come from any region covered by the terrestrial ice sheet, in normal archaeological practice it is mostly recognised by the erratic cortex and blueish-white, intensive patina. At the Hungarian archaeological sites of the period, this raw material was identified in major quantities at Nadap, Bodrogkeresztur and Megyaszó (at Nadap, comprising almost 70% of the artefacts).

There are, however, certain problems with aspects of these raw material studies.

Among the hydroquartzites, for instance, we have some macroscopically similar types with similar texture and patina. Furthermore, no objective (scientific) methods have been used to prove the erratic character of the material. With regard to the Hungarian material, the 'erratic flint' items were classified macroscopically only. At Nadap, if the raw material is really erratic flint, we have to suppose a very fast moving community because of the high ratio of distant raw materials, denoting regular supply or fresh infiltration, supported by another argument as well, i.e. the newcomers did not have information on local resources.

Apart from the main raw materials, on all of the sites yet unidentified raw materials were also found, mainly in the form of *ad hoc* artefacts.

4.3 Technological innovation

The MUP industries arrived in our region, according to our current information, from outside the Carpathian Basin, in completely developed form. Its oldest wave could still have met the rearguards of the aurignacian people. The term 'Aurignaco-Gravettien' or aurignacoid type working denotes at most contemporaneity or formal reminiscences, probably without any real connections. The analogy relates in the first place to the steep endscrapers and the stepwise retouched blades, occurring in place of the classic aurignacian types (altogether missing from the Hungarian aurignacian sites as well).

From the Hungarian sites of the study period, only four assemblages yielded material suitable for statistical analysis (Table 1): Bodrogkeresztur (767 tools), Megyaszó (560 tools), Hidasnémeti (112 tools), and Nadap (68 tools). (Korlát, Püspökhatvan and Mátraháza are workshop assemblages with very specific and asymmetrical type lists, Sajószentpéter has not yet been published, Hont is under publication, at Verseg altogether 5 burins could be fitted into a traditional type list, and Romhány is awaiting authentication).

The Hungarian sites do not conform to the groups suggested by M. Otte (1990), who outlined a model of Central European gravettian development on the basis of his revision of the material from Willendorf. At the time when he compiled his work, he could only base himself on a fraction of the material published by Vértes from Bodrogkeresztur and he had no information on the results of the new (1994) excavations. Table 1 was created on the basis of the complete material. The site can be put into Otte's 'Stade I' only on chronological grounds.

In my opinion, 'Stade II', i.e., "lames retouchées" are not enough as "éléments caractéristiques". As this type occurs frequently in Hungarian sites and is fairly general with the reservations mentioned by Otte ("les lames, plus larges et plus massives"), this facies suits the material better. The classic shouldered blade point is known only from two instances at Hidasnémeti, and even these are far from the Kostenki type (Simán 1989, fig. 9). On the basis of these, the material could be fitted into Otte's 'Stade III, facies A' (Otte 1990: 220-221).

In J. Svoboda's opinion (Svoboda 1991), the most characteristic feature of pavlovian industries is the dominance of burins and microliths. The ratio of burins can be twice that of endscrapers. Among the Hungarian sites, only Nadap agrees with this feature, together with a high ratio of backed microblades. This settlement is nearest in any

Table 1. The distribution of tool types important for cultural classification (the ratio of types is given in percentages).

SONNEVILLE-BORDES - PERROT TYPES

	1 - 15	27 - 44	46 - 47	48 - 49	56 - 57	58 - 59	84 - 90
Bodrogkeresztur	26	28	6	3	-	1	3
Megyaszó	24	21	4	1	1	9	-
Hidasnémeti	10	17	-	4	2	2	7
Nadap	7	37	-	14	-	9	32

sense – raw material, technology, artefact finish – to the Moravian settlements.

We have to point out that in the MUP settlements, a high ratio of 'relict' types can be found. At Hidasnémeti 4% and at Bodrogkeresztur 6% of the scrapers are of Middle Palaeolithic character; at the latter site there were also 3% chopper-chopping tools and pebble tools of Lower Palaeolithic character.

As regards the function of the settlement and the type spectrum, the strongest relation was found at Nadap, where horses were successfully hunted, corresponding to the high ratio of hunting tools (almost 90% of the prey was horse, 37 individuals), thus the settlement could be justly classified as a hunting camp.

Hidasnémeti is interpreted by Simán partly as a hunting camp, but the preservation conditions were unfavourable there and the fauna is missing (Simán 1989: 18).

The type spectrum of both Bodrogkeresztur and Megyaszó is balanced, typical of a habitation site.

5. Discussion

The inhabitants of the Hungarian MUP sites populated the marginal zones of the mountains running parallel to the Carpathian (north, east, southeast) and Alpine (west) arch. The intramountainous basin was open towards the northwest, towards the gravettian habitation area and towards the upper reaches of the Danube and adjacent Morava river valley (Djindjian 1994: 17). The Carpathian and Alpine passes must have been passable in the interstadials. The route running to the southeast of the pavlovian base territory can reach as far as the eastern margin of the interior parts of the Carpathian Basin along hilly regions, without crossing large rivers. In the west, Alpine connections are indicated by comparable environmental conditions, abundance of raw material and the sporadic occurrence of rock crystal in the Hungarian material.

We have no data on the land use of the southwestern zone, the Croatian shore and towards the Apenninian peninsula. In the south, the potential route in the Danube valley (Iron Gorge?) is so far not known. In some phases of the Palaeolithic, contacts may have been established via the southeast (Drobniewicz *et al.* 1992: 418-419).

To the southeast and east, the high arch of the Carpathian range isolated the study area, partly from unfavourable climatic effects but also from direct cultural influences. The cultural centre along the Dniestr river seemingly did not influence the development of the interior parts of the basin. We probably have to consider occasional *ad hoc* crossings via the Carpathian passes and expeditions for raw materials (Volhynian flint/obsidian, repespectively). This direction, however, could not serve for frequent and regular contacts for large groups of people. The large faunal migrations and related movements of the human population took place outside – north and maybe south of – the Carpathian arch, in spite of occasional efforts of communities along the rivers to hunt or acquire raw material.

Accepting the idea of a Central European origin of the gravettian complex, our data seem to suggest that the interior parts of the Carpathian Basin very early on became the home of groups originating from the gravettian/pavlovian core areas. During the MUP period, the potential surplus population of the Moravian territories was able to find similar living conditions as far as the easternmost margin of the Alföld.

The geomorphological conditions of the area offered suitable conditions for habitation. Tools suitable for working various materials, large settlements and exotic objects denoting lasting habitations, support the image indicated by tool type distribution: recognising the advantages of variable natural affordances and their utilisation, the people of the MUP formed lasting settlements in the marginal zone of the Tokaj-Presov Mountain, and in general, in the northern parts of Hungary. This area had a special intermediary position between the western (Pavlov-Willendorf) and eastern (Dniestr-Prut) cultural centres. In a band of *c.* 200 km in length, there are 11 sites known so far. The quality and quantity of the material denotes a most successful period in the Hungarian Upper Palaeolithic.

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Viola Dobosi
Magyar Nemzeti Múzeum
Régészeti Osztály
Bp. VIII, Múzeum krt. 14-16
1370 Budapest
Hungary

Anta Montet-White

18 A scarcity of MUP sites in the Sava Valley, stratigraphic hiatus and/or depopulation

The Sava Valley area, at the boundary between the Central European plains and the mountainous dissected Balkans, has an important record of mousterian and epigravettian sites. The Mid Upper Palaeolithic has left only very few traces though, and a 6000-7000 year long hiatus separates the last traces of aurignacian groups from post-LGM occupations. Though the paucity of the gravettian record is partly due to erosional processes, the marginal character of traces where sediments are preserved indicates that the Sava Basin was largely depopulated between 28,000 and 20,000 bp.

1. Introduction

The Sava River is the major west-east waterway at the southern edge of the Pannonian Basin which marks the boundary between the plains of Central Europe and the more mountainous, dissected terrain of the Balkans. In the late Pleistocene it was also the limit between the preferred habitat of large herds of mammoth, bison, horses, or reindeer to the north and that of a variety of smaller animals living in small groups to the south.

Palaeolithic groups of opportunistic hunters frequented the uplands with a marked preference for plateaus situated between 200 and 400 m above sea level and occupied shelters along the tributaries of the Sava at several periods of the Palaeolithic. The presence of epigravettian groups is attested at a number of sites following the Last Glacial Maximum (LGM) and the area contains a well-known record of mousterian sites which yielded impressive series of hominid remains. The importance and notoriety of a few sites like Vindija (Croatia) which contributed to the debates around the transition from Neanderthals to modern humans overshadowed the fact that there is but a very limited number of camp sites and hunting stations dated between 40,000 and 30,000 years ago: Vindija, Veternica, Velika Pečina in Croatia, Modriča Jama, Potočka and the recently discovered Divje Babe in Slovenia. The middle period of the Upper Palaeolithic, so well represented in the northern sector of the Pannonian Basin, is marked here by the extreme paucity of its archaeological record. Late aurignacian phases dated between 30,000 and 27,000 bp are represented at two sites of the Croatian Zagorije, Vindija, and Velika Pečina, and at a few open air sites along the Ukrina and Vrbas rivers in northern Bosnia. The Šandalija II shelter at the southern edge of the Istrian peninsula yielded several, more recent, layers attributed to the Aurignacian. The poorly defined assemblages recovered from these layers are the only known materials for the whole period ranging from 26,000 to 20,000 years ago. They indicate at least that human groups occasionally frequented the northeastern sector of the Adriatic Basin. But, the Sava Valley and its surrounding territories, including the uplands of northern Bosnia and Croatia, appear to contain no trace of human presence during a time period marked further north by a rich and vigorous culture supported by the harvesting of large herbivores. Here, a hiatus of some 6000 to 7000 years separates the last traces of the Aurignacian from the post-LGM epigravettian occupations.

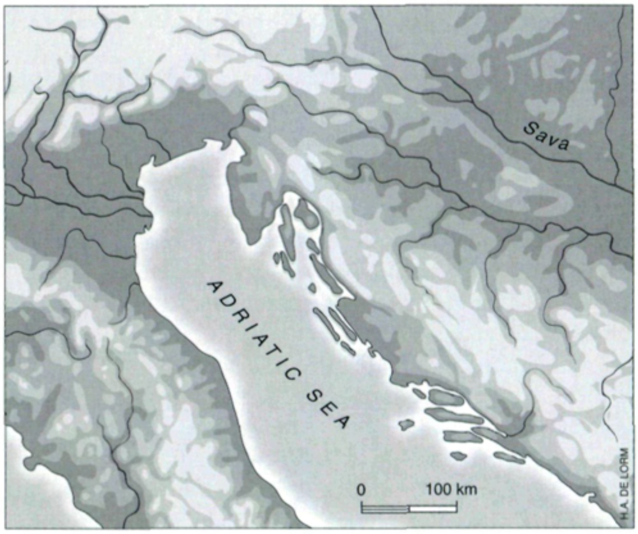

Fig. 1. Location of the Sava River.

This apparent lack of sites in the region may reflect the absence of human populations between 27,000 and 20,000 years ago. The proximity of the Alps with the build-up of high altitude glaciers, the lowering of vegetation zones and depletion of tree cover may well account for harsh environmental conditions which made it difficult for animal and human groups to survive.

But the absence of a record may also be the result of erosional episodes which may have destroyed sediments, thereby eradicating all traces of human occupations. It may even reflect a lack of research which could be attributed to scientific error. The question of erosional phases which would create hiatus in sedimentary sequences is perhaps the easiest to address since a number of sites with long stratigraphic records and series of ^{14}C dates is now available.

2. Stratigraphic hiatus

Evidence derived from caves, rock shelters and open air sites indicates that post-LGM deposits containing epigravettian assemblages are part of sedimentary series which formed above erosional surfaces. Underlying deposits appear separated from the upper series by hiatus of varying duration. In fact, a number of hiatus can be seen within several sequences, indicating the existence of several major erosional episodes preceding the sedimentation cycle which correspond to the LGM. The evidence has been reviewed at length elsewhere (Montet-White 1996) and it will suffice here to summarize stratigraphic sequences from which series of ^{14}C dates provide a solid chronological control.

The Šandalija II shelter and the Crvena Stijena in Montenegro are two key sites of the Adriatic regions. Located at the southern tip of the Istrian peninsula, Šandalija would have overlooked the exposed Adriatic Plain for most of the MUP duration and until 13,000 years ago (Malez 1969; Miracle 1994). The site, now emptied of Pleistocene sediments, contained the most complete Upper Palaeolithic sequence in the region (Table 1).

The upper beds (Layer B) contained a top layer (Bg) dated at 10,830 bp and separated from the lower section of the bed, Bs, by a gap of some 1500 years. The lower section of layer B is dated between 12,300 and 12,700 bp; the latter date derived from a sample taken at the contact between B and C. The topmost section of layer C (C/g) probably belonged to the same series, at least according to the 12,750 bp date associated with it. The lower section of layer C belonged to a different sedimentary cycle which is separated from the upper series of sediments by a hiatus of some 9000 years. Layer D is undated and there is some confusion with the dating of layer F. However, the sequence from F to the base of C could represent a relatively continuous series of sediment accumulation spanning the period between 25,000 and 21,000 bp. But a gap of at least 2000 years separated layers F and G.

The cultural horizons missing from the sequence are those early stages of the LUP comprised between 21,000 and 13,000 years ago. It appears that here, as at the Crvena Stijena, the large rock shelter located in the hills of Montenegro at some distance from the coast, an erosional episode occurred during the Tardiglacial, perhaps related to

Table 1. Šandalija II, ^{14}C dates.

layer B, top [B/g]	EG	10,830 ± 50 (GrN-4976)
Hiatus		
layer B, middle [B/s]	EG	12,320 ± 100 (GrN-4978)
contact between B and C		12,700 ± 100 (Z-2423)
layer C, top [C/g]	EG	12,750 ± 100 (Z-2424)
Hiatus		
layer C, base	?	21,740 ± 450 (Z-193)
layer D	?	
layer E	AUR	23,540 ± 180 (GrN-5013
	?	
layer F	AUR	25,340 ± 170 (GrN-4977)
		22,500 ± 100 (Z-536)
Hiatus		
layer G	AUR	27,500 ± 100 (Z-537)

EG = Epigravettian AUR = Aurignacian ? = Undetermined

Table 2. The Zupanov Spodmol Sequence (Slovenia).

1	topsoil
2	C/D 12,440 ± 150 (GrN-5288)
	A/B16,780 ± 150 (GrN-5098)
2a	ferricrete concretion
Hiatus ?	
3	*éboulis,* cave bear den
4	reddish clay, cave bear den
5	*éboulis,* cave bear den
6	Mousterian

the rise in sea levels. Within the MUP, several erosional episodes of lesser amplitudes affected the sedimentary sequence. During the formation of the lower deposits F, E, and D, the site was primarily a carnivore den, only briefly occupied by human groups.

At the Crvena Stijena, the levels of small scree which contained epigravettian layers (layers VIII to IV) formed on top of an accumulation of large rocks and scree which resulted from a collapse of the overhang (layer IX and X) (Brunnacker 1975). There are no dates available for the site. However, on the basis of comparative typology, Mihailovic (1994) associated the Epigravettian from layer VIII with the late Epigravettian of the Adriatic coast and notably with the lower part of layer B from Šandalija, that is to say between 12,300 and 12,700 bp. The series in turn rested above a layer of volcanic tuffs (layer XI) that sealed the underlying mousterian deposits. Pawlikowski (1992) offered arguments

Table 3. The Vindija and Velika Pečina sequences.

VINDIJA	VELIKA PEČINA
A	a
B	b
C 4,929 ± 134 Neolithic	c
D ?	d
E 18,500 ± 300 (Z-2447) EG	
Hiatus	
F/d 26,970 ± 632 (Z-551) AUR	e 26,450 ± 170 (Grn-4977)
F/dd 26,600 ± 900 (Z-2443) AUR	AUR
	f No date
Hiatus	g No date
	h 31,168 ± 1,400 (Z-198) OLS
G1 ? 33,000 ± 400 (EHT-12714) OLS	i top 33,850 ± 520 (GrN-4979)
G2 ?	OLS
Hiatus	Hiatus
G3 42,400 ± 4,300 MOUST	j MOUST
G4	
G5	
lower series	lower series

EG = Epigravettian AUR = Aurignacian ? = Undetermined MOUST = Mousterian
OLS = Olshevian

supporting a 30,000 bp date for the layer XI tephra which he attributes to a volcanic eruption originating in southern Italy and traces back to Bacho Kiro. The rockfall and *éboulis* from layer IX and X formed at some time between 30,000 and 12,000 years ago and cannot be dated. A small series of artefacts was recovered from the scree; they may not be in place and do not provide solid indication of human occupation in the area during the MUP. The hiatus noted at the Crvena Stijena is of much greater amplitude than any observed at Šandalija. At the latter site, there is evidence of a series of successive erosional episodes during the Interpleniglacial. At the former, the most recent episode eradicated most of the earlier MUP sediments.

Comparable patterns emerge from the Croatian and Slovenian cave sites. LUP occupation levels are registered in series of deposits associated with a milder climatic episode dated between 19,500 bp at Ovca Jama, and 18,500 bp at Vindija, corresponding to the Laugerie interstadial. A second occupation is dated at 16,780 bp at Zupanov Spodmol (Table 2), corresponding to the Lascaux interstadial, and a later phase registered at Zupanov and Lupenska is dated around 12,500 bp (Osole 1979; Montet-White and Kozlowski 1983). The cultural horizons are contained in deposits that form a relatively continuous sedimentary series. But a long hiatus separates the LUP series from the underlying deposits which either contain mousterian industries or are attributed to Würm I or Würm II, corresponding to the first Pleniglacial or the earlier stages of the Interpleniglacial. The amplitude of the phenomenon is in broad terms equivalent to that observed at the Crvena Stijena.

At Vindija (Table 3), layer F with its aurignacian industries is separated from the LUP level E by some 8000 years (Malez and Rukavina 1979). And F in turn is separated from the top of G by at least 5000 years. The gap between deposits containing the Olshevian industries (G1) and the underlying Mousterian (G3) may represent as much as 10,000 years at Vindija. The hiatus is certainly less evident at Velika Pečina where two layers of sediments were recorded between layer e which contained Aurignacian and layer h which contains an Olshevian horizon (Paunovic 1988). The Croatian site sequences are comparable to that of Šandalija where the MUP is contained in series of successive but discontinuous beds.

Lastly, at open air sites like Kadar and Zobiste, both located in the uplands, epigravettian layers rest immediately above sediments containing mousterian industries (Table 4). A more complete sequence was, however, recorded at Luščić, a site located on a somewhat protected terrace of the

Table 4. The Kadar, Zobiste, and Luščić sequencences.

KADAR		ZOBISTE	Luščić	
topsoil		topsoil EG	topsoil	
Hiatus				
layer 2	17,200 ± 2800 EG	Hiatus	II?	
	20,000 ± 1400			
Hiatus			IIIa	
			III	
			IIIb	29,900 ± 2800 AUR
				27,000 ± 3000
			Hiatus	
layer 3	MOUST	layer 2 MOUST	IV	
lower series		lower series 97,500 ± 7000	lower series	

EG = Epigravettian AUR = Aurignacian ? = Undetermined MOUST = Mousterian

Ukrina River (Montet-White *et al.* 1986). A single archaeological horizon identified at Luščić was stratified within a long series of loam deposits; it is attributed to an Aurignacian.

Mention should be made of the site of Visoko Brdo which according to Janekovic (Basler and Janekovic 1961) and Laville had a stratigraphic sequence comparable to that of Luščić (Montet- White *et al.* 1988). An Upper Palaeolithic level, probably Epigravettian, was recovered at the top of the sequence, separated from the Mousterian by several layers of loams. It is clear that a stratigraphic record existed at Visoko Brdo which was more complete and better preserved than at Kadar or Zobiste, but there was no evidence of human occupations during the MUP.

The existence of stratigraphic gaps has been recognized at Franchthi (Farrand 1993), where a long hiatus separated a tephra dated at about 30,000 bp and layer R dated at 22,330 bp. A second, less important but still significant, gap separated R from layer S for which there is a date of 14,680 bp. In other words, the MUP is represented at Franchthi by a sedimentary remnant formed around 22,300 bp. And many cave sites of Central Europe, from the Alpine piedmont, the Jura (Campy *et al.* 1989), or the Bohemian Massif (Valoch 1988) exhibit similar cyclical patterns of erosional episodes.

Research bias, especially in Slovenia and Croatia, has favoured cave sites where there is an abundant faunal record; and these sites have provided and continue to yield a wealth of information on mousterian, early MUP, and LUP settlements of the region. In Bosnia attention has focused on hilltop sites. But open air sites buried in loam deposits and located in protected areas or on low terraces may prove to be better candidates for the eventual recovery of a later MUP record.

3. An absence of human occupations

The absence of a gravettian record is, no doubt, due in large part to widespread erosional episodes which removed sediments at many localities. However, there are, as noted above, a few cases where sediments are preserved. The aurignacian level at Luščić, for example, is a one-artefact thick lens buried in a long series of sediments. The occupation there was a single event. In other cases, preserved sediments contain no trace of human occupation. This suggests that areas or localities occupied at least occasionally during the Mousterian and after the LGM were not utilized during the MUP. The negative evidence must be taken with caution but it supports to some extent the view that the Sava Basin was largely depopulated between 28,000 and 20,000 bp, during the progressive stages of the LGM.

Such as it is, the existing record suggests the possibility of a progressive shift in human settlement within the region between the EUP and the early part of the MUP, followed by the abandonment of the region in the latter part of the MUP. The EUP hunting territories extended from the Croatian hills between the Drava and the Sava Rivers (Vindija, Velika Pečina) to the Divje Babe and the high altitude caves of the Slovenian Alps. Between 29,000 and 28,000 bp, the territory frequented by hunting groups extends north (Vindija) and south of the Sava (Luščić, Mala Gradina, Kammen) but the sections of Slovenia occupied during the EUP were no longer used, probably they were no longer accessible.

There is some evidence in support of the view that a shift in hunting range and a reorganisation of hunting territories may have taken place in response to changing climatic conditions. It is at least possible that stress induced by the continued deterioration of the climate and a reduction of

Table 5. Artefact counts.

SITES AND LEVELS	TOTAL TOOLS	TOTAL DEBITAGE
VINDIJA		
G1	1	37
G/F	20	20
Fd/d + G1	5	
F	45	75
Fd/d	30	48
F/d	28	28
Fd/s	15	49
F/s	5	12
E + F	20	51
E	19	24
D + E	8	9
D	4	49
ŠANDALIJA		
F	21	
E/F	23	
E	17	
Luščić		
	17	1046

natural resources led to the disappearance of human populations from the region around 27,000 years ago.

Several lines of evidence strongly suggest that between 40,000 and 27,000 bp, the Sava Basin was occupied by small, mobile groups who utilized the plateaus and tributary valleys of the Sava Basin as hunting grounds. First and perhaps more importantly, tool assemblages recovered from EUP or early MUP levels are small with a total of less than 100 pieces. According to Karavanic (1995), the number of tools per component at Vindija is 17 on average, with a range of 1 to 45 (Table 5). The 1980 excavations at Luščić recovered 17 tools and an additional 47 or 50 tools came from the much more extensive excavations conducted earlier by Basler (1971). Even when taking into account the fact that these numbers do not include utilized blades and flakes, the totals remain very low indeed and fall well within the range of small temporary camp sites and are distinctly below that of the medium-sized clusters associated with larger seasonal camps (Gamble 1986; Montet-White 1988, 1994). The size of the assemblages is consistent with short-term occupations by small mobile bands.

Radiolarites are the raw materials of choice for the fabrication of blades during the whole course of the Upper Palaeolithic. The ultimate origin of the materials is in the Dinaric Alps; radiolarite cobbles are found in some abundance in gravel bars in northern Bosnia, along the southern tributaries of the Sava River, as well as in rivers running into the Adriatic coast. Quartzites and other more grainy materials better adapted to the manufacture of flakes are commonly found in the vicinity of the Croatian sites. Radiolarites were introduced at Vindija in small quantities during the MUP and did not become common until the Epigravettian (Montet-White 1996). There is, then, some limited evidence of contact between the Croatian Zagorije and regions where radiolarites are to be found – most probably northern Bosnia. The Vindija layer F assemblages are dominated by a variety of flake tools, including scrapers, denticulates, and utilized flakes. These opportunistic tools which exhibit little sharpening or curation were probably butchering and processing tools. The well-made but heavily used and fractured bone points recovered at Vindija and Velika Pečina confirm that hunting was a primary activity. In short, the aurignacian occupants of Vindija were small and mobile hunting parties. Luščić was a place where cobbles of radiolarite obtained from the Ukrina River bed were tested and transformed into blade cores. The small number of blades and blade tools suggests that prepared cores were taken away from the site. In that case, hunting parties would have come to the Ukrina Valley in the course of their yearly rounds to replenish their stock of raw materials. High mobility, small group size, and large hunting territories are elements of a model of economic and social organisation well exemplified by Paleoindian groups of the High Plains of North America. Folsom groups covered distances of 400 km or more during their yearly rounds, tracking bison herds and stopping on their way at sources of raw materials (Hofman and Todd 1990).

With this model in mind, it is possible to propose that small, mobile groups who moved within large and shifting hunting territories, drifted towards the northern sector of the Carpathian Basin in pursuit of game and abandoned the Sava Valley and the regions adjacent to it.

4. Conclusion

In summary, the absence of a gravettian record in the Sava region at the boundary between the Balkans and Central Europe may well reflect an abandonment of the region in the early stages of the Last Glacial Maximum as glaciers were building up in the Alps and vegetation changed, affecting both animal and human populations. Models of hunting groups organisation inspired by those established for Paleoindians may eventually help understand the processes of adaptation and change that took place in Central Europe between 30,000 and 20,000 years ago. It remains that at many sites, especially at cave sites, the MUP record has disappeared, leaving questions of human settlements open and unanswered.

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Anta Montet-White
The University of Kansas
Museum of Anthropology
Lawrence, Kansas 66045
U.S.A.

Joachim Hahn

19 The Gravettian in Southwest Germany – environment and economy

Sediments, flora and faunas are analysed for the Gravettian within the chronological frameworks. The sediments point to a cold and humid climate, as manifest in frost cracked debris and mud flows. The karst dynamics apparently worked on a small scale. Pollen in mineral sediments cannot be directly compared to the limnic deposits because they constitute a different environment as to the selection of species and the preservation. In caves, they represent the local vegetation near the entrance, with a marked difference to nearby waterlogged sediments, as shown by the Weinberghöhlen diagrams. An open vegetation with few trees is indicated. The faunal remains, partly due to animal activity, are varied without a specialisation on one species. The few individuals per species point to an encounter hunt.
AMS dates place most of the gravettian levels near 28,000 bp, in its early phase. The worsening climatic conditions culminating in the glacial maximum nearly 10,000 years later, are not yet evident in the floral and faunal assemblages.

1. Introduction

Generally, the Gravettian is assumed to have developed during the climatic deterioration of the late Pleniglacial. This may have influenced the economy (Hahn 1987), and initiated a widened social network (Gamble 1982).

In Southwest Germany the Gravettian (Fig. 1) is mainly known from cave sites situated in the Swabian Jura (Scheer 1993) with two exceptions: the open air site of Steinacker near Müllheim in the Upper Rhine valley (Pasda 1995) and the open air site of Salching (Weissmüller and Bausch 1986), both with Font Robert points. Detailed studies of the Gravettian are still in preparation.

The climatic and ecological data result mainly from cave sites with their special formation and post-depositional characteristics.

The analysis of the environment is mainly based on modern analogies, with the actual ecological requirements and behaviour applied to the past. In order to monitor the data from archaeological sites, information from neighbouring sedimentary natural contexts are considered too. This small regional analysis is placed into a wider context where possible.

2. The sedimentary context

Sedimentological analyses have been obtained from Geissenklösterle (Laville and Hahn 1981), Hohle Fels

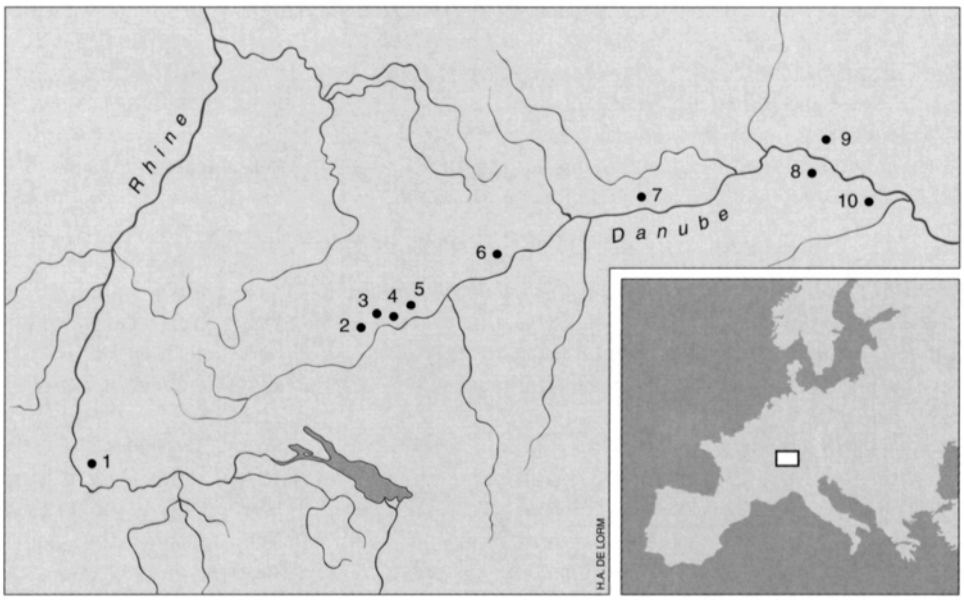

Fig. 1. Gravettian sites in Southern Germany: 1 Steinacker-Müllheim, 2 Hohle Fels, 3 Sirgenstein, 4 Geissenklösterle, 5 Brillenhöhle, 6 Bockstein-Törle IV-VI, 7 Weinberghöhle, 8 Abri im Dorf, 9 Mittlere Klause, 10 Salching.

(Campen 1990) and, in a preliminary form, from Brillenhöhle (Riek 1973). At the latter site, the gravettian sediments indicate, with a high loess component and the many thermal fractures, a rather dry and cold climate for level VII. Level VI with more clay and rounded limestone indicates more humid climatic conditions.

At Geissenklösterle sediments of the major gravettian 7/It level have been subjected to a *lessivage* (Laville and Hahn 1981), forming a dry *éboulis* which has been interpreted as an interstadial, the 'Tursac' oscillation. This succeeded a cold and humid climatic phase. On top, a level with a fine matrix (GH6) contained burnt limestone fragments from the hearth below, arranged in a polygonal pattern. The brownish highest levels with crushed artefacts and bones were attributed to a post-depositional movement of these objects from the gravettian levels below. Campen's (1990) analysis confirmed Laville's interpretation of the Geissenklösterle sediments.

A similar situation occurred at Hohle Fels (Fig. 2). The fine matrix, rich in silt and clays, originates from decomposed rocks and from the karst system. Level 3c/IIc in the interior of the cave entrance tunnel is sectioned by aligned oblique stone slabs, probably not a polygonal frost-crack pattern but the lateral deposition of a mud flow. Differently sized patches are represented by bone ash, bones and artefacts, possibly a nearly *in situ* living floor. Stones polished by repeated rubbing by bears, some with engravings, have been frost fractured like many limestone fragments. The sediments (Campen 1990) suggest a change from a cool humid to a cold and dry climate. The lower levels are in an open matrix with two ash layers showing a strong slope to the valley.

The Gravettian in both caves is associated with a cold and humid climate with intensive frost fracture. At Geissenklösterle the climate of level It is assumed to be cold and humid, with few karst pebbles. At Hohle Fels in level IIc there are many karst pebbles; the climate is considered as cold and dry.

At Hohle Fels, the climatic oscillation is not marked. The two sequences are not identical, though the refittings by Scheer (1986) suggest at least a partial contemporaneity, as do the AMS dates.

The gravettian level at Salching (Weissmüller and Bausch 1986: 241) is situated above a fossil soil correlated with the 'Denekamp' interstadial. This should correspond to the Stillfried B interstadial. At Müllheim, the gravettian level near the surface is situated in a decalcified loess.

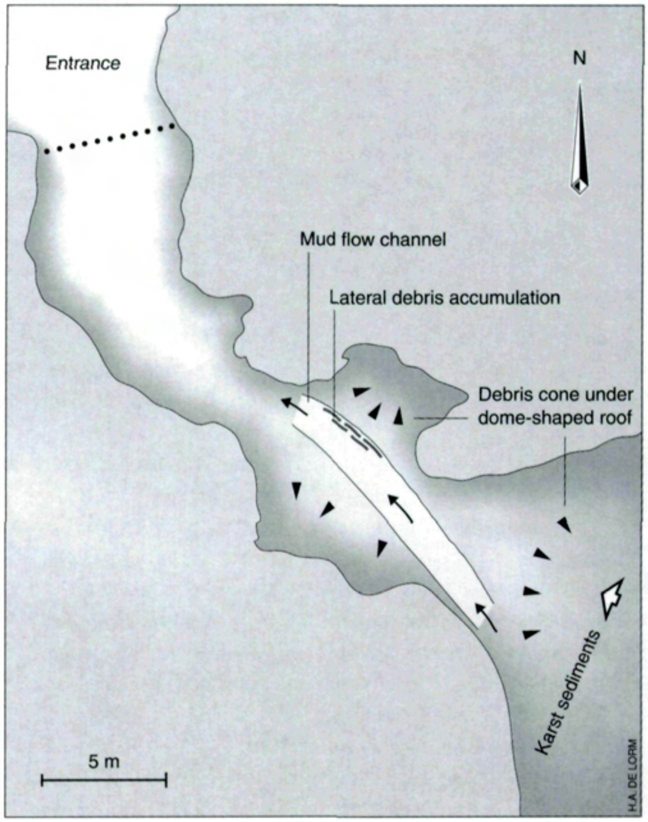

Fig. 2. Hohle Fels – schematic representation of site formation

3. ^{14}C-chronology

Although there are ^{14}C-dates for four major sites, only a few conventional radiocarbon dates on collagen were obtained. Charcoal from the Weinberghöhlen Gravettian gave an age of 28,265 ± 325 bp (GrN 6059). Brillenhöhle VII provided a burnt bone date in excess of 25,000 bp, and Hohle Fels IIb and Geissenklösterle Ia are dated to about 23,000 bp. For Hohle Fels, residue of burnt bone gave an abnormal date of 30 kyr. With the AMS method sufficient sample material became available, and a number of new dates could be processed. Geissenklösterle It with five dates ranging between 26,540 and 29,200 bp and Is with one date of 28,050 bp are earlier than expected (Hahn 1995). The geological horizons 5a to 5d with gravettian finds are dated between 16,940 and 30,950 bp. Except for the 16 kyr date, which is possibly contaminated, this level is only slightly younger than the other gravettian levels below it.

At Hohle Fels IIc, the Gravettian has an age of 29,000 bp, based on two dates on a decorated antler adze. A cave bear bone gave a date of only 26,000 bp. The Gravettian is thus significantly earlier than assumed. According to the AMS dates from the early gravettian levels dated at 27,000-26,000 bp, in Hohle Fels and Geissenklösterle there is a more than 10,000 yr hiatus in sedimentation, since the magdalenian levels dated at 13,000 bp (Hohle Fels) overlay them directly. The Glacial Maximum apparently is not represented in these stratigraphies. The only other sequence, Bockstein-Törle

Table 1. Chronoscheme for the Early and Mid Upper Palaeolithic.

	AURIGNACIAN			GRAVETTIAN	
Phase	Early	Middle	Late	Early	Late
^{14}C	37-34,000	34-32,000	32-30,000	29-26,000	22-20,000
Ach valley	GK III	GK II,		BH VII,	
		BH XIV,		GK I,	
		HF III-IV		HF IIc,	
				Mül,	
				Sal	
Lone valley		Vog V	Vog IV,		BT IV-VI
			HS IV,		
			BT VII		

BH = Brillenhöhle, BT = Bockstein-Törle, GK = Geissenklösterle, HF = Hohle Fels
HS = Hohlenstein-Stadel, Mül = Mülheim, Sal = Salching, Vog = Vogelherd.

(Hahn 1977; Otte 1980) yielded two conventional ^{14}C-dates between 20,000 and 22,000 bp. The corresponding industries, levels VI to IV, are supposedly Gravettian; Otte (1980) thinks it is Epi-Aurignacian because of the presence of flat-faced burins. I claim that the blade technology, a single backed piece (no water sieving was done at the time of the excavations), dihedral burins, Bassaler-like burins, a longitudinal stone retoucher and stone pendants, one deeply notched, place it more appropriately in the Gravettian. These assemblages, occurring in a yellow loess-like sediment may be the late phase of the Gravettian. New dates on the site and its sediments may help to clarify this problem.

Stratigraphies, AMS dates and typology can be compiled to provide a chronoscheme for the Early and Mid Upper Palaeolithic (Table 1) in Southwest Germany.

The early Gravettian is characterized by *fléchettes*, and by shouldered points (Hohle Fels) or tanged Font Robert points (Geissenklösterle), Brillenhöhle VII and Weinberghöhlen C have none. The later Gravettian contains flat-faced burins.

4. Pollen analysis

The criteria for a palaeoecological and climatic interpretation of pollen in an inorganic sediment have been summarised by Sanchez Goni (1994: 380). Her deconstruction of the current palynological chronosystem for the Pleniglacial (25,000-15,000 bp) applies as well to the South German sites.

In South Germany, the first analysis of the pollen of cave sediments has been performed for the Weinberghöhlen (Brande 1975). Here the correlation of limnic open air and inorganic cave deposits has been attempted.

Pollen analysis is restricted to two sites from the Swabian Jura, Geissenklösterle and Hohle Fels, and one site from the Franconian Jura, Weinberghöhlen (Fig. 3). The pollen diagram is situated below the gravettian level, but in the same sedimentary unit. A comparison with reference sites, especially from bogs, is difficult.

Our research has indicated:

a) a cyclic sedimentation which consists of deposition, and a sedimentation 'stop', followed by erosion;
b) the pollen deposition occurs by the wind, by older sediments of the karst system, by animals and/or by men;
c) a taphonomic disturbance by differential preservation and by percolation of recent pollen;
d) bioturbation (e.g., by earthworms) is common, and more in humid Hohle Fels than Geissenklösterle. This may have resulted in a mixing of the sediments, creating an apparently homogeneous pollen composition. Differential pollen preservation may also stem from this bioturbation.

At Geissenklösterle the pollen frequency and preservation is somewhat better with the exception of the upper Late Glacial/Holocene levels.

The rare tree pollen (AP) from willow, spruce and birch do not conform to the pattern for an interstadial oscillation (max. 5% instead of the necessary 20%) in Geissenklösterle (Wille 1978). The highest percentage (5%) occurs in the levels 10-13 at the top of the aurignacian sequence. Herbaceous and grass pollen (NAP) dominate. The gravettian level IIc (Fig. 3) is characterised by a higher percentage of umbelliferae pollen. At the same time, the liguliflorae are more frequent which may point to a poor preservation. The ecological interpretation for the Gravettian indicates a more humid climate than during the early Aurignacian which is less rigorous. The middle Aurignacian has a more dry-cold climate; the lower Aurignacian is less cold and dry. Finally, the Late Glacial is characterised by more cruciferae, which suggests bad preservation.

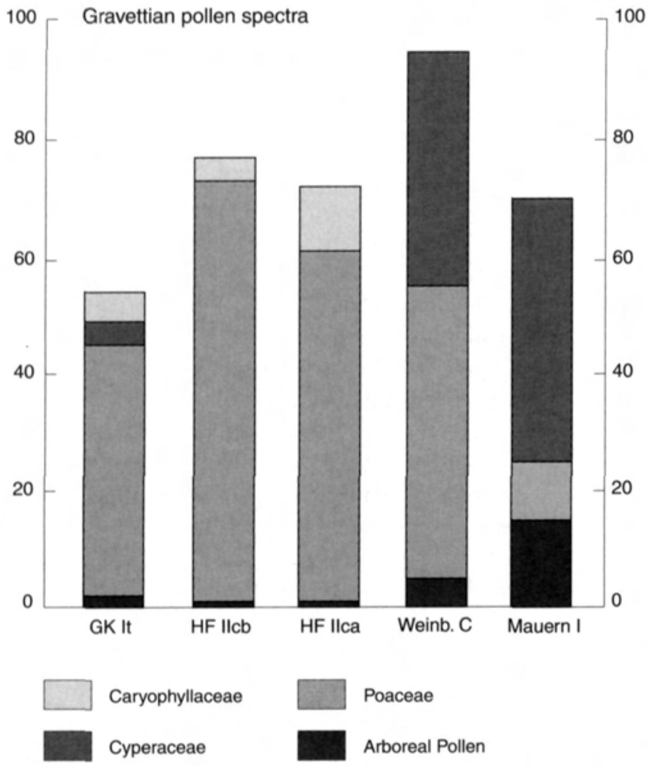

Fig. 3. Simplified pollen diagram of the gravettian levels from Hohle Fels (HF), Geissenklösterle (GK), Weinberghöhlen (Weinb. C) and Mauern I.

The pollen profile from Hohle Fels is represented by two samples from level IIc (Fig. 3). Pollen preservation is generally medium to poor. Pollen frequency, however, ranges between 68 and 850. Due to the rarity of tree pollen, these are supposed to belong to a similar pollen vegetation scheme and preservation spectrum. The analysis of level IIc by B. Albrecht indicated pollen from three different periods: pre-Quaternary, and altered and unaltered Quaternary ones, differing in patination and taxa. In the Late Quaternary, the rare arboreal pollen (AP) such as pine are represented by fragments, and the dominance of grasses, cichoridaeae, points to a differential preservation of the more resistent taxa. The histogram is subdivided into an upper part with many cichoridae and tree pollen, probably due to increased destruction and contamination, and a central part with many grasses and more asteraceae. The lower part with more cichoridae points again to poor preservation.

A zonation and a comparison to reference pollen stratigraphies is not possible. Despite evidence for poor preservation, the low frequency of tree pollen can be considered as real, even if minuscule wood fragments and charcoals are present in all samples. The presence of wood may be suggested from the charcoal fragments in all levels. As these occur also in archaeologically poor or in sterile levels, it is more appropriate to see them as a result of the bioturbation processes.

Through time, there is no change of composition and taxa, except for the upper Late Glacial levels. The pollen sequences cannot be compared due to the different sample treatment, differing percentages and location.

The rare charcoals from the ashy levels III and IV at Hohle Fels consist of birch and willow, both of the dwarf type (research by W. Schoch).

The only pollen diagram from the Ach Valley area came from the Schmiech lake. An open landscape without trees is suggested by the pollen (Grüger 1995). The absence of ^{14}C-dates does not permit a direct comparison. In contrast to the Ach Valley cave samples cyperaceae (sedges) reach the same values as in the Bavarian sites.

Pollen sections were analysed from the Weinberghöhlen near Neuburg in Bavaria, two in the cave itself and several from the valley below (Brande 1975). Both cave sections are roughly comparable, with Gramineae dominant and equal percentages of Cyperaceae, but with varying frequencies of AP. The AP consist of pine, birch, spruce and willow with a percentage below 20%. The pollen sequence from the valley below is characterised by more AP, more Cyperaceae, *Artemisia*, and less Gramineae. Different local plant communities and differential conditions of preservation do not allow a direct comparison.

The pollen composition of these sequences corresponds more to a grassland vegetation (in this case of a slope) vegetation with many Gramineae and herbs than to a tundra with few grasses (Birks 1973). The pollen from these and other caves (Sanchez Goni 1994) cannot establish the existence of an interstadial like Tursac or Arcy.

An important conclusion that can be drawn from the palaeoecological data is that the climate in the Gravettian was generally more humid than during the Aurignacian. Due to the nature of the sediments, it is not possible to correlate open air to cave sediments, even if the horizontal distance is minimal, as the example from the Weinberghöhlen indicates.

5. Fauna

Faunal analyses have been conducted for Geissenklösterle and Brillenhöhle. For Hohle Fels and Bockstein-Törle only partial, preliminary studies are available. Generally, the macromammals indicate a gradual change from more temperate to cool to cold conditions. This is visible in the increasing rarity of red deer and red fox, and also by mammoth and ibex (Table 2).

The minimum numbers are low, usually 1-2 individuals. This may indicate no specialisation on a certain species, but also reflects the nature of caves. Cut marks on cave bear bones also indicate the hunting of this species. The majority of the bones and teeth belong to animals which had lost their milk teeth or died naturally in the caves. The high number of carnivores is also due to the nature of the sites. At Weinberghöhlen, the minimum number of mammoths (6) is higher than in the other assemblages, but cave bear is rarer.

Cut marks and butchering traces are rare. Often both young and adult mammoths, horses and reindeer, occur. For mammoth, this may indicate a preference for the hunting of inexperienced young animals.

The Geissenklösterle analysis demonstrated a dominance of cave bear, part of which has been hunted. Mammoth is represented by ribs of an adult individual. An indication of seasonality is given by a horse foetus, pointing to winter, and by fish remains (Torke 1981) pointing to spring. This fauna has been attributed to spring and autumn occupations.

The temporal proximity of the three assemblages in the Ach Valley as evidenced from the refitting of lithics (Scheer 1986) should apply also to the fauna. At Brillenhöhle, with an apparent mix of magdalenian and gravettian artefacts, the re-analysis of the stratigraphy by refitting (Lauxmann and Scheer 1986) makes an evaluation of this faunal record difficult.

Ecological and climatic inferences may be made from fish, birds and microfauna. Water sieving has only been undertaken at Geissenklösterle and Hohle Fels. The analysis of birds is not complete, and of the microfauna only a sample (Münzel *et al.* 1995) has been studied. At Geissenklösterle the dominance of the collared lemming over the microtines of the *Microtus arvalis/agrestis* group are noteworthy. Ecologically, both are attributed to an open landscape. The *Microtus oeconomus* of humid areas is rare, in contrast to the birds. At Hohle Fels IIb species preferring humid environments are equally rare, but the microtines dominate the lemmings (Markert 1995). Generally, from the lower level there is an increase from cold to more humid forms. The microfauna of the Weinberghöhle (von Koenigswald 1974) is similar, but has less collared lemming. Some levels have more *Microtus oeconomus*, some have none. The small numbers do not permit an analysis.

At Brillenhöhle (Boessneck and Van Den Driesch 1973), birds come mainly from marshy or water areas, like the nearby Schmiechener See, with fewer indicators of an open tundra-like landscape, as typified by ptarmigans. Woodland species are not represented. Hohle Fels and Geissenklösterle have numerous fish remains, salmonids (*Hucho hucho*, *Thymallus thymallus* and *Lota lota*) which point to an oxygen-rich, but not too cold water.

The only natural fauna from the Kemathenhöhle in Bavaria (von Koenigswald 1978), dated at 30,000 bp, contains red deer, horse, ibex and more reindeer in the mammalian fauna. Fox and hare are well represented. As far as the small assemblage is relevant, the animal species seem not to be really different from faunas where humans played a role.

Table 2. MNI of the hunted fauna.

	BH	GK	HF	WH
Lepus sp.	22	8	5	9
Canis lupus	1	2		1
Alopex lagopus	5	(13)	2	3
Vulpes vulpes	8	(13)		2
Ursus spelaeus	27	69	7	6
Crocuta spelaea	1			3
Mammuthus primigenius	2	1	2	6
Equus sp.	3	2		3
Coelodonta antiquitatis	1	1		1
Capra ibex	4	1		
Rupicapra rupicapra	2	1		
Rangifer tarandus	6	1	1	2
Bos/Bison	2	1?		1

BH = Brillenhöhle, GK = Geissenklösterle, HF = Hohle Fels, WH = Weinberghöhle.

6. Discussion

The major problem is that there are no clear palaeoenvironmental data: there is only a tendency of a climatic change from the Aurignacian to the Gravettian. Floral remains from cave sequences are determined by taphomomy, like preservation and bioturbation. Even under favourable conditions, only the local vegetation is represented. Flotation of burnt material has just started to yield some macro plant remains.

With respect to fauna, the apparent use of bones as fuel may distort the representation of faunal skeletal elements, and species. It is assumed for Hohle Fels that some large pieces of burnt and unburnt bone may belong to mammoth (or rhinoceros?). Apart from this, mammoth is only represented by ivory fragments. Differing data collections, e.g. water sieving at Geissenklösterle and Hohle Fels and the preliminary nature of the faunal analysis for Hohle Fels, render final conclusions impossible.

Microfauna analysis of the Kemathenhöhle (von Koenigswald 1978) in Bavaria indicates a climatic amelioration between 33 and 24 kyr, i.e., during the Gravettian, with an increase in the climatically indifferent species.

However, thick levels and small absolute numbers make any specific attribution impossible. Comparison with the Geissenklösterle and Hohle Fels gravettian and aurignacian microfaunas is not possible. Regional differences between the Ach Valley and the Weinberghöhlen cannot be established. While hunting is very probable, the use of plant food remains unknown.

7. Conclusion

Climatically, the Gravettian is attributed to a cold to cool, dry and also humid climate. Frost fracture is frequent, karst elements like karst pebbles vary numerically from site to site. The layer at Salching, located above a fossil soil, may be attributed to a cold, dry climatic phase. The pollen sequences are rather similar with many Gramineae, and few tree pollen. They represent more a local flora from near the site, highly influenced by differential preservation. The microfauna indicates a change from cold to more cool and humid conditions.

Raw material use has changed. Whereas the aurignacian groups obtained the raw material locally, and only a small amount from the southern lowlands, the latter material was widely used in the Gravettian, even if the local materials remained the major lithic resource. An overexploitation or an environmental geomorphological change as indicated by a different slope of the gravettian and aurignacian levels at Hohle Fels may be responsible for this phenomenon.

According to the AMS dates, the Gravettian follows the late Aurignacian rather directly at Vogelherd IV, Hohlenstein-Stadel IV, Bockstein-Törle VII and Hohlenstein-Bärenhöhle II. There may have been an overlap, but the early Gravettian occurs only in the Ach Valley where no late Aurignacian has been identified. In the Lone Valley there is no early Gravettian. It is assumed that this is a bias due to the small sample of sites and levels.

As far as pollen and faunas are representative, the ecological change between 40,000 and 20,000 bp was minimal and cannot be used as an argument for the adaptation to a changed environment.

The economy is based on a variety of animals, the Gravettians of the sites considered apparently were generalised hunters who also practised some fishing. The amount and kind of plant food has not yet been ascertained.

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Joachim Hahn †
Institut für Ur- und Frühgeschichte
Schloss-Burgsteige 11
72070 Tübingen
Germany

Anne Scheer

20 The Gravettian in Southwest Germany: stylistic features, raw material resources and settlement patterns

Gravettian sites are rare in Southwest Germany and are mainly limited to cave sites. Nearly all have to be considered as early Mid Upper Palaeolithic. Font Robert points are rare in caves and more abundant in open air sites. Ivory pendants seem to play a characteristic role in the Gravettian of South Germany. The art is poor, in contrast to the Aurignacian, and is represented by some engravings and the female figurine of Weinberghöhle. Local raw material was mainly used but other lithic and organic materials indicate long distances of up to 300 km; movements seem to be dictated by the river Danube. The most intensive relationship exists between the caves in the Ach Valley, as proven by the raw materials and the pendants. Contemporaneity of the Ach Valley sites is demonstrated by the refittings of stone artefacts between the caves. The independency of the settlement groups is reflected in their own special material, as well as in production techniques or in different contacts and activities, as shown by the distinct raw material resources and tool assemblages.

Settlement density seems to decrease from the Middle Palaeolithic to the Gravettian, with a hiatus during the Pleniglacial and an increase towards the late Magdalenian. This change in settlement pattern could have been caused by climatic events. Even though there is a partial overlapping of settlement areas we cannot speak of a real cultural continuity. Only in some techniques, like the production of ivory beads, does there seem to be a development from the Aurignacian to the Gravettian.

1. Introduction

Most gravettian sites in Southwest Germany are cave sites, concentrated in the Swabian Jura in the Ach Valley, 20 km west of Ulm: Brillenhöhle (Riek 1973), Geissenklösterle (Hahn 1988), Sirgenstein (Schmidt 1910, 1912), and Hohle Fels (Saier 1994). The cave site of Bockstein-Törle (Hahn 1977) in the Lone Valley should probably also be considered a Mid Upper Palaeolithic (MUP) site. More cave sites are situated in the Bavarian Jura, such as the Weinberghöhle near Mauern (Bohmers 1951; Zotz *et al.* 1955), and perhaps also the nearby Mittlere and Obere Klause (Freund 1963), as well as the Abri im Dorf (Prüfer 1961).

Open air sites are less numerous: Steinacker (Pasda 1995, in prep; Holdermann 1997) in the Upper Rhine Valley, and Salching (Weissmüller 1985, 1987, 1990; Weissmüller and Bausch 1986) in Bavaria. In Ried near Dollnstein, a single Font Robert point was found (Freund 1963; Zotz 1964), as well as some blades and endscrapers (Rieder 1989).

The only site with Font Robert points in Eastern Germany is Bilzingsleben (Mania 1981). Probably also Ilsenhöhle/Ranis (Feustel 1989) should be considered, but Font Robert points are absent there.

If one compares the local results of climatic analyses with those of French sites, most of the old dates of two gravettian cave sites (Geissenklösterle and Hohle Fels) assumed a parallelism with the 'Tursac' oscillation (Laville and Hahn 1981), a period which in the Ach Valley is cool and humid, changing to a cold and dry climate (Hahn, this volume). The ^{14}C dates correlated approximately to this oscillation, but newly available AMS dates are evidently older, as at other sites, more comparable with the older datings from Weinberghöhle and Brillenhöhle, and they could be correlated to what Movius called the 'Les Eyzies/Kesselt' oscillation (Bricker *et al.* 1995).

For the open air site of Salching, which should be considered because of its microgravette- and Font Robert points, the climatic situation also points to the early MUP. Artefacts were found in a loess layer above a soil which is referred to as 'Paudorf-Denekamp' (Weissmüller 1985: fig. 4, 199, 239), which is comparable to the stratigraphic position of Mainz-Linsenberg and Sprendlingen above the 'Lohne-soil' (cf. Bosinski, this volume). Notable in Salching is the vertical distribution of artefacts over about 70 cm, certain indications of solifluction, and the position in a loess without soil which indicates a cold climatic situation. It is uncertain here whether a correlating soil has eroded or that it is a matter of (sheet)solifluction originally deposited on top of the soil which corresponds to the 'Denekamp'.

The geochronological position of Steinacker (Holdermann 1997) still requires investigation of the soil. The artefacts were found above a loess layer in a decalcified loess with gastropods characteristic of a cold and humid period.

2. Lithic industry

Not only the climatic references but also the lithic typology (Table 1) of Geissenklösterle correlates to the early French

Table 1. Tools of the main cave sites in southwest Germany, numbers considered until 1983.

SITE	GK		BH		HF		SI		WH		ST	
artefact number	3141		6554		1135		522		1641		17650	
tool number	239		535		113		42		151		210	
perc. of tools[1]	7.6		8.2		10.0		8.1		9.2		1.2	
perc. of tools[2]	12.4		9.8		11.1		7.5		10.1		1.5	
TOOLS	n	%	n	%	n	%	n	%	n	%	n	%
burins	59	24.7	146	27.3	28	24.8	16	38.1	50	33.1	59	28.1
backed points	47	19.7	31	5.8	13	11.5	2	4.8	16	10.6	9	4.3
backed blades	40	16.7	15	2.8	18	15.9	1	2.4	9	6.0	5	2.4
scalar pieces	31	13.0	168	31.4	11	9.7	5	11.9	8	5.3		
scrapers	12	5.0	57	10.7	8	7.1	7	16.7	14	9.3	16	7.6
borers	8	3.3	1	0.2	3	2.7			7	4.6	5	4.3
fléchettes	7	2.9	13	2.4	6	5.3			14	9.3		
scraper/burins	6	2.5	13	2.4	2	1.8						
truncated pieces	5	2.1	10	1.9	7	6.2	3	7.1	13	8.6	22	10.5
pointed blades	5	2.1	4	0.7	?		2	4.8	6	4.0		
Font Robert	2	0.8							11	5.2		
shouldered points	1	0.4	2	0.4	2	1.8			1	0.7	2	1.0
Kostenki			7	1.3	1	0.9			1	0.7	1	0.5
others	16	6.7	68	12.7	14	12.4	6	14.3	12	8.0	80	38.1
spalls[3]	134	4.3	95	1.5	13	1.1			13	0.8	44	0.3
unfinished/deblet	15	0.5	8	0.1	1	0.1			1	0.1	16	0.1
backed pieces												

GK = Geissenklösterle BH = Brillenhöhle HF = Hohle Fels SI = Sirgenstein WH = Weinberghöhle St = Steinacker
[1] without spalls and deblet [2] with spalls and deblet [3] percentage of whole assemblage

Gravettian (Abri Pataud V; Bosselin 1996) with more than 34% backed pieces (backed points, 60% of which are Gravette points, and blades), burins (of which 19.4% are truncation burins and 29.1% dihedral burins), scalar pieces, endscrapers, a few *fléchettes*, two Font Robert points and one shouldered point. Because of the two Font Robert points, we have to consider Geissenklösterle as early Gravettian. Apart from Hohle Fels, the other sites were excavated without (Brillenhöhle, Weinberghöhle) or with wide-meshed sieving (Sirgenstein), thus preventing a comparison of the small tools (mainly microgravette-points, backed blades or burin spalls).

Excluding Steinacker, and neglecting the backed pieces, the percentages of tools vary only 2.4% between the presented cave sites (Table 1), so they are more or less comparable. With an estimate of the missing small tools in Brillenhöhle, Weinberghöhle and Sirgenstein, we reach nearly 10% (even more when tool spalls are included). Geissenklösterle has the lowest percentage of tools. The data of the Hohle Fels assemblage are only preliminary, as analysis of the last excavations has not yet been done. A large part of the sieve residue artefacts are still awaiting analysis, which means that the small tools are probably underrepresented. Even the tool percentage has to be regarded with caution.

The open air sites have a lower percentage of tools, with 5.6% for Salching and only 1.2% for Steinacker (2.2% only excavated assemblage).

Burins generally form the largest group of tools, with the exception of Brillehöhle, especially if we do not consider the small backed pieces. At Geissenklösterle, the low percentage of tools is compensated by a high number of burin spalls. This means that originally more burins were produced there, which were used outside the cave. Burin spalls from the other sites cannot be compared.

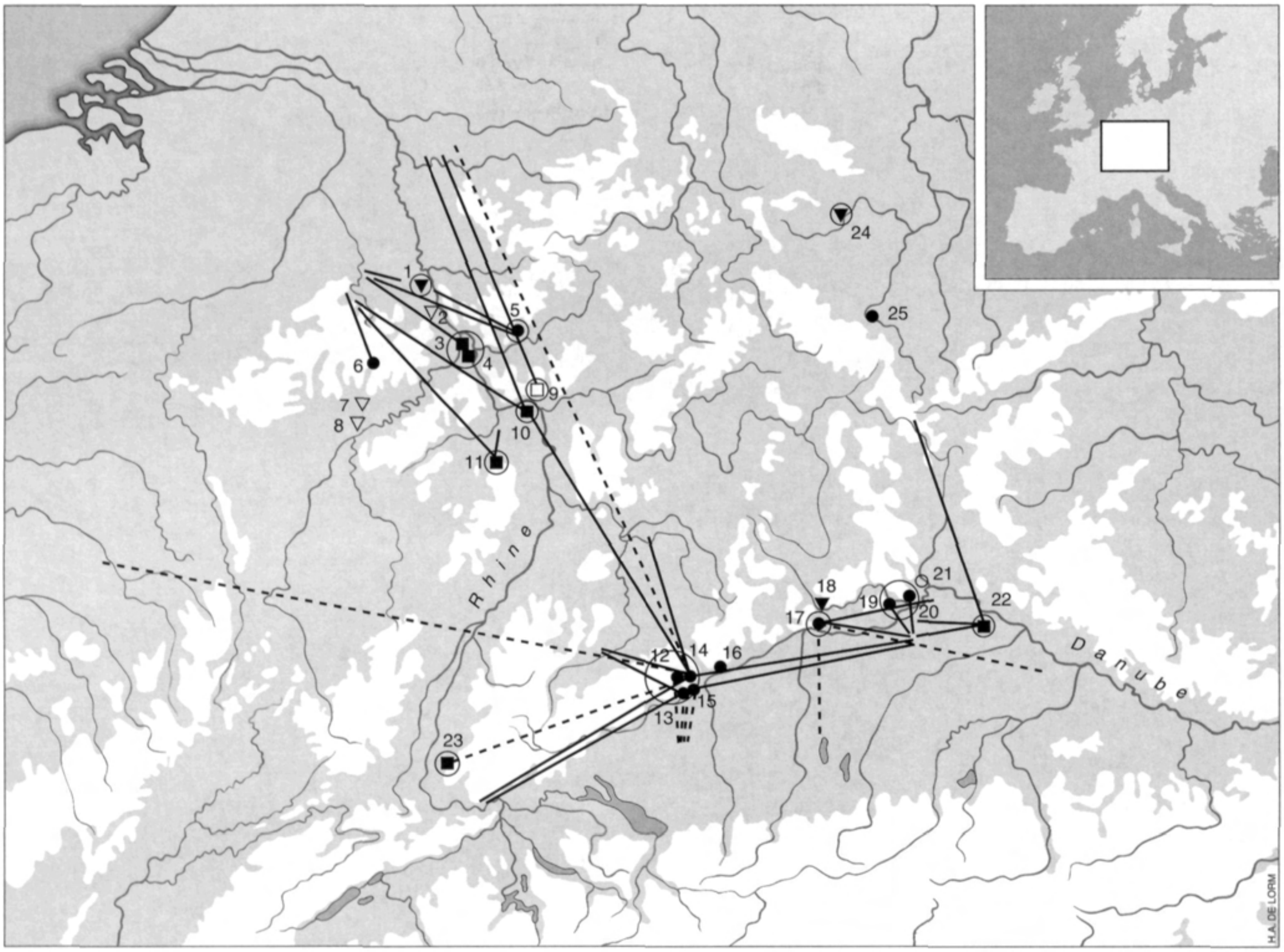

Fig. 1. Distribution of gravettian sites and their raw material sources in South Germany. Circle: cave site, square: open air site, triangle: surface collection, empty symbols: gravettian attribution uncertain.
1. Muffendorf; 2. Unkelbach; 3. Metternich; 4. Rhens; 5. Wildscheuer; 6. Magdalenahöhle; 7. Königsberg; 8. Aspelt; 9. Adlerquelle; 10. Mainz-Linsenberg; 11. Sprendlingen; 12. Sirgenstein; 13. Hohle Fels; 14. Brillenhöhle; 15. Geissenklösterle; 16. Bockstein-Törle; 17. Weinberghöhlen; 18. Dollnstein; 19. Obere Klause; 20. Abri im Dorf; 21. Räuberhöhle; 22. Salching; 23. Steinacker; 24. Bilzingsleben; 25. Ilsenhöhle/Ranis.

Backed points and blades as small tools can only be considered in Geissenklösterle, with the highest percentage, followed by Hohle Fels and, with a higher number than expected, in Weinberghöhle. In the latter site, *fléchettes* occur frequently, and they are well represented in Hohle Fels.

The scalar pieces seem to play a characteristic role in the Ach Valley, while rarely elsewhere. In Brillenhöhle, they even represent the largest group of tools, whereas in Weinberghöhle and Hohle Fels a much smaller percentage of scalar pieces is evident.

Scrapers are well represented, particularly in Sirgenstein. In Geissenklösterle, their small number is somewhat compensated by the combined scrapers/burins category. This combined total is comparable to the total of Weinberghöhle.

Truncated pieces are well-represented only in Sirgenstein, Hohle Fels and Weinberghöhle, elsewhere they are as rare as all the other tools: Font Robert points only in Geissenklösterle, Kostenki technique in Brillenhöhle, Hohle Fels and Weinberghöhle.

In the cave site of Obere Klause, a separation of the gravettian material (with three Gravette points) from the other assemblages is difficult. The geological interpretation of the Abri im Dorf also seems to be problematic (Prüfer 1961). The lithic assemblage differs from the Ach Valley Gravettian and even the Weinberghöhle, but the tools (*c.* 8%) clearly show gravettian elements, with burins as the most

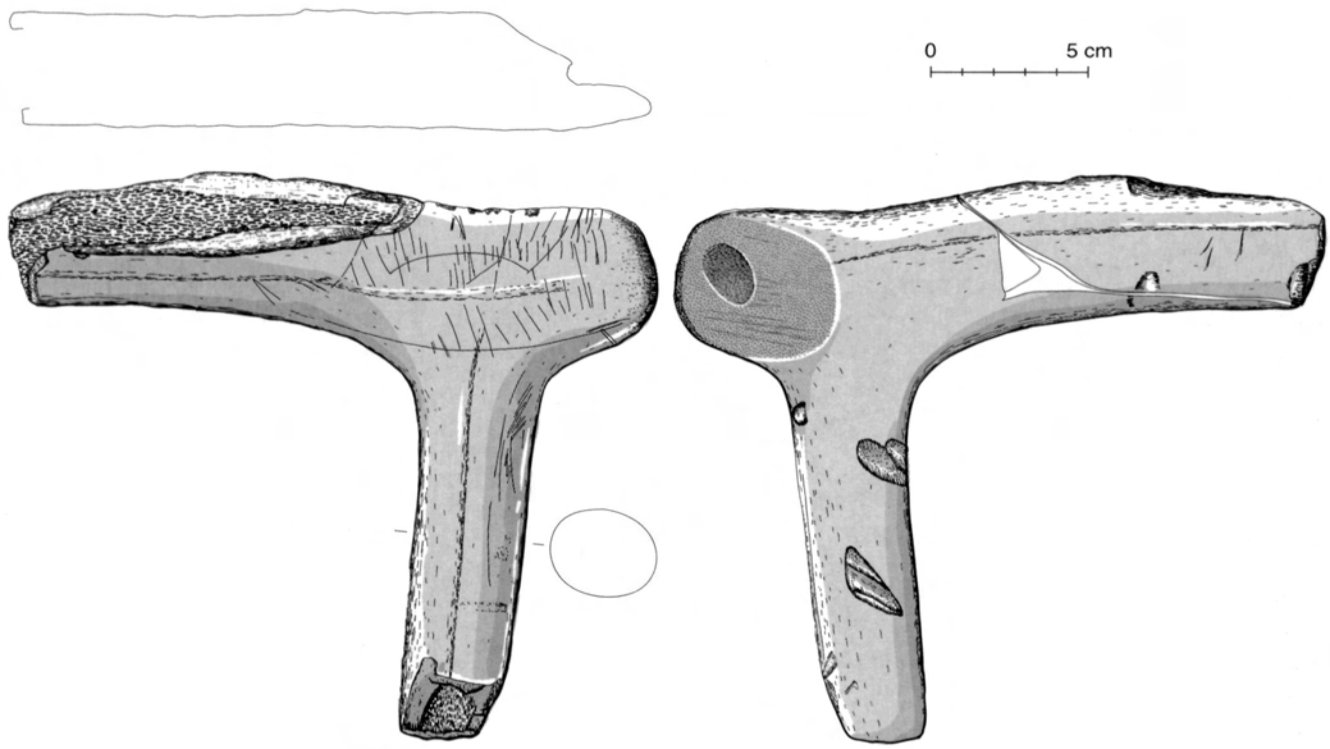

Fig. 2. Antler tool from Hohle Fels with an engraving of a bovid and incisions. (drawing by C. Pasda).

common type of tool, backed blades and points, one Gravette point and a *fléchette*, pointed blades (partly with a heavy marginal retouch), shouldered points, laterally retouched borers, and notched blades, but no scrapers or scalar pieces.

In Salching, as well as in these other sites, a large number of dihedral, truncation or break burins were produced. Less frequent are scrapers. The Gravettes and one Font Robert point, and perhaps another two fragmented Font Robert points, show the chronological order; pointed blades, scalar pieces and some Kostenki ends accompany the tools.

The open air site of Steinacker was found near the Isteiner Klotz, about 40 km south of Freiburg, with a very large number of blades, flakes and cores of jasper, a high-quality homogeneous fine-structured material; this jasper can be red (Blutjaspis), pink, yellow or white. Only very few tools (Table 1) are among the material (about 17,650 artefacts) from the survey and excavation: a large number of Font Robert points (better worked than those from Geissenklösterle), burins, microgravette points, backed blades, scrapers, a shouldered point, a Kostenki end, etc. but no *fléchettes* or scalar pieces. The largest group is again formed by the burins, while truncated pieces, and mainly retouched blades are well presented. Most of the artefacts are surface finds, about 40% of the total, but without sieving. So also for this site the small tools must be underrepresented.

In the Ranis cave, a small gravettian assemblage (n=62) includes some backed points and backed blades, burins and scrapers. A survey at nearby Bilzingsleben showed that the burins are well represented; 20 Font Robert points were found there, representing 10% of all tools. Scalar and truncated pieces are rare, and no *fléchettes* were found. The percentage of backed pieces is lower than expected for a survey, but the percentage of burin spalls with 3.4% is really high. In comparison to Salching and mainly to Steinacker the percentage of tools here reaches 16.3%.

Although these different assemblages represent primarily a typical gravettian industry, they may also signify different functions of sites or different activities of the occupants. Most striking is the high percentage of Font Robert points in the open air sites, the absence of *fléchettes* and none or a low number of scalar pieces. This may have a chronological but also a functional reason.

3. Bone industry

The bone artefacts in the gravettian layers of the Ach Valley are characterised by numerous projectile points with rounded bases, so-called bone polishers, some awls and needle-like bone points without loops, chisels or punches, worked antler and ivory, such as for example small rods. Some of the projectile points show transversal engravings, particularly in Brillenhöhle. The cross section mostly ranges from oval to nearly rectangular; originally some rods must have been longer than 30 cm but they are only preserved in fragments. Very similar are two shafts made from reindeer antler, one from Geissenklösterle, the other from Weinberghöhle. Both were hollowed out at the distal end, between 1.3-3.8 cm deep and 0.5-0.7 cm in diameter. Notable are a pierced *bâton* from Brillenhöhle and two antler tools from Hohle Fels, which at first sight seem similar to the antler adzes from Pavlov or Lyngby (Scheer 1994 a and b), but the basal, proximal end of the main beam is bevelled along the longitudinal axis. The bevel is highly polished with only a few notches. This may infer a different function, perhaps a scraper-like tool.

The antler tool from Hohle Fels (Fig. 2) has been fashioned out of the left antler beam. The bevel of this tool is complete and highly polished; the end of the bez antler is broken, while the end of the main beam, in continuation of the bevel, shows traces of having been cut off. On the surface, the antler tool has transverse incisions and a figural engraving. The bevel of the second antler tool from Hohle Fels (comparable in form, technology and probable use) is broken but seems less polished. The two legs are longer than in the first tool and the end is coloured by red ochre, the surface shows geometrical, rhomboid engravings. The bone tools from Weinberghöhle are comparable, with their round-based projectile points (only one has a single bezel), transversally engraved bone polishers, awls, etc. For the Abri im Dorf, apart from only one worked bone spatula and a fragment of cut ivory, an ivory 'shovel' (Zotz 1961; Freund 1963) is striking, and could indicate some relation with the east (Předmostí and Pavlov). No bone tools are known from the open air sites.

4. Decorative objects

Other chronological and even regional items are the numerous ivory pendants (Fig. 3) in Geissenklösterle, as well as in Brillenhöhle, Hohle Fels and Weinberghöhle. These pendants in the shape of tear drops (Scheer 1985), perhaps imitating canines of deer, are characteristic for this period and especially for this region. The production scheme is well known, especially from Geissenklösterle. They were made both in series and as individual pieces. For the production in series served a notched, in cross section oval ivory stick (Geissenklösterle, Brillenhöhle, Weinberghöhle). In some sites *bilobées* were also found (Geissenklösterle, Hohle Fels, and Weinberghöhle). Pendants from all three Ach Valley sites had very similar reduction strategies. Slightly different but also comparable, are the pendants from Weinberghöhle and Obere Klause in Bavaria. Despite the similarity, in form, technology and dimensions, there are small differences between all the sites. This shows that they were not made by one person (Scheer 1995), but that one common tradition may have existed, close inside the Ach Valley and less intensive in Weinberghöhle. The pendants are also found in other gravettian sites (Scheer 1995) but only as single pieces and often made of different material or in a different form, such as for instance in Bockstein-Törle (Lone Valley) and Mainz-Linsenberg (Middle Rhine Valley), and even at long distances as for example in Willendorf, Dolní Věstonice, Pavlov, Mamutowa, some French sites (Pataud, La Gravette), Isturitz, Barma Grande, etc., sometimes made of bone, in the Moravian sites often of stone. There, form and reduction strategies are changing slightly.

Many other characteristic, ornamental objects of various materials are comparable, especially in the Ach Valley caves (Table 2, Fig. 4). Each cave also shows its individual or another quantity of materials for pendants: there are bone tubes, animal teeth, pierced molluscs, canines of deer, tubes of ivory, ammonites, and pendants of bone, antler or stone and fish vertebras. In South Germany, they are found only in cave sites, perhaps as a result of preservation. In the lower Rhineland, however, organic remains, and art and jewelry were found in loess sites, where gastropods were also preserved. So the reason could also be a functional one, as proposed by Bosinski (1985), who mentions art and jewelry as characteristic for settlement sites.

5. Art

Mobiliary art in South Germany is very poor in the gravettian layers, in contrast to the Aurignacian. Riek (1973) mentions a female figurine which broke during the excavation but nobody has ever seen it. In his descriptions, he notes an ivory fragment as part of the seat of a Venus but it could also have been a fragment of a big ivory pendant. Only in the Weinberghöhle was a complete figurine discovered, the well-known female statuette made of limestone (Zotz 1955: fig. 40), and found in a soil coloured by red ochre – comparable with other female statuettes of this period. Zotz also describes figural engravings on an animal rib, at least one of which resembles a female representation (Zotz 1955: fig. 39.12).

There was no sure reference to art in the Ach Valley until 1994 when the antler tools were found in Hohle Fels. The surface of the first antler tool (Fig. 2) has been worked in the lower third part of the bevel with incised, transverse rows of

Fig. 3. Ivory pendants from Geissenklösterle with production pieces. For serial production: ivory stick, notched ivory stick, limb; individual manufacture: ivory flake and roughout.

parallel engravings, which were applied before use, while the lowest part is polished, probably from use. Perhaps a figure, which can be interpreted as a bovid (Scheer 1994b), was at the same time engraved on the upper part of the tool, together with these parallel engravings. Only the main lines of the figure are visible: the back, the abdomen, a hint of the legs and the two horns. The figure shows an archaic style, comparable to the animal engraving of the Paglicci cave in Italy, which has a younger ^{14}C (conventional) date of about 23,000 bp (Mezzena and Palma di Cesnola 1972). Another comparable figure, an ibex, is described from Gargas (Zampetti 1987). In spite of the younger date, the lithic tools of Paglicci could also be attributed to an early phase of the MUP, with an a-typical Font Robert point and an absence of Noailles burins.

The second antler tool shows only geometrical, rhomboid engravings and lines. These antlers were dated to 29,000 bp. In the same level highly polished limestones from the former cave wall were found (Hahn 1994). The polish was produced by cave bear, and men used these stones later for fine engravings. So far no figures or symbols can be recognised. The design seems to form irregular lines.

No art is known from Geissenklösterle. Only one bone was covered with engraved lines, which could represent a fish in the same archaic style as Hohle Fels, but not as clear; the lines could also be accidental. Despite the uncertainty of the chronostratigraphy of the Obere Klause, a piece of ivory must be discussed on which several mammoths were engraved. Bosinski (1982) attributes it cautiously to a middle phase of the Late Upper Palaeolithic, a phase rather rare in South Germany. The object was described by the excavator as coming from a 'Solutréan' layer below the lower magdalenian layer (Freund 1963), together with an ivory tusk and a lower jaw of a cave bear – both animals are rare in the Late Upper Palaeolithic.

6. Lithic raw materials

Settlement or trade patterns as well as regional mobility are shown primarily by sources of lithic raw material. Therefore the provenance of raw material must be known, which of course is not possible in all cases (Fig. 1). The sites of the Swabian Jura have lithic raw materials which mainly (more than 50%) come from local sources in the immediate vicinity of the caves, and not more than 30 km away. Mainly local Jurassic chert was used but also radiolarite. There are also raw materials from much farther away than 30 km which come from Bavaria and the Black Forest. The main east-west axis of long distance movement is dictated by the river Danube.

The greatest number of different raw materials (20 raw materials and 59 variants) with the largest spatial distribution was found at Brillenhöhle. The Bavarian connections of the lithic raw material between Brillenhöhle, Geissenklösterle, Sirgenstein and Hohle Fels were supported by the presence of ivory beads. In Brillenhöhle, as in Hohle Fels and

Table 2. Number of ornamental objects in the caves of South Germany.

SITES	GK	BH	HF	WH
OBJECTS				
teeth pierced	7	5	5	6
canines of deer	1	-	1	-
molluscs	1	31	2	-
tubes bone	2	4	1	-
tubes ivory	-	-	1	-
ammonites	3	-	2	-
pendants ivory (finished)	56	34	20	15
pendants bone	-	2	-	-
pendants stone	-	1	-	-
vert. fish	1	-	-	-

GK = Geissenklösterle, BH = Brillenhöhle, HF = Hohle Fels, WH = Weinberghöhle.

Fig. 4. Ornamental objects from Geissenklösterle: pierced tooth, ammonites, notched tooth of ibex, hare tubes.

Sirgenstein, we have some raw material which comes from the Upper Rhine Valley, from around the Isteiner Klotz.

At Steinacker we most probably have an extraction site where a first reduction took place before exportation. This is demonstrated by the very few blades (28.7%), the high percentage of cortex material and the few tools. The cores are very large and most (70%) were in a primary reduction stage, while debris is rare; the raw material (Holdermann 1996) which comes from around 50 to 150 m from the site was abundant, of good quality and probably well known to the people or tested outside the site. Probably not only cores but also blades were exported. Maybe it is this site which had connections with the Ach Valley. However, also southeast of Isteiner Klotz, the same facies of this Tertiary material is known. In Brillenhöhle we have three or four of these nodules, partially reduced before being introduced in the site. Connections with France with some Cretaceous flint material are not as sure; perhaps there are also sources of this raw material less far away, for example in Bavaria. Many raw materials with sources between 50 and 300 km away are represented in small numbers and consist of imported blades or tools. But also reduced cores were imported in the caves.

In the Bavarian site of Weinberghöhle, the raw material also comes mainly from local sources (92%), more than in the Swabian sites. This contrasts with the Rhineland sites, which have a higher percentage of raw material with longer distances. In Salching on the other hand, the sources are presumed to be not in the immediate vicinity; the nearest source of keratophyr (42% of the raw material) was found approximately 150 km away. The longest distance of the source of the other raw material is about 50 km. The largest group of keratophyr artefacts came in as prepared cores with a lot of blades in production. Although refittings were not possible, the chips prove a debitage at the site. Also in the cave site of Obere Klause and in Abri im Dorf, most of the raw material seems to be local, mainly tabular flint and flint pebbles from the nearby Danube. Radiolarite is rare in these Bavarian sites. The few radiolarite nodules from Weinberghöhle, mainly blades, might indicate, together with the ivory beads, contacts with the Ach Valley. At Bilzingsleben raw material can be proven in the immediate vicinity.

Not only in the raw material but also in ornamental objects, for example molluscs, can we prove long distances from the caves of the Ach Valley: there are the fossil mollusc outcrops in the Steinheimer and Mainzer basins, and there are molluscs sites at Geissenklösterle and Brillenhöhle which await determination and may have come from an even greater distance. Especially the Mainzer basin seems to be a source, not only for the South German sites but also for the Upper Rhineland sites. This could be one of the places where contact with other groups was possible.

In order to reconstruct the distribution mobility, the primary production of blades, flakes, cores and tools must be known and refits have to be considered. Partial reduction and final use of nodules, cores and blanks did not always take place in one cave, even if local raw material was used.

Local material is usually reduced at the site. In the Ach Valley caves, local chert is often of very poor quality, with a lot of debris and the greatest number of preparation flakes with cortex and a high percentage of flakes. This means that the chert was often brought onto the sites as complete cores without prior testing, and then prepared, flaked and used. Most of the tools are made of Jurassic chert.

Radiolarite from slightly more distant sources (Alpine rivers) comes in tested and prepared, and shows only partial reduction; apparently, complete nodules never arrived at the site and this radiolarite yielded a relatively larger number of tools. More distant lithics come onto the sites as blades or sometimes as prepared tools or as partially reduced cores (Brillenhöhle). The distance of the sources is also reflected in the quality of the raw material: the greater the distance, the better the quality. Many tools are evidently missing, they were probably used elsewhere. The ratio of burins and spalls may give a good indication. In Geissenklösterle, for example, we can estimate that 50-70% of the burins are missing; maybe this statement also applies to other tools.

Refitting shows besides horizontal movements between structures also vertical movements; nearby layers have to be interpreted carefully, even if distributed in different sediments. Both in Geissenklösterle and in Brillenhöhle refitting proves that the various gravettian layers, differentiated by geological criteria, cannot be separated nor could they have been caused by a single occupation (Lauxmann and Scheer 1986; Scheer 1990).

At the same time refitting shows the high mobility of artefacts; in no case could large series be conjoined. This means that on the one hand many blades and flakes were taken away from the sites, on the other hand other examples also show that the cores were transported and flaked outside or in the other caves. In Geissenklösterle, for example, six stages of reduction of nodules were brought into the site: complete, tested, prepared, reduced nodules and imported blanks or tools, which often could be associated with the distance to the source (Scheer 1993).

The sites in the Ach Valley hint at a remarkable resemblance between some groups of raw materials. Exploitation, use and discard were puzzling: in one of the caves the results of the first stage of the reduction sequence were found, while at another cave the products of the next stage of the process were found. But transportation of the material would indicate a contemporaneity of the sites, if we exclude the possibility of re-use of the material by later inhabitants of the caves. First contact was suggested already by the ivory beads. Confirmation can be given only in refittings between the sites.

7. Settlement patterns and relationships

In the Ach Valley, all the caves are less than one hour's walk from each other, with only the Ach in between. In a brief test, refittings were possible in eight cases, mainly between Geissenklösterle and Brillenhöhle, but also between

Brillenhöhle and Hohle Fels. These refittings included flakes, blades, debris and even tools, such as two burins or a scalar piece (in general two pieces could be conjoined, only once could three pieces be conjoined; Scheer 1986, 1990). The direction of transport following the reduction sequence was mainly towards Brillenhöhle (four from Geissenklösterle, one from Hohle Fels), but also in other directions (two from Brillenhöhle to Geissenklösterle and one or two to Hohle Fels), so it seems to have been an open relationship. This fact also precludes the interpretation of re-use of old materials at the site. The high number of connections with Brillenhöhle may be caused by the larger number of artefacts. In addition to these conjoined pieces, there are several raw materials which correspond to each other in all or some of these caves, and even to Sirgenstein. Nine nodules from Sirgenstein correspond with material from the other sites – all of them are found at Geissenklösterle, half at Hohle Fels and Brillenhöhle. From Hohle Fels, 15 nodules are comparable to those from Geissenklösterle, and several to those from Brillenhöhle and Sirgenstein. This implies that probably also Sirgenstein is connected contemporaneously with the other three sites.

The independency of the settlement groups can be proven with the rest of the raw materials. In all caves we find comparable material or material from the same nodules, but each cave also has its own different raw material, of which only a small portion was conjoinable. Together with the observations on production techniques of the ivory beads or other ornamental objects, we can probably suppose different (independent?) groups, who had some kind of relationship. Depending on the raw material resources, the contacts were different. It seems that Brillenhöhle had the largest contacts. The most evident relationship seems to be between the Bavarian site of Weinberghöhle and the caves of the Ach Valley, based on raw material and ivory beads, even if no refittings were possible between these sites. Contact with the Upper Rhine Valley is demonstrated by the red jasper. A first short test to conjoin this material with that from Brillenhöhle gave no result, but it would take a great deal of time to examine the thousands of flakes and blades from Steinacker. Contacts (even if indirectly) have to be considered also to the east with the Pavlovian, mainly based on the pendants and bone tools. A local contribution to technological development might be the pendants in Southwest Germany.

This conclusion about contemporaneity also implies a different interpretation of the settlement pattern. During the Gravettian, the visits of group(s) of the Ach Valley were even rarer but with a greater number of members than assumed before. This also means that groups probably made their own migration but met from time to time. Based on the estimations of Weniger (1982), we can postulate a population of about 500 persons for Southwest Germany (50,000 km^2) during the Magdalenian. Jochim (1976) also gives an indication of about 900 persons but only for the upper Swabian region (6700 km^2) for the Mesolithic period. So perhaps for the Gravettian we should consider a sparse density of between 0.01 and 0.1 persons/km^2.

Dwelling structures are not known from the open air sites. Only Riek (1973) mentions a stone structure in the back of the Brillenhöhle cave and interprets it as a kind of tent; he describes an accumulation of bone ash inside this 'stonewall'. In any case we can discern a certain organisation in the cave sites (Geissenklösterle, Brillenhöhle, Weinberghöhle) with fireplaces and activity areas.

No burials are known so far in South Germany, whether in caves or in the open air, if we do not attribute the burial of an adult (30 yrs) in the Mittlere Klause (Bavaria) to the Gravettian. There is no chronostratigraphical assignment but the bones of a modern human with cut marks was found in a concentration of red ochre, with fragments of mammoth teeth above and below the head. Nearby two bone polishers were found, abundant in the Gravettian. The Magdalenian can be excluded on stratigraphical grounds (Freund 1963: 46), and the burial should be older. Freund (1963) and Müller-Beck (1956) would not exclude an attribution to the Late Middle Palaeolithic with bifacial points. Arguing against this are ^{14}C and amino acid datings which indicate a date of about 18,000 bp (Schröter 1979) – a phase which normally presents a hiatus.

An important resource of food during the Gravettian are mammoth, reindeer and equids, a few bovids, capra ibex and hares. The recently found cut marks on cave bear bones from Geissenklösterle renews the old question of cave bear as hunting game (Münzel *et al.* 1994). Even though Geissenklösterle is an open cave shelter, the number of cave bear remains is much higher than in all other caves. The MNI of hunting game lies only between 8 and 42 MNI (Hahn, this volume). We have different proportions from the gravettian cave sites of the Ach Valley and Weinberghöhle. It seems therefore that there was a specialisation of mammoths in the Weinberghöhle (MNI=6), whereas in Brillenhöhle we have the largest number of reindeer and capra ibex but fewer horses. In Geissenklösterle horse is more frequent, reindeer on the other hand is less well represented. Horse, capra ibex and bison are missing in Hohle Fels (but we have to take into account the restricted excavation area). In all caves the hare is well represented with the highest MNI. This discard underlines the independent character of the sites.

For the early MUP in South Germany we can assume a sparse human population, not an intensive occupation as during the late Magdalenian. The caves were visited only seasonably (probably including winter!) for a short time for hunting or for raw material procurement. The inhabitants of the caves in the Ach Valley probably belonged to different but related groups, with a strong exchange of technologies and even objects, meeting perhaps for a hunting season or something else. The inhabitants of Weinberghöhle were less closely related, but more than Salching where no relationship is evident. Raw material shows an indirect or direct (?) connection with the region of the Isteiner Klotz Steinacker. Ammonites point to the northern Swabian Jura and molluscs to Steinheim, and also to the Mainzer basin.

The open air sites differ from the cave sites with their low percentage of tools (with the exception of Bilzingsleben), the number of Font Robert and shouldered points but fewer or no *fléchettes*, scalar or truncated pieces, and the absence of art and ornamental objects. This discard pattern may have chronological or simply functional reasons. Then also these industries have to be placed in an early Middle Upper Palaeolithic.

8. Discussion

We cannot speak of a real cultural continuity from the Middle Palaeolithic to the Upper Palaeolithic, even if we have both in the Ach Valley and in the Lone Valley a rich Middle Palaeolithic. Not only the technology but also the raw material is changing. The distribution of archaeological sites indicates that the settlement area of the Middle Palaeolithic in Southwest Germany is more extended than in the following Aurignacian – a development which seems to continue in the Gravettian, with even fewer known sites. We could also assume a certain shift, perhaps based on different hunting methods or different prey species.

Stratigraphically the Middle Palaeolithic of Geissenklösterle is followed by an early and middle Aurignacian. Mainly here and probably also in Sirgenstein, we can speak of a continuity from the Aurignacian to the Gravettian when referring to the objects, even though the late Aurignacian is lacking. This period on the other hand is well known in the Lone Valley. Comparing the gravettian with the aurignacian settlement sites, we notice an overlapping of settlement areas for the moment only in the Ach Valley (without interpreting it as a continuity of settlement), mainly in Geissenklösterle and Sirgenstein. In Brillenhöhle is a very rich level with Gravettian but only two fragments of split-based bone points. On the other hand, we have a rich Aurignacian in the Lone Valley, and only a few dates for the Gravettian in Bockstein-Törle, probably a younger facies and not comparable with the Gravettian of the Ach Valley. Also in Bavaria there are not many aurignacian sites: a few artefacts are mentioned by Bohmers (1951) at Weinberghöhle and there are old excavations of Kematenhöhle, Fischleitenhöhle, Obernederhöhle, Ofnet, etc. (Freund 1963). Open air sites are really rare. Recently, four open air areas were excavated near Regensburg (Uthmayer 1996).

From the Aurignacian to the Gravettian we can observe a climatic change. In the gravettian levels, a cooling seems evident after the humid temperate climate of the upper Aurignacian, with a new increase in temperatures but less warm perhaps and more humid.

A comparison of the aurignacian lithic material from Geissenklösterle with the gravettian material shows that the percentage of tools for the Aurignacian with 11.3% (both aurignacian levels combined) is higher than for the Gravettian. In the Aurignacian, the scalar pieces (32%) represent the largest group of tools, followed by the scrapers (24%), a higher percentage than in the Gravettian. Nearly half of the scrapers are carinated and nosed scrapers; burin scrapers reach only 1.4%. The burins (16%) are much rarer than in the Gravettian. The laterally retouched pieces (15%), mainly blades, are rare in the Gravettian. Pointed blades (10%) are better represented in the Aurignacian, borers (1%) are rare. There are some Kostenki truncations (2%). All typical gravettian backed and truncated pieces are missing in the Aurignacian.

We can also observe a change in raw material, distance to resources, technology and debitage. In the Aurignacian, 96% of the raw material is local chert, while only 56% in the Gravettian, when radiolarite with 39% is well represented. During the Aurignacian, radiolarite was very rarely used (1%). Jasper on the other hand was used more by the Aurignacians (1.2%) than by the Gravettians (0.2%). 99% of the exploitation area in the Aurignacian lies in the immediate vicinity or nearby areas (under 25 km) and only less than 1% of the raw material was brought from distances over 25 km. In the Gravettian, more than 8% was imported from upto 300 km. This could be the reason why in the Aurignacian the percentage of pieces with cortex (39%) is higher than in the Gravettian (30%), and also why the flakes (54%) in the Aurignacian are more abundant than in the Gravettian (40%).

Cores and blades occur more frequently in the Gravettian. Particularly the blades and nearly all cores had more often cortex in the aurignacian assemblage. This means not only a different reduction technique but also that the Aurignacians brought in more whole nodules and produced blades in early stages of reduction. It is also possible that there was either less mobility or less trade contact with distant regions, if we assume that it is not only a different view of the importance of the raw material. The percentage of debitage, however, shows no significant difference between the Aurignacian and the Gravettian.

For the bone tools it is obvious that in the Gravettian there are no longer split-based bone points and maybe less ivory working. Above all, there are the ivory pendants, the production of which begins in the Aurignacian already with the technique of manufacturing in series, similar to that in the later Gravettian. In the technology of the production of these pendants, there seems to be a development from the Aurignacian to the

Gravettian, as demonstrated in Geissenklösterle and some other sites. The size of the beads increases towards the Gravettian and the flattening of the cutting ends is no longer used for piercing/cutting a hole at both ends; now only one hole is pierced at the smaller and thinner end of the piece.

Also other ornamental objects, like pierced canines, continue to be used. The variety of other ornamental objects increases in the Gravettian.

Striking is the rarity of mobiliary art, which is abundant in the Aurignacian. It is present in the eastern and western Gravettian, and nearly missing in the Swabian Gravettian, even when there is enough ivory. Perhaps the art was made from a different organic material.

No change could be established in the food resources from the Aurignacian to the Gravettian. In the Magdalenian we can recognise an increase in hare and birds.

The late Gravettian is obviously missing in the Ach Valley as well as in Bavaria but may be present in Bockstein-Törle in the Lone Valley. This site is comparable to the sites of the Middle Rhine Valley, with their ivory pendants, and similar also for example to those of Italy (Grimaldi etc.)? In any case, the decrease in the number of sites in South Germany is obvious. So far there are no techno-complexes with Noailles burins which are missing all over Germany.

During the Pleniglacial we notice a hiatus all over until the late Magdalenian, when we can observe an increase in the settlement area. Thus the change in settlement pattern could be caused by and correlated with climatic events; parallel to the cooling of the climate, we have a decrease in settlements towards the Upper Palaeolithic in the south of Germany, close to the Alpine glaciers. Maybe settlement only took place during warmer periods or interstadials. The full decrease or even absence of a late Gravettian, and above all the Epigravettian or Solutrean, until the late Magdalenian, can be interpreted climatically as a migration before, during and after the Pleniglacial, until that time when in the south we have an increase in settlements. Alternatively, we could attribute the apparent change in settlement pattern to a sediment hiatus, or to a large-scale erosion/solifluction.

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Anne Scheer
Urgeschichtliches Museum Blaubeuren
Karlstrasse 21
89143 Blaubeuren
Germany

Gerhard Bosinski

21 The period 30,000-20,000 bp in the Rhineland

A total of 15 sites from various contexts (loess, cave, surface scatter) testify to human occupation of the Rhineland in the period 30-20 kyr. The stone industries can be divided into a group with Font Robert points and a group with many microgravettes. Settlement features are known from various sites, some of which may have been real base camps, e.g. Mainz-Linsenberg. As to subsistence, reindeer and horse were the most important species, whereas the gathering of plant food is also documented in the Rhenish record. The presence of Mediterranean shells in sites in the Rhineland shows that the local groups formed part of a significantly larger social unit.

1. Introduction

From the Rhineland 15 sites are known from the middle part of the Upper Palaeolithic (MUP), belonging to the period 30,000-20,000 ^{14}C bp (Fig. 1). The finds are from loess deposits (Unkelbach, Plaidter Hummerich, Metternich, Rhens, Heddesheim, Sprendlingen, Mainz-Linsenberg, and Achenheim), from surface collections (Muffendorf, Welschbillig, Ingendorf, and Feldberg), from caves (Magdalenahöhle and Wildscheuer), and from boreholes near a thermal spring (Wiesbaden-Adlerquelle). Excavations took place at the sites of Plaidter Hummerich, Metternich, Sprendlingen, and Mainz-Linsenberg, and at the cave sites of Magdalenahöhle and Wildscheuer.

2. Stratigraphy

The reference section of the Upper Palaeolithic in the Rhineland is the Metternich loess profile. At the beginning of this century A. Günther observed three "pale brown stripes" within the profile (Günther 1907). During H. Hofer's work in the 1930's, the upper and lower interstadial soils were merely represented by denudation horizons (*Feinkiesstreifen*) and only the middle soil could be observed as a pale brown loam (Hofer 1937). This is also the present situation (Frechen *et al.* 1995). The subdivision of the yellow loess by three interstadial soil formations is common in the Rhineland (Fig. 2). These inner Würmian soils I, II and III described by K. Brunnacker (1978a, 1978b) correspond to A. Semmel's *Gräselberger Boden*, *Lohner Boden* and *Erbenheimer Naßboden* (E4) respectively (Semmel 1969) and are correlated to the Hengelo, Denekamp and Lascaux interstadial periods.

An important horizon of the Rhenish loess sections is the Eltville Tuff, situated between the inner Würmian soils II and III (Löhr and Brunnacker 1974; Meijs *et al.* 1983; Löhr 1987). The Eltville Tuff, distributed in the Rhineland, Hessia and Frankonia, dates to the Pleniglacial.

Of interest for this paper is the segment from the inner Würmian soil II (*Lohner Boden*) up to the Eltville Tuff (Fig. 2). This part comprises three different biotopes:

1. the more humid period of the soil formation,
2. the time of loess sedimentation,
3. the permafrost of the Pleniglacial.

Until now the archaeological finds are restricted to the soil formation period and the beginning of the loess sedimentation.

3. Industries

The lithic artefacts represent two groups: assemblages with Font Robert points (Perigordian Va) and sites with many microgravettes (Perigordian VI/VII).

Perigordian Va (Font Robert)

The site of 'Steinacker' near Feldberg in the Upper Rhine Graben contains Font Robert points, Gravette points, burins and endscrapers (Pasda 1995a, 1995b).

Tanged artefacts, but no complete Font Robert points, are known from different Rhenish find spots. Possibly the Wildscheuer IV finds also belong to this horizon (Terberger 1993), with ornaments on ivory and bone objects similar to Maisières-Canal.

Hints to the stratigraphy of these finds are known only from Achenheim. The collection of P. Wernert contains 32 lithic artefacts including a fragment of a Font Robert point and two Gravette points, as well as reindeer and marmot bones from level 8 (Junkmanns 1991). Level 8 is a brownish loam with indications of solifluction which could correspond to the inner Würmian soil II (*Lohner Boden*). Above this loam is a cryoturbated soil which may represent the *Sol de Kesselt* (28,000 bp; Heim *et al.* 1982). Outside the Rhineland, the site of Maisières-Canal has a comparable age. At Maisières-Canal there were not only many tanged tools,

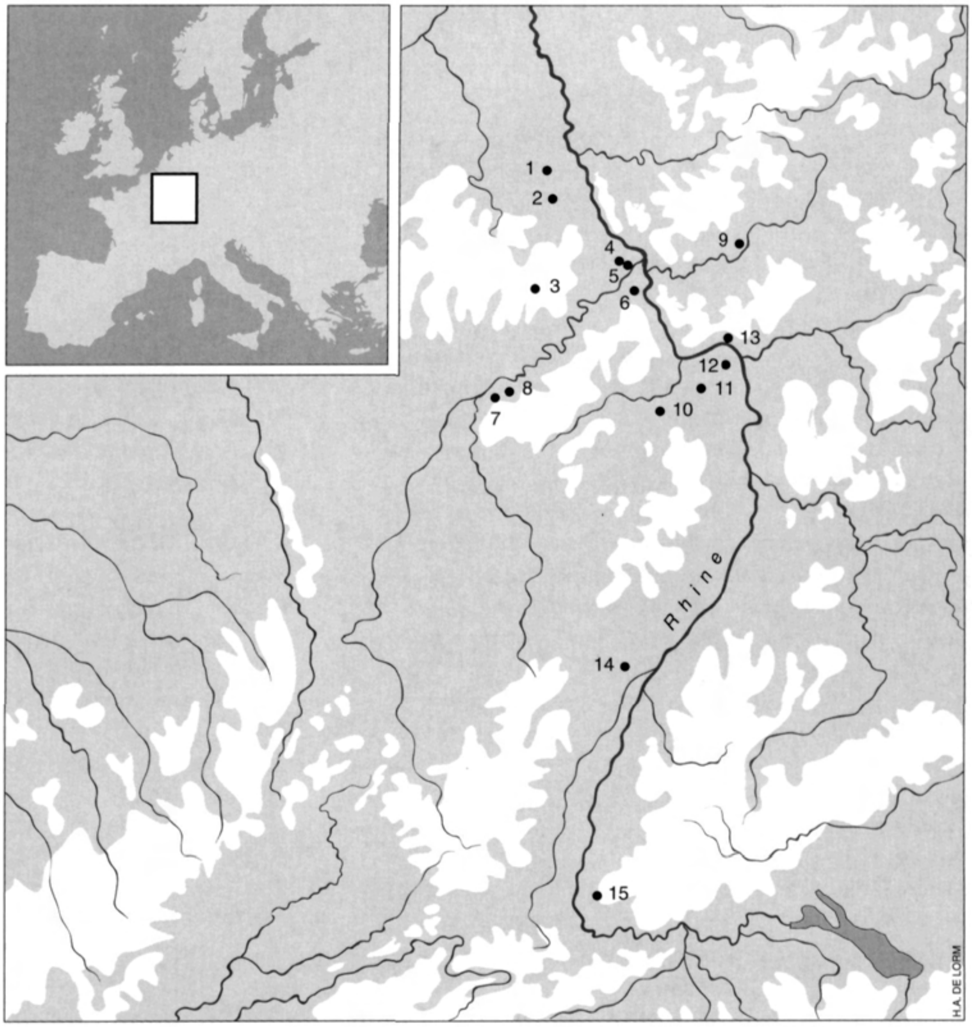

Fig. 1. Sites 30-20 kyr bp in the Rhineland
1. Muffendorf; 2. Unkelbach; 3. Magdalenahöhle; 4. Plaidter Hummerich; 5. Metternich; 6. Rhens; 7. Welschbillig; 8. Ingendorf; 9. Wildscheuer IV; 10. Heddesheim; 11. Sprendlingen; 12. Mainz-Linsenberg; 13. Wiesbaden-Adlerquelle; 14. Achenheim; 15. Feldberg.

including Font Robert points, but also bones (reindeer, horse, mammoth, arctic fox and isolated bones of deer and *Bos/Bison*) and artefacts of bone and ivory. The site is dated to the Maisières interstadial (27,965 ± 260 bp; Haesaerts and de Heinzelin 1979).

The Font Robert horizon (Perigordian Va) is distributed in the Dordogne and eastern France with an extension to Central Europe. The distribution far to the North, including the British Isles, underlines the interstadial position. In contrast, the Noailles finds (Perigordian Vc) are restricted to southern France and the Mediterranean without any traces in Central Europe.

Perigordian VI/VII

Especially at Mainz-Linsenberg (Neeb and Schmidtgen 1921/24; Hahn 1969) and Sprendlingen (Bosinski *et al.* 1985), there are many small backed bladelets and microgravettes. The finds also include bladelet cores ('polyhedric burins'), pointed blades, burins, and borers. These finds correspond to the Perigordian VI/VII of southwestern France but also have parallels in Eastern Europe (e.g. Molodova V, 7; Cernys 1987).

The female figurines of Mainz-Linsenberg (Bosinski 1982) are of more than regional importance. If these statuettes characterise a chronological horizon, they may help to compare the different industries with female statuettes in larger parts of Europe.

At Mainz-Linsenberg and Sprendlingen the find horizon is situated above the inner Würmian soil II (*Lohner Boden*). The finds are immediately above the denudation horizon (*Steinsohle*) on top of the soil and belong to the first part of loess sedimentation (Fig. 2). The sites of Metternich and Rhens have a corresponding stratigraphic position. At these sites microgravettes are not numerous (collected finds) but the bladelet cores ('polyhedric burins') indicate the same industry (Perigordian VI/VII).

4. Settlement features

Some sites, e.g. Mainz-Linsenberg, Heddesheim, Metternich, Rhens, and Achenheim, are located in a sheltered topographical situation. Classic is the position on a step above a large river, opposite a large plain, and backed by a slope ('*Sessellage*'). The sites of Mainz-Linsenberg, Metternich, Rhens and Achenheim are in such a '*Sessellage*' position, which may be characteristic for settlements where occupation took place over longer periods. At such places there are rich settlement layers which have been only poorly investigated in the Rhineland. At Metternich the layer went through the brickyard in a 20 m wide band running from east to west, whereas at Mainz-Linsenberg the layer could be observed over a length of 30 m in a modern channel (Fig. 3).

Both at Mainz-Linsenberg and Heddesheim (Thieme and Lanser 1982) there were two types of fireplaces: small round pits lined with slabs of stones with a diameter of about 0.30 m and pebble layers on the surface with a 0.70 m (Mainz-Linsenberg) and 0.80 m (Heddesheim) diameter. A few approximately four metres wide and 0.15-0.20 m thick fireplaces were found at Metternich, consisting of arranged stone slabs with ashes and burned and split animal bones, where most of the flint artefacts were found (Günther 1907). Also at Mainz-Linsenberg and Heddesheim too, most of the finds (lithic artefacts, bones) were concentrated around the fireplaces.

At Mainz-Linsenberg there were 'stone arrangements' of one or two layers of slabs of limestone around the fireplaces. Besides, in a corner between two Roman and one modern channel another 'stone arrangement' was preserved, as well as a solid, floor-like place (*Tenne*), where at its boundary the (humid or wet) loess was moulded by hand into a small dam-like structure (Neeb and Schmidtgen 1921/24). Of this interesting feature only a triangular segment (1.80 x 0.60 m) with part of the uplifted edge was preserved. The added sketch of the profile shows that the *Tenne* was about 0.25-0.30 m deeper than the 'stone arrangement', this means that it was deepened into the surface (Fig. 3).

One of the female figurines from Mainz-Linsenberg, made of sandstone, was found in a small hand-size depression to the west of the smaller fireplace (at "B" in Fig. 3).

Besides these sites in a sheltered topographical position, a rich settlement layer with ash layers and some fireplaces partly in pits lined with stone slabs was also observed in the Wildscheuer cave (layer IV; Terberger 1993).

Other sites such as Sprendlingen and Plaidter Hummerich are located on hills, in exposed places with a good view in every direction. The site of Sprendlingen (Bosinski *et al.* 1985) is situated on the Napoleonshöhe at the Rheinhessische

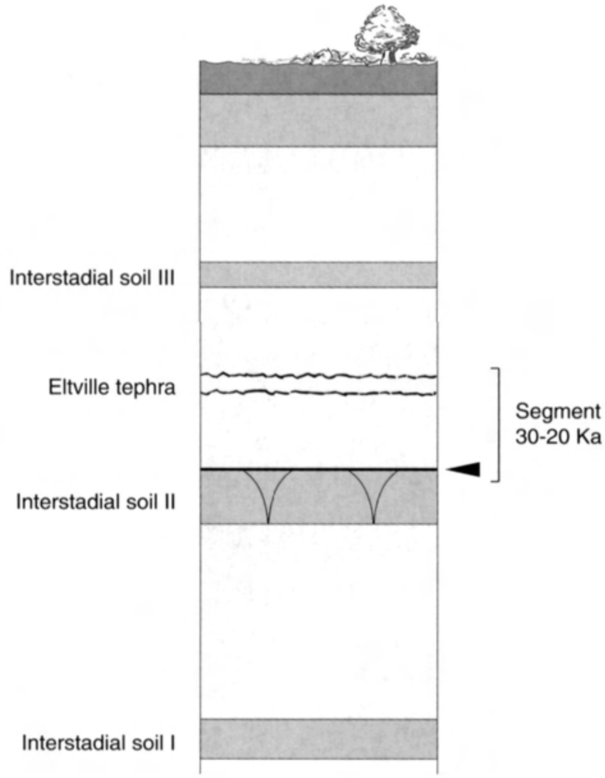

Fig. 2. Schematic Upper Würmian loess section in the Rhineland. The arrow indicates the find horizon at Mainz-Linsenberg, Sprendlingen, and Metternich.

Plateau in a place where the present-day road (like probably the former reindeer herds) crosses the plateau at a narrow pass. Most of the site was already destroyed by sand quarrying activities before excavation. On the northern border of our excavation, a reddish layer of about 4.0 m wide was preserved, which contained most of the finds. It was possible to reconstruct the position of the fireplace further north. In the excavated part near the border of the reddish coloration was a larger limestone slab, surrounded by many artefacts and bones.

Most of the lithic artefacts are from this central part, while cores and pieces of raw material lay outside. Small backed implements as well as burin spalls were found in the reddish part. The burins and pointed blades occurred west of the reddish region, in what was probably an area of specialised activity.

In spite of the remnant nature of the inventory, many artefacts could be refitted. The middle distances (0.5-2.0 m)

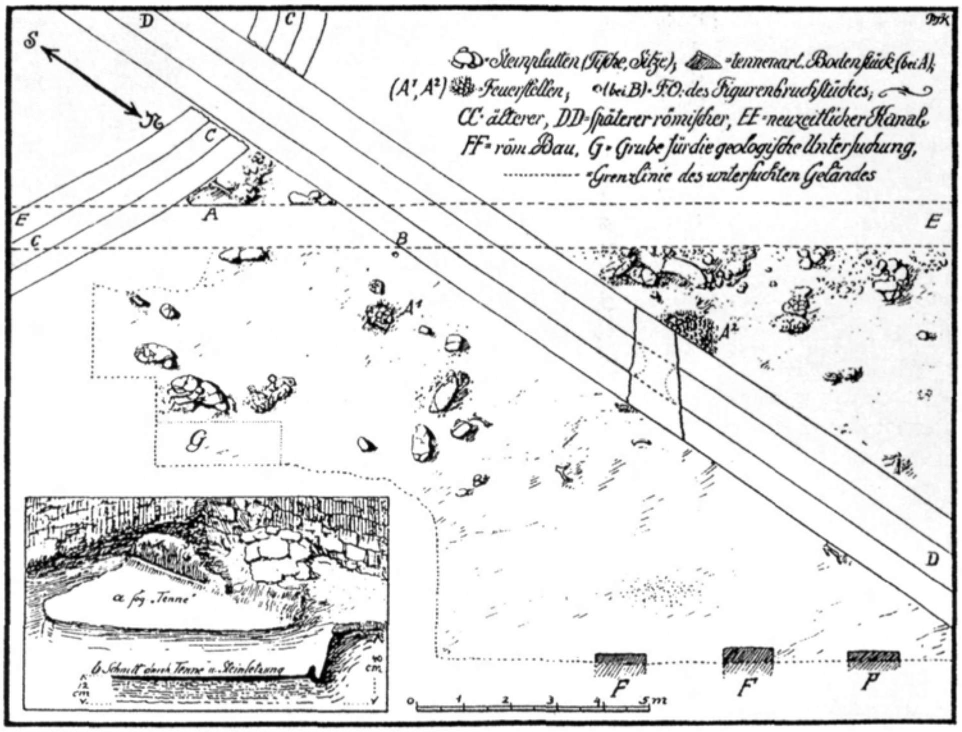

Fig. 3. Mainz-Linsenberg. Settlement features (after E. Neeb).

of the connection lines between refitted artefacts (n=49) dominate (53%, n=26) followed by short distances (< 0.5 m; 29%, n=14).

At Sprendlingen we found many Tertiary shells and snails. They are mostly fragmentary and rarely larger or complete specimens. Among the snails there are numerous fragments of *Tympanotonus margariceus*; unlike at Mainz-Linsenberg, there is not a single shell with an incision or perforation. The Tertiary shells and snails could be collected on the slope of the Napoleonshöhe. As at Szob near the Danube (Gábori 1969), this was a place for collecting Tertiary molluscs, which occur at other sites as perforated pieces of jewellery.

In spite of the largely destroyed feature, we tried to reconstruct a tent (Fig. 4). In our reconstruction the reddish coloured area corresponds to the interior with a fireplace and a working place (stone slab). Here the small backed tools, burin spalls, and endscrapers were used. The entrance was possibly to the southeast. Outside/west of the tent there was a working place with burins and pointed blades.

The finds of Mainz-Linsenberg and Sprendlingen are almost identical. Refitting of artefacts between the two sites has not proved possible. But the raw materials – chalcedony and silicified limestone – are almost identical and differ only in percentages of the varieties used. Some of the artefacts from both sites are almost certainly struck from the same nodule (Fehlings 1993).

Interesting are also the Tertiary snails. At Sprendlingen, at the source of the snails, the shells consist of only small specimen and mostly waste. By contrast, at Mainz-Linsenberg, far from the natural occurrences, there are only selected larger pieces with an incision for threading. So it is very likely that Mainz-Linsenberg was a long-term base camp and Sprendlingen a corresponding hunting camp, 28 km away.

On top of the Plaidter Hummerich (Bosinski *et al.* 1986), a Middle Pleistocene volcano in the Neuwied Basin, in the upper part of the loess in the crater filling, a fireplace, a piece of reindeer antler and two lithic artefacts testify to a short stay. It was a very exposed place, only lightly sheltered by the crater walls.

Finally, at the Adlerquelle in Wiesbaden and the Magdalenahöhle in the Eifel, there are 'special' sites. The Magdalenahöhle is a small narrow cave not very suitable as a settlement. Most of the finds, including several thin shed reindeer antlers, occurred around a fireplace in front of the cave. One of the antlers was ^{14}C dated to 25,540 ± 720 bp (Weiß 1978). Among the few (115) lithic artefacts there are no typical tools. Besides perforated teeth (deer, wolf) there are fragments of at least three ivory bracelets with a rectangular cross-section. The rings are decorated with groups of lines and dots and are without known parallels. The Adlerquelle is a hot thermal spring with a temperature of

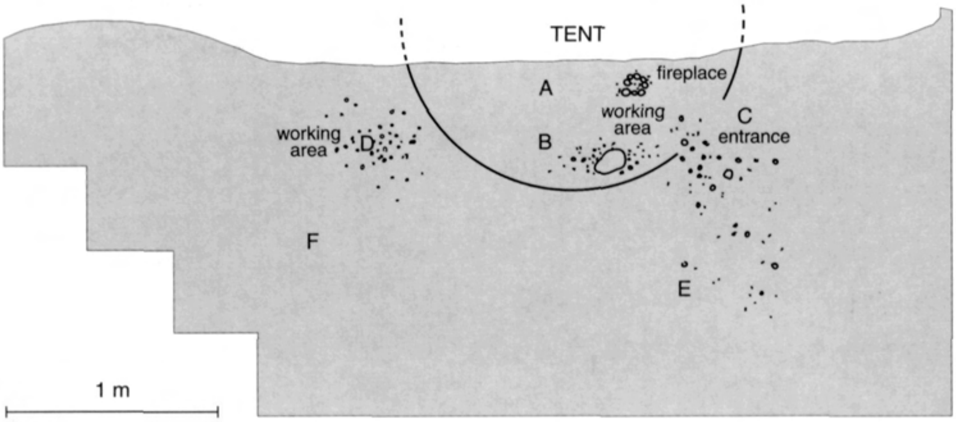

Fig. 4. Sprendlingen. Settlement features.

60°C, in the city of Wiesbaden. From boreholes connected with a new setting of the spring come lithic artefacts, bones, and plant remains (Floss 1991, 1995). The find horizon is 4.0-4.6 m below the surface in stream gravels. The odd-looking finds are covered by shiny pyrite and include tooth fragments (*Bos/Bison, Equus, Cervus, Sus*) and lithic artefacts including grinding stones (Fig. 5).

5. Subsistence

Generally we have to take into consideration that only the sites formed during the time of loess sedimentation are preserved and that the interstadial sites are mostly destroyed. The most important prey species were reindeer and horse (Table 1). Obviously settlement and subsistence were largely orientated to the reindeer and horse herds. At the almost destroyed site of Sprendlingen, reindeer dominates with at least 5 animals aged between 30 months and 8 years, while horse is also present. In spite of the fact that the assemblage was not uncovered during a proper excavation, at Heddesheim there are at least 10 horses and 6 reindeer represented. In the Magdalenahöhle reindeer is well attested, first of all by small shed antlers.

Besides reindeer and horse, mammoth and rhino also play a role. At Mainz-Linsenberg there are some rhino and possibly mammoth bones. From Heddesheim we know teeth and bones of at least three rhinos. In Wildscheuer IV, apart from reindeer and horse, there are numerous fragments of mammoth and rhino. In Rhens, rhino was especially numerous (Günther 1907, 1910).

At Metternich, Rhens and Adlerquelle reindeer is missing; instead red deer (*Cervus elaphus*) is represented. Especially at the big site of Metternich this could be fortuitous, and related to the biased character of the collection.

Bovids (*Bos/Bison*) occur only seldomly. Isolated bones are known from Wildscheuer IV, Heddesheim, Rhens, and Adlerquelle.

Bear is represented at Heddesheim and Rhens, ibex only at Heddesheim (including a skull fragment with horn core). Boar (tooth fragments) appears only at Adlerquelle; either this is a result of admixture (finds from drilling cores) or suids were present in this oasis-like biotope around the hot spring. Altogether one gets the impression of a population largely depending on reindeer and horse, besides which mammoth, rhino and deer were hunted. Subsistence was not only based on hunting, but also on plant gathering. This is indicated by grinding stones found at Adlerquelle and Sprendlingen (Fig. 5). Especially indicative is a grinding stone from Adlerquelle with distinct traces of grinding (i.e. polishing). These traces possibly resulted from grinding of grains (Floss 1991). Around the hot spring, the vegetation should have been richer than in the surrounding loess steppe. But also in the loess steppe are many edible plants, including wild cereals. The grinding stones from Adlerquelle and Sprendlingen testify to the importance of plant gathering. Outside the Rhineland, this is especially known from Kostenki IV, 1 (Rogačev 1955).

6. Mobility

Assuming that the siliceous rocks were not traded but occurred in the group's territory, the raw materials of the lithic artefacts may give an indication of the size of this territory. The raw material mostly occurs in an area less than

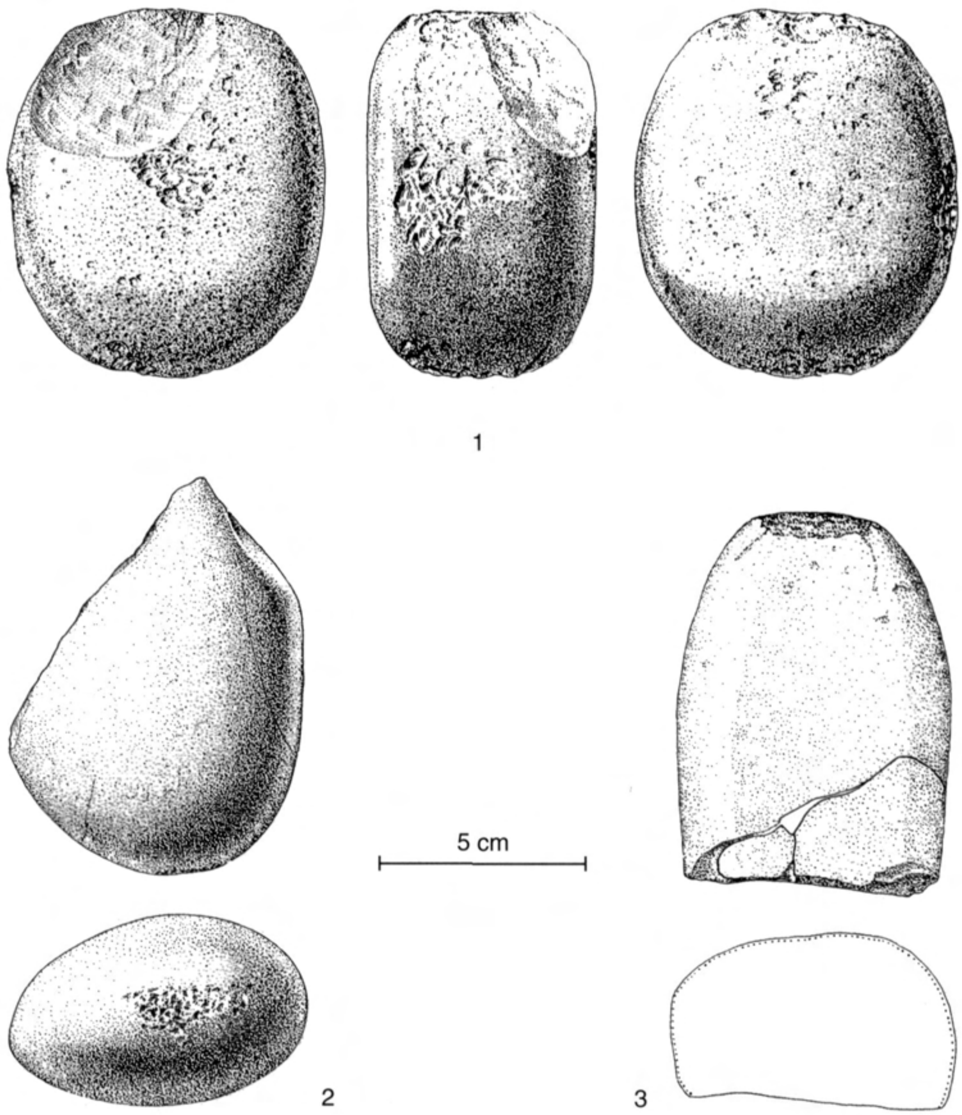

Fig. 5. Grinding stones from Wiesbaden-Adlerquelle (1-2) (after H. Floss), and Sprendlingen (3). Scale 2:3.

50 km from the site (Floss 1994). At Mainz-Linsenberg and Sprendlingen, and possibly also in Wildscheuer IV and Magdalenahöhle, all the artefacts were made from such regionally available siliceous rocks.

At Adlerquelle, besides the dominating artefacts from regional rocks, there are two long scraper-burins of 'baltic' flint, which occurs in a region more than 100 km to the north. At Metternich and Rhens most of the artefacts are of a kind of flint which according to Floss (1994) possibly comes from the Mons region (Belgium), about 200 km away. This indicates the utilization of a rather large territory.

From Mainz-Linsenberg there are 17 Mediterranean shells (including 15 *Homalopoma sanguineum*, 1 *Cyclope*). At Sprendlingen we found 9 perforated Mediterranean shells of *Cyclope* (3) and *Hinia* (6). A reconstruction showed that they were alternately strung and belonged to a bracelet or necklace (H. Bosinski 1985). These Mediterranean shells indicate contacts with the Mediterranean more than 1000 km away which may possibly be explained by trade (barter) with several intermediate places.

Table 1. Animals represented at Rhenish sites 30-20 kyr bp.

	Rangifer	*Equus*	*Coelodonta*	*Mammuthus*	*Cervus*	*Bos/Bison*	*Capra ibex*	*Ursus*	*Lupus*	*Alopex*	*Marmota*	*Sus*
Mainz-Linzenberg	•	•	•	?								
Sprendlingen	• (5)	•										
Heddesheim	• (6)	•(10)	• (3)			•	•	•	•	•		
Metternich		•			•							
Rhens			•		•	•		•				
Achenheim	•										•	
Adlerquelle		•			?	•						•
Plaidter Hummerich	•											
Wildscheuer IV	•	•	•	•	•	•						
Magdalenahöhle	•											

7. Conclusions

This short review of the Rhineland evidence shows that the lithic assemblages from our working area can be divided into two groups, i.e. assemblages with Font Robert points (Perigordian Va) and assemblages with many microgravettes (Perigordian VI/VII). Of the small sample of 15 sites, some were located in a sheltered topographic position (*Sessellage*), and yielded rich find layers which may be indicative of longer usage of the locations as base camps. Other sites were located on hills and had a good view in every direction. As for subsistence strategies, our sample is biased as only bones are preserved from sites formed during periods of loess sedimentation. Reindeer and horse are the most common species, with mammoth, rhino and deer also being a prey species. Grinding stones from Adlerquelle and Sprendlingen point to the importance of plant food. While most raw materials come from within a radius of approximately 50 km around the site, at the *Sessellage* sites of Metternich and Rhens most flints may have been imported from the Belgian Mons region, at a distance of 200 km. Mediterranean shells from Mainz-Linsenberg indicate contacts with areas at significantly larger distances, roughly 1000 km away.

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Gerhard Bosinski
Forschungsbereich Altsteinzeit
Schloss Monrepos
56567 Neuwied
Germany

Martin Street
Thomas Terberger

22 The German Upper Palaeolithic 35,000-15,000 bp. New dates and insights with emphasis on the Rhineland

The paper examines the existing radiocarbon dating evidence for the German Upper Palaeolithic between 35,000 and 15,000 bp (mainly from southern Germany) and presents a number of new results from other regions (Rhineland, Thuringia) obtained in collaboration with the Oxford Radiocarbon Accelerator Unit. Critical assessment of the increased total number of dates allows the recognition of phases broadly equivalent to the Early Upper Palaeolithic (Aurignacian) and Mid Upper Palaeolithic (Gravettian), but also suggests that there may be finer subdivisions within these phases or possibly overlap between them (e.g. at Breitenbach). The question of a late gravettian survival, possibly in the form of 'aurignacoid' industries, and of the Upper Pleniglacial hiatus in settlement is discussed. It is suggested that the period between 23,000 and 13,000 bp (which traditionally separates classic gravettian industries from the Upper Magdalenian) might profitably be re-examined in detail, both in Germany and in neighbouring regions.

1. Introduction

As in much of western and central Europe, the subdivision of the German Upper Palaeolithic has traditionally been based on typology. R.R. Schmidt's (1912: 104 ff.) monograph "Die diluviale Vorzeit Deutschlands" established for Germany the French system of subdivision we today know as Aurignacian, Gravettian and Magdalenian on the basis of type fossils and a few important stratigraphies, and for many years this was the only basis for a chronological attribution of archaeological assemblages. Absolute (radiometric) chronological methods became available only later; today the most reliable of these methods is radiocarbon dating, particularly when in the form of AMS measurements of critically selected single samples, and taking into account increasing possibilities for correction of radiocarbon years to true ages.

Thanks in large part to cooperation over several years with the Oxford Radiocarbon Accelerator Unit (ORAU), it has been possible to obtain many radiocarbon AMS dates for German, and especially for Rhineland assemblages and thus to obtain a better understanding of the absolute chronology of this period (Street *et al.* 1994; Hedges *et al.* 1998a, 1998b). This has been especially the case for late glacial magdalenian sites, the chronological and geographical distribution of which is now quite well understood (Housley *et al.* 1997; Street 1998a, 1998b; Street and Gaudzinski 1998; Street and Höck 1998), whereas for the older periods there has been (with notable exceptions) a deficit in the numbers of radiocarbon dates available.

2. Absolute dating of the German Early Upper Palaeolithic

2.1 State of research

Until the end of the 1980's, the only larger series of absolute dates available for the German Aurignacian were from the two south German cave sites of Vogelherd and Geißenklösterle and from the Rhineland open air site of Lommersum. These were complemented by isolated radiocarbon dates from further sites such as Hohlenstein-Stadel IV, Bockstein-Törle VII, Wildscheuer, Breitenbach (dating evidence summarised in Hahn 1977, 1989, 1993, 1995; Dombek and Hahn 1989). Overall, the dates showed a relatively clear concentration between *c.* 36,500 bp and 29,000 bp (24 dates), although eight dates were appreciably younger, and in some cases, e.g. Breitenbach (18,100 ± 200 bp; 12,320 ± 200 bp), were regarded as irrelevant for the cultural attribution of the assemblage (Richter 1987).

The appreciable number of younger, in some cases clearly too young (five dates <25,000 bp), radiocarbon dates made it difficult at this stage to establish a well-founded absolute chronological definition of the aurignacian technocomplex. The oldest dates from the Rhineland site of Lommersum were slightly younger than those from south Germany, but the series as a whole showed a parallel development.

The database available for dating the early Upper Palaeolithic has now increased appreciably (Fig. 1). In south Germany new AMS dates obtained by the ORAU suggest a relatively high age of up to 40,200 bp for layer IIIa at the Geißenklösterle (Hahn 1995), although the heterogeneity of dates from the layer generally and the high standard deviation (± 1600) of the oldest date in particular, call for caution in interpretation. Nevertheless, a degree of support for an early phase of the Aurignacian in southern Germany is provided by the recently discovered Bavarian open air site of Keilberg-Kirche, where conventional dating of charcoal yielded a very consistent series of three ages between 38,600 and 37,500 bp (Uthmeier 1996). Together, the two sites suggest that the early Aurignacian was indeed very probably present in southern Germany by *c*. 38,000 bp. The implications of these early German dates for the transition from the Middle to the Upper Palaeolithic (e.g. Richter 1996) remain to be discussed in detail in the light of new southwestern and southeastern European evidence (D'Errico *et al*. 1998; Duarte *et al*. 1999; Pettitt and Trinkaus in press).

2.2 New AMS dates

In collaboration with the ORAU and the University of Cambridge and in the context of the project "The German Aurignacian and the colonization of Northern Europe", the present authors have recently initiated the AMS dating of three sites located further to the north in Germany. In the case of two sites previously dated by the conventional radiocarbon method, Wildscheuer III (Terberger 1993) and Breitenbach B (Pohl 1958; Richter 1987), the ORAU results revise the dates for the sites (Fig. 1), while a third site, Wiesbaden Igstadt (Terberger 1992, 1998; Serangeli 1996; Pettitt *et al*. 1998; Street and Terberger 1999), was discovered only recently and had been undated. In general terms the Oxford AMS dates provide a broader basis than the conventional radiocarbon dates for the absolute chronology of the German Early Upper Palaeolithic and related questions.

2.3 Wildscheuer III

The interior of the Wildscheuer cave (now destroyed by quarrying) in the Lahn valley, east of Limburg, was excavated during the 19th century by von Cohausen, in a period of only a few weeks (Terberger 1993). Minor excavations at the beginning of the 20th century and especially the excavation of the cave platform by H.E. Mandera during the 1950's provide the most reliable information on stratigraphy (Mandera 1954). Above a layer with a few Middle Palaeolithic finds, preserved only in a fissure at the base of the section, Mandera discovered a well-defined "*terra rossa*" sediment (Layer III), containing aurignacian artefacts. Above this were a less clearly defined gravettian level (IV) and a largely destroyed layer (V) with magdalenian material.

Ten samples of bone, antler and ivory from the Wildscheuer cave kept in the Wiesbaden Museum were chosen for AMS dating. Samples with evidence of human manipulation were preferred and a range of materials/species was selected. Most samples fulfilling these criteria were from the Mandera excavation, although three specimens were from older investigations. Attribution to aurignacian Level III was helped by features such as adhering red sediment and the typically dark stained colour of the specimens.

Of the Wildscheuer III assemblage, all but one specimen of ivory yielded a result. The dates fall between 34,200 and 20,480 bp, although the youngest date can clearly be rejected for an aurignacian context, leaving the next youngest date as 28,340 bp. Even then, the dates cover a span of almost 6,000 radiocarbon years. There is no finer patterning between age and material/species dated and the mean age of the samples is *c*. 31,750 bp.

The large range of the Wildscheuer dates (Fig. 1) can be interpreted in several ways. The relatively small size of the assemblage and the homogeneous appearance of the material make it likely that the site was occupied over a relatively short period of time. The former interpretation would imply a methodological problem with the dates, which might be related to major fluctuations in the radiocarbon record at this period (Jöris and Weninger 1998, 1999). Alternatively, the site was indeed used on different occasions over a period of several millenia and the dates accurately reflect this. A similar spread of dates can be observed at other sites (e.g. Lommersum, Geißenklösterle IIIa), so that this phenomenon must in future be examined generally in order to assess the value of radiocarbon date series for the Aurignacian.

2.4 Breitenbach B

The Breitenbach site (Pohl 1958; Richter 1987) lies in eastern Germany. Two archaeological complexes exist at present, although these clearly belong together. The assemblage designated Breitenbach A was excavated by Niklasson in 1927 over a surface of 400 m^2 and is now stored at the Halle Museum in Sachsen-Anhalt, while Breitenbach B represents material originally (*c*. 1930) from the private collection Wlost, and now kept in the German National Museum in Nuremberg.

The geochronological position of the assemblage was discussed by Hahn (1977: 159), who, following P. Wolstedt and V. Toepfer, suggests that the assemblage was found within a soil horizon and possibly dates to just before the Stillfried B oscillation. Richter (1987: 65) is more cautious and suggests that ambiguous observations made in several test trenches across the large site are possibly only locally valid. It seems that geomorphology cannot give sufficiently precise information on the geochronology of the assemblage. Although two conventional radiocarbon dates already existed (Richter 1987), they were inconsistent with each other and with an aurignacian occupation.

Samples for AMS dating were taken from the Breitenbach B faunal material kept in Nuremberg and chosen to cover a range of species/materials. It was not possible to identify samples with unambiguous human modification due to poor surface preservation, but the association of the faunal remains and the lithic assemblage is supported by labels with the material which refer to a provenance in e.g. "*Schlagplatz 3*" and "*4*".

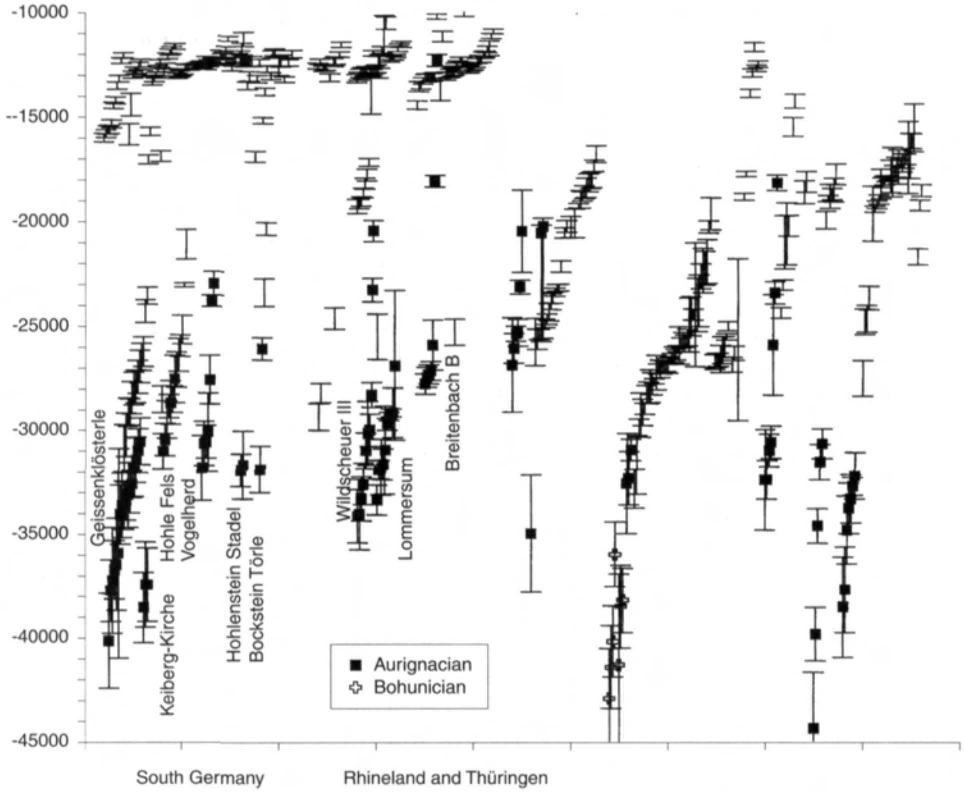

Fig. 1. Uncalibrated dates for the Aurignacian of Germany (at left of the diagram) and for selected aurignacian sites in eastern Central Europe (Austria: Alberndorf, Krems; Czech Republic: Bohunice, Stránská skála; Poland: Oblazowa Cave; Hungary: Istállóskö, Peskö; Bulgaria: Bacho Kiro). Aurignacian dates are represented by symbols; for comparison non-aurignacian dates are represented without symbol to one standard deviation.

The Breitenbach AMS results are somewhat younger than expected for an aurignacian context (Fig. 1), falling well within the period (30-20 kyr) treated by this volume. Nevertheless, the Oxford series is internally consistent and appears to be acceptable, thereby dating a very recent (youngest?) phase of the Aurignacian to the 28th millennium bp. By contrast, the reliability of a still younger conventional date (H 4059-3356: 26,133 ± 376) for the south German Bockstein Törle VII assemblage (Hahn 1977) is questionable, since a second date (H 4059-3527: 31,965 ± 790) from the same layer (Hahn *ibid.*) is appreciably older.

2.5 IMPLICATIONS OF NEW AURIGNACIAN DATING RESULTS

Of the 62 dates considered here, six (Table 1 in italics) are several thousand years younger than others in the series from the same site and therefore apparently have major errors. This may be due to contamination, since even a minute amount of younger material can have considerable implications for a date at this period, close to the limits of the radicarbon method (Mellars *et al.* 1987: 128; Haesaerts *et al.* 1996: 39; Pettitt this volume). The seriously deviant dates are commonly those obtained many years ago, although the new Wildscheuer series shows that even modern series of AMS dates can contain a single aberrant result. The youngest Wildscheuer AMS date (OxA-7498: 20,480 ± 360) was obtained on a specimen of ivory, a material which produced no result for a second Wildscheuer sample, and, in other contexts (e.g. magdalenian samples from Gönnersdorf and Andernach-Martinsberg) has produced anomalously young results.

The remaining, acceptable aurignacian dates show a trimodal distribution. The classic Aurignacian is present in southern Germany and the Rhineland from *c.* 34,000 bp, while in southern Germany earlier ages for the Aurignacian, obtained by both conventional and accelerator dating, are found at Geißenklösterle and Keilberg-Kirche. In view of these results it is questionable whether a proposed formal definition of the period 40-30 kyr as the Early Upper Palaeolithic (equated with the Aurignacian) is a useful concept. The third set of AMS dates from Breitenbach suggests that (at least in eastern Germany) the Aurignacian in fact persisted well into the following period of time 30-20 kyr, and specifically throw into sharper perspective the question of the absolute age of the end of the Aurignacian and its chronological distinction from and relationship to the Gravettian, and particularly to early gravettian industries such as those with Font Robert points. In particular, attention should be paid to potential regional differences.

3. Absolute dating of the German Mid Upper Palaeolithic

A review of the available German radiocarbon record (Fig. 2, Table 2) shows that most dates for gravettian industries fall before the last Pleniglacial, between 30,000 and 23,000 bp, results which are consistent with the European Gravettian/Pavlovian/*Périgordien supérieur* generally. The oldest potentially gravettian dates fall around 31,000 bp, although not all the dated samples can be unequivocally associated with clearly gravettian, rather than non-diagnostic industries, and there is thus a definite overlap between dates for the German Gravettian and for the Aurignacian until *c.* 27,000 bp (Breitenbach). The majority of gravettian dates lie before 25,000 bp, a feature shown particularly by the two sites with the largest series of dates, Hohle Fels and Geißenklösterle, where only two and three of the nine and fourteen 'gravettian' dates respectively are younger than this. Both dates from the Weinberghöhle also lie at the centre of this distribution.

The few dates from Obere Klause in Bavaria, the Kniegrotte in Thuringia and the Magdalenahöhle in the Eifel fall at the younger end of this range close to 25,000 bp. The Kniegrotte result, on a bear bone with clear marks of chopping, apparently documents human activity at the well-known magdalenian site at a period which was not hitherto demonstrated by the lithic assemblage, although some tools were described as "Gravette-Spitzen" (Feustel 1974).

Although the Gravettian of southwestern Germany is quite well dated by radiocarbon (see also Hahn, this volume and Scheer, this volume), the Rhineland Gravettian (Hahn 1969; Bosinski *et al.* 1985; Bosinski 1992, 1995a, 1995b, 1995c, this volume) is still inadequately dated by absolute methods. Only one western German site, the Magdalenahöhle, close to Gerolstein in the Eifel (Weiß 1978), is radiocarbon dated to the time range dealt with by this volume. Weniger (1990: 174) quotes a date of 25,540 ± 770 bp, given by Weiß (1978: 105) as 23,590 bc, and the single date for reindeer may not, in fact, be relevant to human activity at all.

Work is now in progress by the authors to obtain dates for the Gravettian in western Germany using samples stored in museums which were recovered by previous investigations at the sites of Metternich near Koblenz (Hahn 1969), Sprendlingen (Bosinski *et al.* 1985; Bosinski 1995a), Mainz-Linsenberg (Hahn 1969; Bosinski 1995b), and Wildscheuer IV (Mandera 1954; Terberger 1993) in the Lahn Valley.

4. The problem between 23-13 kyr

Although they are not numerous, a special problem is presented by radiocarbon dates younger than the main range established for the Gravettian, specifically those lying

Table 1. Uncalibrated dates for the German Aurignacian. Potential explanations for six dates rejected as too young from Vogelherd, Wildscheuer III and Breitenbach B (in italics) are discussed in the text.

KEILBERG-KIRCHE (Uthmeier 1996)		
	38,600 ± 1200	KN-4692
	37,500 ± 1450	KN-4690
	37,500 ± 1250	KN-4691
GEIßENKLÖSTERLE (Hahn 1995; Housley *et al.* 1997)		
IIIa	40,200 ± 1600	OxA-4595
IIIa	37,800 ± 1050	ETH-8267
III	37,300 ± 1800	OxA-5163
IIa	36,800 ± 1000	OxA-4594
III/8	36,450 ± 1570	H-5316-4909
III/7	36,000 ± 3560	H-5315-4908
III/6	34,140 ± 1000	H-5118-4600
IIa	33,700 ± 1100	OxA-5160
III/4	33,700 ± 825	H-4751-4404
IIIa	33,500 ± 640	ETH-8269
IIb	33,200 ± 1100	OxA-5162
IIIa	33,100 ± 680	ETH-8268
IIb/3	32,680 ± 470	Pta-2116
IIb/1	31,870 ± 1000	Pta-2270
IIa/2	31,525 ± 770	H-4279-3534
IIb/2	31,070 ± 750	Pta-2361
IIa/1	30,625 ± 796	H-4147-3346
VOGELHERD (Hahn 1977, 1993)		
V/7	31,900 ± 1100	H 4056-3208
IV/4	30,730 ± 750	H 4053-3211
V	30,650 ± 560	GrN-6661
V/5	30,162 ± 1340	H 4054-3210
IV-V	27,630 ± 830	GrN-6662
IV-V	*23,860 ± 190*	*GrN-6583*
V/6	*23,020 ± 400*	*H 4055-3209*
HOHLENSTEIN STADEL (Hahn 1977, 1995)		
IV	32,000 ± 550	H-3800-3025
IV	31,750 ± 1150	ETH-2877
BOCKSTEIN-TÖRLE VII (Hahn 1977, 1993)		
	31,965 ± 790	H-4059-3527
	26,133 ± 376	H 4059-3356

between 23,000 bp and the well-dated lateglacial Upper Magdalenian at around 13,000 bp (Fig. 3, Table 3). Dates of this period can be subdivided into different categories:

1. A first group of dates for both the Gravettian and the Aurignacian can clearly be regarded as aberrant and unreliable since they differ from larger series of older dates from the same context. This group can be rejected.
2. A second group is formed by dates from unclear context, such as the faunal remains from Aschenstein in Lower Saxony (Weniger 1990) dated to 18,820 ± 180 bp, but where an association with human activity is not demonstrated. Similarly, the dates of 25,000-15,000 bp from the Hohle Fels site must be excluded due to the presence of mixed samples and stratigraphic problems (Hahn 1995).
3. Dates which potentially indeed date a late Gravettian are those of 23,440 and 20,400 bp (mean = 21,920 bp) for Bockstein Törle VI. The dates, which were obtained many years ago, are associated with the industry containing a number of "aurignacoid"features (Hahn 1977: 297). The validity and interpretation of the Bockstein dates cannot be decided in the context of this paper, but comparable dates are also known from Austrian sites (Table 4) described variously as late Aurignacian like Albemdorf (Bachner *et al.* 1996), or late Gravettian, for example Langmannersdorf A and B, 20,260 bp and 20,580 bp respectively (Hahn 1977: 168), and Rosenburg, 20,120 bp (Ott 1996). In the case of Albemdorf only the two youngest dates (20,500 and 23,170 bp) lie in the problematic time range, while four dates are appreciably older, if still too young for a classic Aurignacian. In this they resemble rather the AMS date series from Breitenbach (see above). Furthermore, the interpretation of the Albemdorf dates is complicated by problems of stratigraphy and potential reworking of material (Bachner *et al.* 1996). Nevertheless, late 'aurignacoid' industries similar to Bockstein VI are also known from further east in Europe (Kozlowski 1996; Oliva 1996), being perhaps an equivalent to the contemporary French "Aurignacien V" (Peyrony and Peyrony 1938; Bazile 1996; Djindjian 1996), and this entire phenomenon has been recently examined in some detail (Palma di Cesnola and Montet White 1996). In the light of this it therefore seems possible that German industries with combinations of aurignacian and gravettian features could indeed also date to the period just before 20,000 bp.
4. A further group comprises dates which convincingly demonstrate a human presence during the period in question. Here must be mentioned the series of dates from the Hessian site of Wiesbaden-Igstadt (Terberger 1998; Street and Terberger 1999). The lithic assemblage was believed to be Aurignacian and the site was included in the ORAU and University of Cambridge dating project described above. Whereas the consistent

Table 1 continued.

LOMMERSUM (Hahn 1989)			
IIc-1	33,420 ± 500	GrN-6191	
IIc-2	31,950 ± 320	GrN-6699	
IIc-3	31,882 ± 950	H 4148-3356	
IIc-5	31,700 ± 520	Pta-2753	
IIc-4	31,000 ± 1500	H 4745-4144	
IIc-8	29,730 ± 150	Pta-2937	
IIc-7	29,390 ± 140	Pta-2912	
IIc-6	29,210 ± 140	Pta-2918	
IIc-8	29,200 ± 850	Pta-3079	
IIc-7	26,930 ± 2540	Pta-2939	
WILDSCHEUER III (Pettitt *et al.* 1998)			
	34,200 ± 900	OxA-7394	
	34,100 ± 1200	OxA-6920	
	33,350 ± 750	OxA-7393	
	32,650 ± 700	OxA-7390	
	31,050 ± 600	OxA-7392	
	30,200 ± 1100	OxA-7499	
	30,050 ± 550	OxA-6807	
	28,340 ± 420	OxA-7391	
	23,300 ± 400 ?	*KN-3595*	
	20,480 ± 360 ?	*OxA-7498*	
BREITENBACH B (Richter 1987: 92; Street and Terberger, this volume)			
	27,800 ± 340	OxA-8512	*Mammuthus primigenius* mandible?
	27,480 ± 340	OxA-8511	*Equus* sp. pelvis
	27,340 ± 320	OxA-8509	*Rangifer tarandus* skull
	27,180 ± 320	OxA-8510	*Rangifer tarandus* shed antler
	25,950 ± 850	OxA-8513	*Mammuthus primigenius* limb bone shaft
	18,100 ± 200 ?	*KN-3332*	*Mammuthus* bone (mandible)
	12,320 ± 200 ?	*KN-3620*	*Mammuthus* ivory

Table 2. Uncalibrated dates for the German Gravettian. The interpretation of dates younger than 23,000 bp from Hohle Fels, Bockstein VI and Geißenklösterle (italics) is discussed in the text. The date for the Magdalenahöhle is possibly unconnected to human activity.

MAGDALENA-HÖHLE (Weiß 1978)		
	25,540 ± 770	BONN-1568
HOHLE FELS SCHELKLINGEN (Weniger 1990; Hahn 1995; Housley *et al.* 1997)		
IV-12	31,100 ± 600	OxA-4600
III-13	30,550 ± 550	OxA-4601
	29,550 ± 650	OxA-5007
IIc-11	28,920 ± 400	OxA-4599
	28,750 ± 750	OxA-4980
I-9	28,580 ± 460	OxA-4597
	27,600 ± 800	OxA-4979
	27,150 ± 600	OxA-4978
	26,450 ± 550	OxA-4976
IIc-10	26,000 ± 360	OxA-4598
	25,240 ± 480	OxA-4974
IIb	23,100 ± 70	Pta-2746
IIb	*21,160 ± 500*	*H 5314-4899*
GEIßENKLÖSTERLE Ia (Hahn 1995; Housley *et al.* 1997)		
	30,950 ± 800	OxA-4856
Ic	30,300 ± 750	OxA-5161
It	29,200 ± 500	OxA-4593
It	29,200 ± 460	OxA-4592
It	28,500 ± 550	OxA-5228
Is	28,050 ± 550	OxA-5227
It	27,950 ± 550	OxA-5229
Ir	27,500 ± 550	OxA-4857
Ir	27,000 ± 550	OxA-4855
It	26,540 ± 460	OxA-5226
Ir	26,300 ± 500	OxA-5159
	24,360 ± 380	OxA-5157
Ia	23,625 ± 290	H-5117-4568
	16,940 ± 380	*OxA-5156*
WEINBERGHÖHLE (Weniger 1990)		
	29,410 ± 470	GrN-5000
	28,265 ± 325	GrN-6059
OBERE KLAUSE (Hedges *et al.* 1997)		
	24,680 ± 360	OxA-5721

Table 2 continued.

BOCKSTEIN-TÖRLE VI (Hahn 1977; Weniger 1990)		
	23,440 ± 290	*H-4058-3526*
	20,400 ± 220	*H 4058-3355*
KNIEGROTTE (Street and Höck 1998)		
	25,340 ± 440	OxA-4847

dating results for Wildscheuer III (Pettitt *et al.* 1998) and Breitenbach B confirmed the expected aurignacian age of the assemblages, results from Wiesbaden-Igstadt were completely unexpected, yielding a *quasi* Pleniglacial age for the assemblage (Pettitt *et al.* 1998). It is now believed that the assemblage can possibly be compared with contemporary French Badegoulian industries (Schmider 1971, 1989, 1990) and also shows similarities with industries further east such as Grubgraben Layer III in Austria (Montet White 1990; Brandtner 1996) (Table 4).

5. A final group consists of dates (Table 5) which possibly reflect a magdalenian presence in Central Europe earlier than the Upper Magdalenian which is well attested in northern Europe by *c.* 13,000 bp (Charles 1993, 1996; Housley *et al.* 1997). Dates for the southern German open air site of Munzingen have been discussed as possibly representing such an early phase of magdalenian occupation (Pasda 1994, 1998) and in northwestern Switzerland an assemblage from Kastelhöhle-Nord (Leesch 1993) must also be mentioned in the context of early magdalenian occupation, although no radiocarbon dates are yet available. Work is now in progress to obtain new dates for the relevant middle layer of the cave and for other sites with potentially early magdalenian occupation.

Although the subject of the post Pleniglacial recolonisation of central and northern Europe (Housley *et al.* 1997) lies outside the scope of this paper, it can at least be stated that the idea that Europe was totally deserted by man from the onset of the Pleniglacial at 20,000 bp until the appearance of upper magdalenian industries after *c.* 13,500 bp (e.g. Gamble 1986; Bosinski 1990; Soffer and Gamble 1990; Weniger 1990) must probably be revised or at least qualified. If before 23,000 bp the region was occupied by 'classic' gravettian industries, after this period we can recognise a number of industries with broadly 'aurignacoid' characteristics, dating to *c.* 23,000-20,000 bp and 19,000-17,000 bp, while still younger dates have been interpreted as showing a relatively early magdalenian presence.

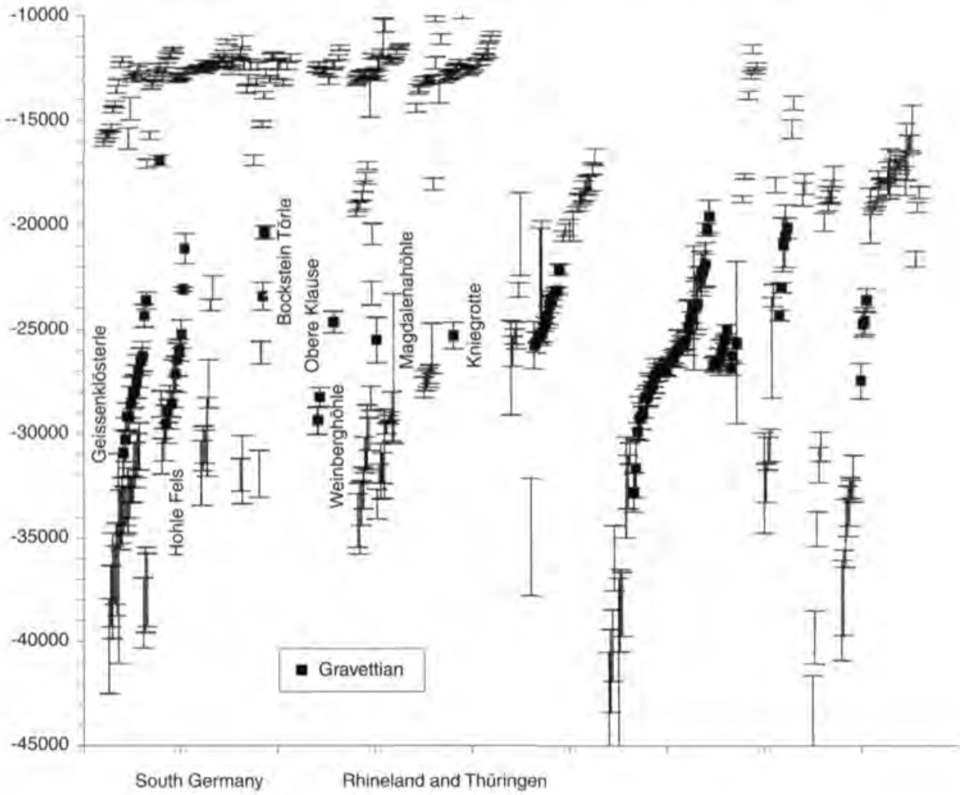

Fig. 2. Uncalibrated dates for the Gravettian of Germany (at left of the diagram) and for selected gravettian sites in eastern Central Europe (Austria: Willendorf; Czech Republic: Dolní Věstonice, Pavlov, Předmostí, Bulhary; Poland: Spadzista Street; Roumania: Mitoc Malu Galben). Gravettian dates are represented by symbols; for comparison non-gravettian dates are represented without symbol to one standard deviation.

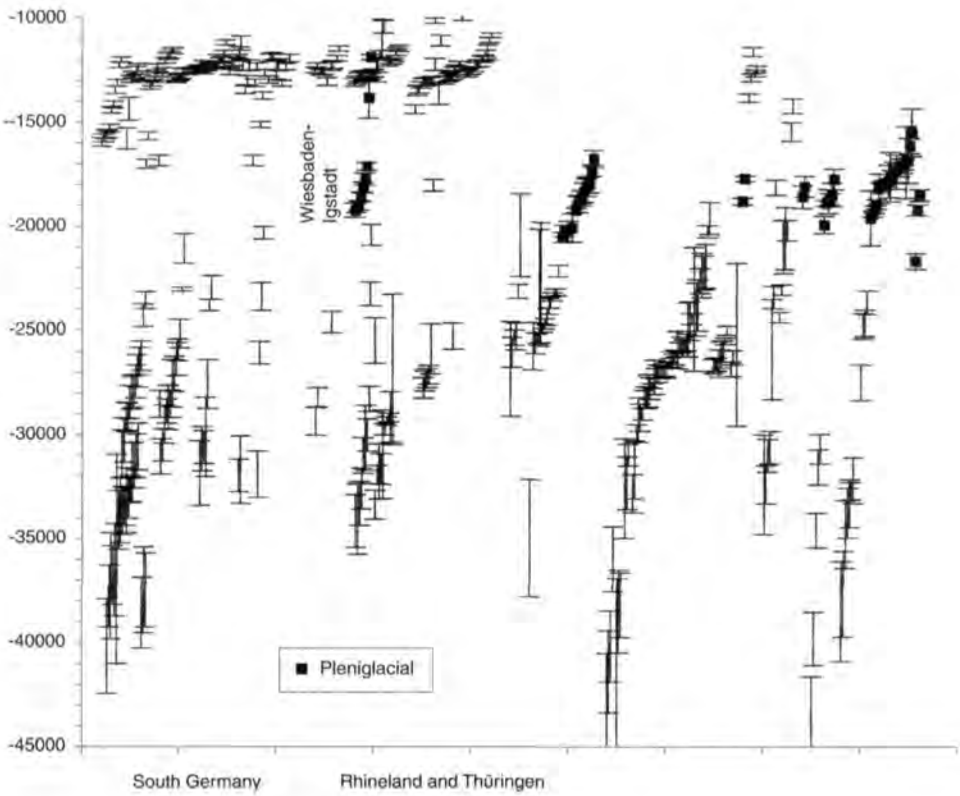

Fig. 3. Uncalibrated dates for the Pleniglacial of Germany (at left of the diagram) and for selected Pleniglacial sites in eastern Central Europe (Austria: Grubgraben; Czech Republic: Stránská skála IV; Slovakia: Kasov, Moravany-Zalovska; Hungary: Mogyorós-bánya, Sagvar, Madaras, Arka, Jászefelsószentgyörgy; Moldavia: Cosautsi, Ciuntu Cave, Brinzeni). Pleniglacial dates are represented by symbols; for comparison non-Pleniglacial dates are represented without symbol to one standard deviation.

Table 3. Uncalibrated German dates close to the Pleniglacial. The dates in italics are to be rejected either on methodological grounds (Wiesbaden-Igstadt) or are probably unassociated with human activity (Aschenstein, see text).

WIESBADEN-IGSTADT (Pettitt *et al.* 1998)	
19,320 ± 240	OxA-7502
19,200 ± 160	OxA-7406
19,080 ± 160	OxA-6808
18,670 ± 160	OxA-6809
18,220 ± 180	OxA-7501
17,820 ± 200	OxA-7500
17,210 ± 135	UZ-3768
13,940 ± 690	*Hd-15742-15440*
12,000 ± 90	*UZ-3767*
ASCHENSTEIN (Weniger 1990)	
18,820 ± 180	*KN-2712*

5. Summary

This paper has attempted to review the German Upper Palaeolithic absolute dating evidence for the period 30,000-20,000 bp against the background of the preceding and succeeding periods. The quantity and quality of the evidence is very different according to region and period. Generally, southern Germany has until now had the larger and more comprehensive series of absolute dates, although even here the total number of dated sites is not large.

Certain general trends can be recognised. The German aurignacian dates show a tripartite division. One group of dates before 35,000 bp is found only in southern Germany at Geißenklösterle and Keilberg-Kirche, obtained both by conventional and AMS measurement of wood charcoal and bone respectively. The second and largest group of dates lies between 35,000 and 29,000 bp and includes sites in southern Germany and the Rhineland. Younger than this is the series of dates between 28,000 and 27,000 bp for Breitenbach B in Thuringia (with a potential parallel in Albemdorf, Austria), which are therefore similar to dates for the Gravettian. It is unclear whether this perhaps implies a more complex relationship between the two traditions than a simple chronological succession. Further series of dates are necessary to verify whether the apparent overlap between the Aurignacian and Gravettian of some 3,000 radiocarbon years can be confirmed at other sites, and how this potentially parallel existence of different lithic traditions (in different regions?) could be interpreted (a question discussed by Weißmüller 1997). It should however be stressed that no interstratification of the two traditions is yet known from

Table 4. Selected uncalibrated dates for the 'Epi-Aurignacian', 'Epigravettian' and Badegoulian / Lower Magdalenian of neighbouring regions. It is unclear whether the youngest dates from Alberndorf (italics) can be accepted as valid or are to be rejected on methodological grounds. Dates for the Moldavian sites of Cosautsi (Damblon *et al.* 1996) and Ciuntu Cave (Hedges *et al.* 1996) are not listed here, but they are included in Fig. 3.

AUSTRIA:	
LANGMANNERSDORF A and B (Hahn 1977)	
20,580 ± 170	GrN-6659
20,260 ± 200	GrN-6660
GROßWEIKERSDORF (Gilot 1997)	
20,300 ± 360	Lv-1755
ROSENBURG (Ott 1996)	
20,120 ± 480	Lv-1756
ALBERNDORF (Bachner *et al.* 1996)	
26,900 ± 1600	VRI-1374
26,100 ± 500	VRI-1537
25,400 ± 260	ETH-13040
25,350 ± 450	VRI-1536
23,170 ± 230	*ETH-13041*
20,500 ± 1400	*VRI-1272*
GRUBGRABEN (Damblon *et al.* 1996)	
19,270 ± 80	GrN-21790
18,960 ± 290	AA-1746
18,820 ± 160	GrN-21893
18,620 ± 220	Lv-1822
18,400 ± 330	Lv-1680
18,170 ± 300	Lv-1660
18,070 ± 270	Lv-1823
18,030 ± 270	Lv-1810
17,350 ± 190	Lv-1821
16,800 ± 280	Lv-1825
CZECH REPUBLIC:	
STRÁNSKÁ SKÁLA IV (Svoboda *et al.* 1991)	
18,820 ± 120	GrN-13945
17,740 ± 90	GrN-14351
SLOVAKIA (Hromada and Kozlowski 1995: 84):	
KASOV	
18,600 ± 390	Gd-6569

Table 4 continued.

MORAVANY-ZAKOVSKA	
18,100 ± 350	Gd-4915
CEJKOV (Bárta and Bánesz 1987: 24)	
19,600 ± 340	KN-14
19,755 ± 240	"Berlin"
HUNGARY (Hromada and Kozlowski 1995: 84): MOGYORÓSBÁNYA	
19,930 ± 300	Deb-1169
SAGVAR (lower level)	
18,900 ± 100	GrN-1783
MADARAS	
18,805 ± 405	Hv-1619
ARKA	
18,700 ± 190	A518
JÁSZEFELSÓSZENTGYÖRGY	
18,500 ± 400	Deb-1647
SAGVAR (upper level)	
17,760 ± 350	GrN-4038
FRANCE: LAUGERIE HAUTE EST (Délibrias *et al.* 1976)	
18,260 ± 360	Ly-972
17,040 ± 440	Ly-973
CUZOUL DE VERS (Chollet 1989)	
18,400 ± 200	Gif-6798
18,300 ± 200	Gif-6370
16,800 ± 170	Gif-6371
15,980 ± 150	Gif-6638
ABRI FRITSCH (Chollet 1989; Schmider 1990)	
17,980 ± 150	Gif-1124
17,130 ± 350	Ly-1121
PÉGOURIÉ (Séronie-Vivien *et al.* 1981; Lorblanchet 1989)	
17,490 ± 520	Ly-1394
17,420 ± 390	Ly-1836
17,320 ± 460	Ly-1834
LASSAC (Délibrias *et al.* 1976)	
16,750 ± 250	Gif-2981

Table 5. Uncalibrated dates for selected German sites with a possibly early magdalenian presence.

HOHLE FELS (Weniger 1990; Hahn 1995; Housley *et al.* 1997)	
17,100 ± 150	H-5120-4569
15,760 ± 140	H-5313-4898
MUNZINGEN (Weniger 1990; Hahn 1995; Housley *et al.* 1997; Pasda 1998)	
16,060 ± 140	OxA-4785
15,870 ± 135	H-4156-3373
15,700 ± 135	ETH-7499
15,670 ± 140	OxA-4786
15,400 ± 130	OxA-4783
14,510 ± 110	OxA-4784
14,270 ± 120	OxA-4788
13,560 ± 120	ETH-7500
13,230 ± 110	OxA-4820
12,370 ± 100	OxA-4787
12,130 ± 95	H-4738-4660
SPITZBUBENHÖHLE (Weniger 1990)	
15,230 ± 100	H-4149-3348
13,840 ± 120	H-4314-3715
12,747 ± 110	H-4052-3212

Germany or indeed from Central Europe. By contrast, all well-documented and dated stratigraphies suggest that the Gravettian replaced the Aurignacian by *c*. 30,000 bp (Hahn 1995; Haesaerts *et al.* 1996).

There is still an urgent need to obtain absolute dates for the Rhineland gravettian sites, and this work is now in progress by the authors and the ORAU laboratory. By contrast, the south German sites of Hohle Fels and Geißenklösterle have consistent series of gravettian dates between 31,000 and 25,000 bp, and most dates from other, less comprehensively dated south German gravettian sites fall into the same range, only a few dates being younger. Almost all of the younger 'gravettian' dates can probably be rejected on methodological or contextual grounds, although the existence of a younger, 'aurignacoid' gravettian assemblage at Bockstein Törle VI must still be considered a possibility.

It would be desirable to re-examine, and where possible, critically date this phenomenon of 'aurignacoid' industries in order to understand better the nature of the changes which took place at the end of the Gravettian, probably as a reaction to the onset of Pleniglacial conditions. That the Pleniglacial cooling did not simply lead to the rapid and complete desertion of Central Europe seems increasingly

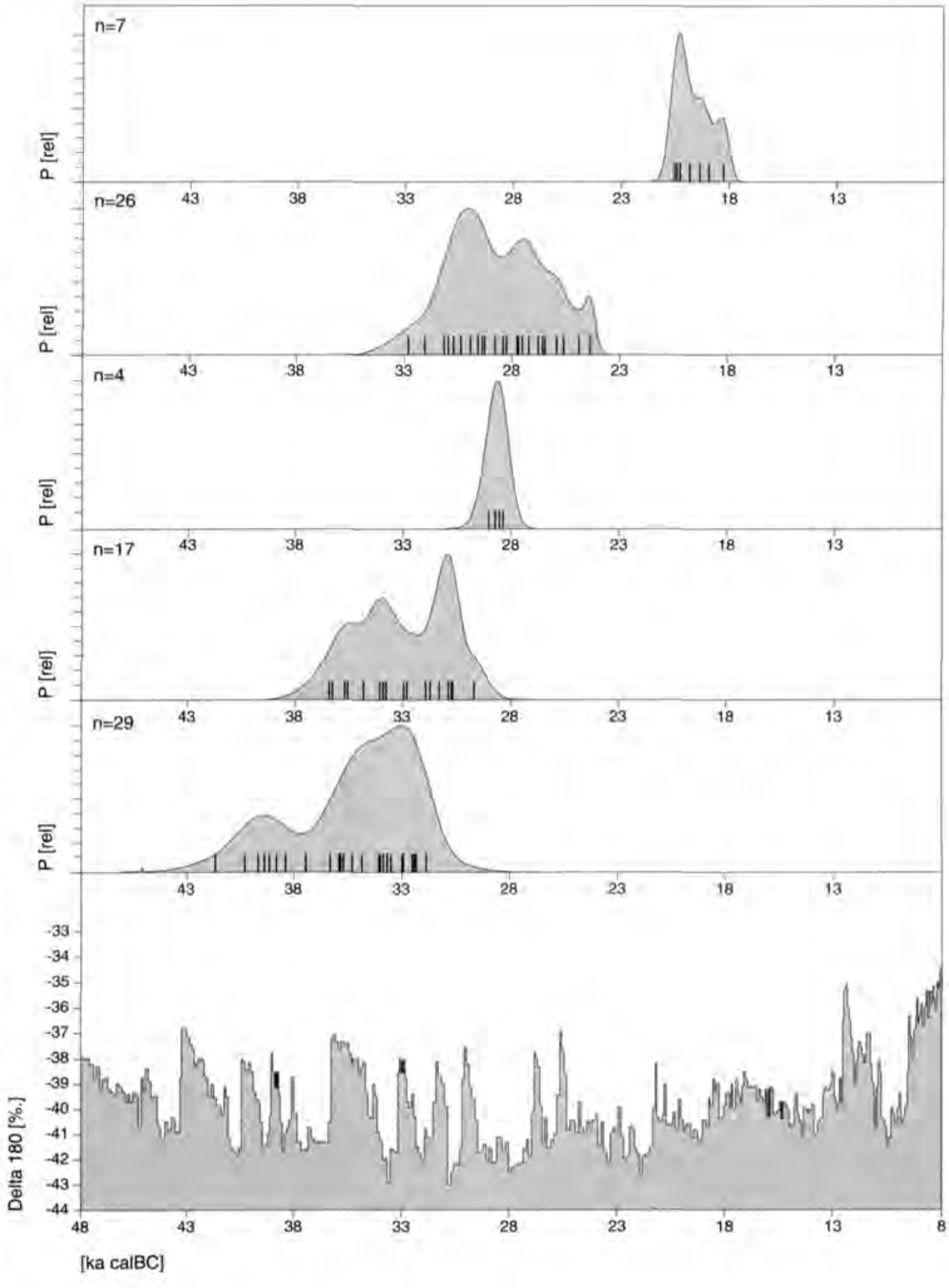

Fig. 4. Calibrated dates for the south German Aurignacian, the Rhineland and Thuringian Aurignacian, the German Gravettian and the quasi Pleniglacial Rhineland site of Wiesbaden-Igstadt (calibration using the CalPal program of Jöris and Weninger, version August 1999). The comparison of calibrated radiocarbon ages with climatic data derived from Greenland ice cores (here GISP2) will potentially allow critically dated Upper Palaeolithic archaeological assemblages to be precisely attributed to specific climatic events (see also Weißmüller 1997).
The uncalibrated dates which form the basis of the calibration (after O. Jöris and B. Weniger perhaps more neutrally expressed as "calendric conversion") are listed in tables 1-3. Not included in the 'calendric conversion' are all the dates from the tables printed in italics, although an exception was made in the case of the Magdalenahöhle (where human association is not clear), since this *is the only radiometrically dated site* from the period in the Rhineland. Also left out of the conversion are five aurignacian dates from southern Germany (Vogelherd, Hohle Fels, Bockstein-Törle) and the Rhineland (Lommersum), which appear too young in comparison with the remaining dates from the respective sites. Only the four very coherent dates from Breitenbach B were included in figure 4.

probable. Evidence for the complex and rapid succession of short-term climatic events preserved in Greenland ice cores makes it more likely that Central Europe could have been visited sporadically on several occasions during much of the period between 23,000-15,000 bp (Fig. 4). Wiesbaden-Igstadt, apparently contemporary with the French Badegoulian, probably represents one such 'incursion' and similar events may potentially have taken place earlier, in the form of 'aurignacoid' gravettian industries or later, in the form of typologically more ancient magdalenian industries. It nevertheless seems clear that these phenomena remained ephemeral and that the main upper magdalenian expansion only occurred in the late glacial between *c.* 13,500 and 12,500 bp.

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Martin Street
Forschungsbereich Altsteinzeit des
Römisch-Germanischen Zentralmuseums Mainz
Schloss Monrepos
56567 Neuwied
Germany

Thomas Terberger
Institut für Ur- und Frühgeschichte
der Universität Greifswald
Hans-Falladastrasse 1
17487 Greifswald
Germany

Wil Roebroeks

23 A marginal matter: the human occupation of northwestern Europe – 30,000 to 20,000 years bp

Northwestern Europe has yielded only few traces of occupation in the 30 to 20 kyr bp time period, and their study is limited by the early date at which most key sites were excavated. The area was severely affected by Late Pleistocene climatic fluctuations; occupation was intermittent, as illustrated by recently reported dates from Paviland Cave (Wales), and may have taken place within far-flung hunting and collecting excursions from base camps situated in the south and southeast of the area at stake here. In these excursions, marine resources may have played a more significant role than hitherto acknowledged.

1. Introduction

This paper gives a short survey of the traces of human occupation of northwestern Europe, taken here to include Great Britain, the Low Countries and northern France. The richest area is the southern part of Belgium, and most data presented here come from that area, though AMS dating has recently put Britain firmly on the gravettian map too (Aldhouse-Green and Pettitt 1998). We will see that traces of occupation are rather meagre in northwestern Europe, and that they are basically limited to the southern rim of the northern plains. The paper first addresses the palaeoenvironment of the area, then focuses on the history and quality of the archaeological record and moves from there to a discussion of the chronological evidence. Next, raw materials, burials and art come into focus, and these combined data are put to use in a series of inter-site comparisons. The pattern thus established will be discussed in the final part.

2. Palaeoenvironment

The northwestern part of Europe was severely affected by Late Pleistocene climatic fluctuations, and the land-sea division was significantly different from the actual one. As extensive ice sheets accumulated during the period at stake, the sea level was 75 to 125 metres below the present level, with Britain attached to the European mainland and much of the North Sea dry land, as testified by the large amounts of Weichselian mammal bones recovered from the bottom of the North Sea in the nets of present-day fishermen (Kolfschoten and Laban 1995). The course of the rivers Rhine and Meuse continued southwest from their present mouth, and ended, joined by the waters of the Thames, somewhere between the extreme southwest of present-day England and Brittanny (cf. Zagwijn 1975).

The sedimentary and vegetational records from this area are discontinuous, and most represent rather short time intervals only. Kolstrup (1995) has recently used the various data from vegetational records, frost wedge casts, aeolian and other periglacial processes to make inferences on palaeoenvironmental conditions in northern Europe during the 50 to 10 kyr bp time period (see also Huijzer and Vandenberghe 1998). In most cases, the vegetations from this period represent pioneer stages, with a dominance of plants that tolerate or prefer raw soils associated with unstable soil surface conditions. Often, time simply seemed too short for the establishment of a stable and continuous plant cover that could protect the soil against erosion and provide a soil development where for example trees could thrive (Kolstrup 1995: 41). The mean July temperatures reconstructed from various plant taxa are about ten degrees Celsius for many intervals, but other parts may have been a few degrees warmer as deduced from plant and beetle remains. A recent estimate of the mean temperature during the coldest month in the 27-20 kyr bp interval, based on periglacial and Coleoptera data, suggests a temperature of between -25 and -20 degrees Celsius. The same data yielded estimates of the mean annual temperature from about -8 to -4 degrees Celsius (Huijzer and Vandenberghe 1998).

The 30 to 20 kyr bp interval is characterised by the regular occurrence of frost wedge casts and hence permafrost, while slope deposits with cold soil surface conditions occur in the latter half of this interval. This part of the interval also sees the onset of the Pleniglacial loess deposition, which had a very high rate around the formation of the Eltville tephra layer, at about 16 kyr bp (Juvigné and Wintle 1988; cf. Bosinski, this volume). Kolstrup stresses the swift environmental changes that occurred through time, and the high diversity of subenvironments even over short distances. In spite of a generally dry environment, there was enough water for plants to grow – as testified by the large number of mammalian remains recovered from deposits of the 30 to 20 kyr bp range. The interaction of these Pleistocene

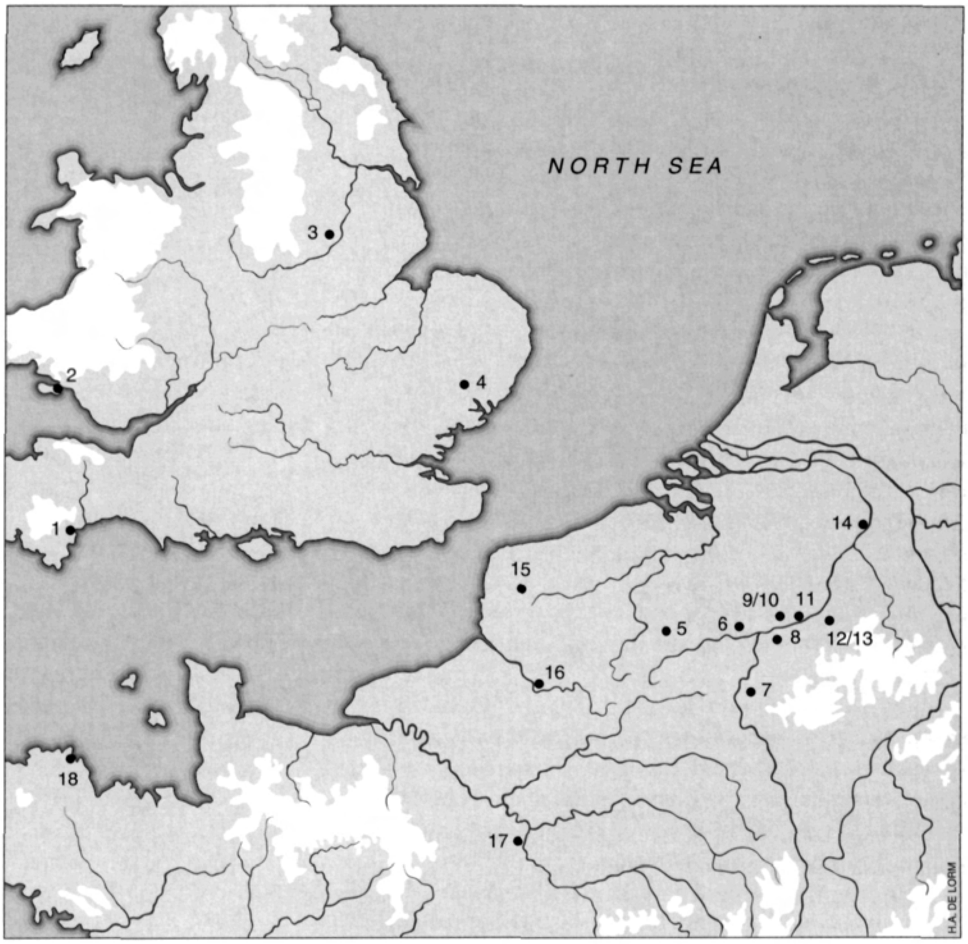

Fig. 1. Mid Upper Palaeolithic sites in northwestern Europe, mentioned in the text:
1. Kent's Cavern; 2. Paviland cave; 3. Pin Hole; 4. Bramford Road; 5. Maisières-Canal; 6. Spy; 7. Trou Magrite; 8. Goyet; 9. and 10. Trou du Chena (Moha) and La Station de l'Hermitage (Huccorgne); 11. Engis; 12. Fonds-de-Forêt; 13. *Grotte Walou*; 14. *Venray*; 15. Elnes; 16. Renancourt-lès-Amiens; 17. Le Cirque de la Patrie (Nemours); 18. Plasenn-al-Lomm (Ile-de-Bréha).

environments with the diverse animal community (Guthrie and Van Kolfschoten, this volume) created a unique Pleistocene mixture that Guthrie (1990) has described as the Mammoth Steppe.

Apart from these general data on the palaeoenvironment of the area between 30 and 20 kyr bp, specific information on the environmental background of the Gravettians' presence is limited to the Belgian open air sites of Maisières-Canal and Huccorgne and the faunal evidence from some of the cave sites. For Maisières the faunal remains indicate a kind of steppe-tundra environment, with open wooded areas along water courses. The rich mammal fauna includes remains of brown bear, polar fox, mammoth, horse and reindeer (Gautier *et al.* 1973). The last three species were also recovered during the recent excavations at Huccorgne (Otte *et al.* 1993).

The absence of provenance data for most cave finds makes it difficult to characterise the faunas associated with the gravettian occupation, though reindeer and horse are among the animals Otte (1979) was able to assign to the cave Gravettian. Compared to the Aurignacian, mammoth and woolly rhino are rare in the Belgian caves (Otte 1979: 625). Mammoth was present during the whole 30-20 kyr bp interval though: recently excavated mammoth remains from the open air site of Huccorgne (Straus *et al.* 1997) date from the first half of the interval, while at Paviland (Wales) they are said to occur up to 21-22 kyr bp (Aldhouse-Green and Pettitt 1998). Finally, Larsson (this volume) shows that mammoth was present further north almost throughout the 30-20 kyr bp range. Beside mammoth, Paviland cave has yielded quite a number of large mammals from the period 30 to 20 kyr bp, e.g. bovids, horses, hyaena, wolf and bear (Aldhouse-Green and Pettitt 1998: table 1).

3. The archaeological record

The area reviewed here attracted attention from antiquarians in a very early phase of the development of the discipline of archaeology, and many sites of relevance to the period at stake had already been excavated before the end of the nineteenth century. Thus, in 1823 Buckland uncovered a human skeleton associated with bone and ivory artefacts in Paviland Cave (South Wales), which became known as the "Red Lady of Paviland". John MacEnery dug at Kent's Cavern between 1825 and 1829, and systematic excavations took place from 1865 to 1880 there by William Pengelly. The Belgian cave sites Fonds de Forêt and Engis (both with gravettian levels) were dug by Schmerling from 1829 onwards, while Ed. Dupont excavated an important series of cave sites in the Meuse basin in the second half of the nineteenth century. In fact, he uncovered the second palaeolithic female statuette ever at Trou Magrite in 1867, three years after the *Venus impudique* from Laugerie Basse was found by De Vibraye (Delporte 1993: 67). The important site of the Grotte de la Betche-aux-Rotches at Spy, well known for its Neanderthal finds, was excavated in the period 1885-1886 by De Puydt and Lohest, and yielded, above the mousterian and aurignacian layers, a gravettian assemblage with Font Robert and Gravette points. Reliable data on stratigraphy, palaeoenvironment and typological composition of an assemblage are only known from the open air site of Maisières-Canal, excavated in 1966 (De Heinzelin 1973) and the recent excavations at Huccorgne (Otte *et al.* 1993; Straus *et al.* 1997). Recent field work shows that the Upper Palaeolithic record from this area is far from exhausted, and that major new discoveries are still possible (Straus and Otte 1995; Straus *et al.* 1997).

As most sites were excavated in the late 19th-early 20th century, the quality of the work done and the resulting database is in general poor (cf. Dewez 1985). In his major survey of the Belgian record, Otte (1979) mentions a total of 26 gravettian sites, eight of which are certain and testify to what Otte (1976) has called "une occupation", while 18 others have only yielded a small number of traces of gravettian presence, such as isolated finds from quarries. With Grotte Walou (Trooz) being a recent addition to the number of certain sites (Dewez 1992; Draily 1998), there now are nine, seven of which are in an abri/cave setting in the Meuse basin: Engis, Fonds-de-Forêt, Grotte Walou, Goyet, Spy, Trou Magrite (Pont-à-Lesse) and the Trou du Chena at Moha. Two are large open air sites, both situated near a river: Maisières-Canal and la Station de l'Hermitage (Huccorgne), where recently new excavations have been undertaken (Otte *et al* 1993; Straus *et al.* 1997).

The record from other countries is poorer: in Great Britain, Kent's Cavern has yielded dates of around 28,000 bp for bones 'associated' with an Upper Palaeolithic industry with leaf points and a fragment of a tanged point, also known from Paviland Cave, by far the most important site in Britain (Aldhouse-Green and Pettitt 1998). A large tanged point from Pin Hole, in the Creswell Crags, is the only complete specimen from the British Early and Mid Upper Palaeolithic caves so far (Campbell 1977), while the open air site of Bramford Road (Ipswich) yielded an assemblage with unifacial leaf points similar to those from the caves with "a fairly convincing, large tanged "point", more or less comparable to that from Pin Hole" (Campbell 1977: the specimen is however not pointed, but rounded, see Campbell 1977: fig. 107). Northern France has two open air sites attributed to the *Périgordien supérieur* by Fagnart (1988), although the assemblages are not very diagnostic: Renancourt-lès-Amiens (Somme, Commont 1913; Fagnart 1988) and Elnes (Pas-de-Calais, Baudet 1960; Fagnart 1988). A few isolated Font Robert points furthermore document a gravettian presence in Luxembourg (Ziesaire 1998). Though outside the area at stake here, it is worthwhile mentioning that the nearest gravettian sites further south are in the Île-de-France (Paris Basin), e.g. the rich site of Le Cirque de la Patrie, near Nemours (Schmider 1971, 1990). Finally, the Belgian gravettian presence can be followed eastward into the German Rhineland (Bosinski, this volume), and northward through the Meuse valley in the Netherlands, where a broken Font Robert-like point from Venray (Driessens 1982) forms the only trace of gravettian groups at the rim of the northern plains. Northern Germany and Poland also fit into this 'empty' pattern (see Mania 1981, Feustel 1989, and Bosinski, this volume, for finds from the neighbouring German Rhineland, and also Scheer, this volume).

The relative scarcity of gravettian (and aurignacian) finds in this area is not a matter of lack of research, as is obvious from the history of archaeological investigations. Despite the high intensity of investigations of the loess sections in the area, occupation traces from the EUP and MUP are scarce. In the loess sections an important erosional level just below the so-called Nagelbeek tongued horizon (Haesaerts *et al.* 1981; Juvigné and Wintle 1988) testifies to a major erosion during the Last Glacial Maximum. In the corresponding stone line (reworked) Middle Palaeolithic artefacts are a common phenomenon, but the extreme rarity of diagnostic Upper Palaeolithic artefacts also testifies to the marginal character of gravettian and earlier Upper Palaeolithic occupation.

4. Chronology

Most of the sites mentioned above have no good dating evidence, neither relative – because of the absence of data on the stratigraphic context of the assemblages – nor in terms of absolute dating work. Two decades ago, Campbell concluded on the basis of the radiocarbon age estimates for bones 'associated' with Upper Palaeolithic artefacts that "the Earlier Upper Palaeolithic was possibly current in Britain, however sporadically, from about 38,000 to 18,000 B.P., but mostly round about 28,000 B.P." (Campbell 1977: 80). This assessment was based on a series of conventional

Table 1. Selected Oxford Radiocarbon Accelerator Unit dates (in years bp) for British Upper Palaeolithic sites mentioned in the text (source: Hedges *et al.* 1996; Aldhouse-Green and Pettitt 1998).

Kent's cavern	Human bone	30,900±900	OxA-1621
Paviland Cave	Charred bone	29,600±1900	OxA-365
Paviland Cave	Humics from OxA-365	28,000±1700	OxA-366
Paviland Cave	Charred bone	28,860±260	OxA-7789
Paviland Cave	Charred bone	27,780±320	OxA-7877
Paviland Cave	Modified bone	26,350±550	OxA-1815
Paviland Cave	'Red Lady' bone	25,840±280	OxA-8025
Paviland Cave	mammoth ivory pendant	24,140±400	OxA-7111
Paviland Cave	bone spatula (horse)	23,670±400	OxA-1790
Paviland Cave	bone spatula (cervid)	22,780±320	OxA-7081
Paviland Cave	modified mammoth ivory	21,100±550	OxA-7112
Hyaena Den	bone/antler point	24,600±300	OxA-300

radiocarbon dates of around 28 kyr bp for bones found in close association with artefacts at Kent's Cavern and Robin Hood's cave (Campbell 1977: table 4; but see Pettitt, this volume, for the dating of Kent's Cavern). Now, twenty years later, a recent series of AMS dates of definitely humanly modified samples shows that there were various 'blips' of human activity (Gowlett 1986) in the range 31,000 to 21,000 bp, as very well illustrated at Kent's Cavern by a dated human maxillary (Table 1), a bone/antler point from Hyaena Den and the recently published Oxford accelerator dates for Goat's Hole, Paviland (Aldhouse-Green and Pettitt 1998). A series of dates unambiguously pertaining to human activities at the site (Table 1) shows that 1) there was (aurignacian?) occupation around 29,500 to 28,000 bp, 2) that the 'Red Lady' (see below) died at around 26 kyr bp, and 3) that further short visits or brief occupations occurred around 23.5 (bone pendant and spatula) and 21 (ivory working) kyr bp (but see below)[1].

From the 1970's onwards, Otte has repeatedly linked the British early Upper Palaeolithic sites with the assemblage from Maisières-Canal, because of typological characteristics – the presence of points "à face plane" and of tanged points – and because of the widely quoted conventional radiocarbon age for Maisières-Canal of 27,965 ± 260 bp (GrN-5523). At Maisières, the archaeological assemblage was embedded within the lower third of a humic soil developed within loamy colluvial deposits, and the date was obtained for humic extracts from a sample taken "immédiatement sous l'horizon d'occupation" (De Heinzelin 1973: 45). The Groningen date was corroborated by an age of 30,780 ± 400 bp (GrN 5690) for humic extract from a lower horizon. However, dates obtained by the Louvain laboratory for humic extracts from and around the archaeological horizon (Table 2) gave results that were indeed incoherent and at odds with the stratigraphy ("des résultats discordants, non interprétables", Otte 1976: 335). The dates ranged from *c.* 36,000 to 23,000 for humic sediments in and around the archaeological level, with four dates clustering around 24,000 bp. The problems with the Louvain dates were ascribed to the calcareous matrix in which the samples were collected (Gilot 1971), but this surely has to apply to the two Groningen dates as well. In actual fact, Gilot (1984) has stressed the extreme reservations one should have against these ^{14}C dates of soils, even if the dates are stratigraphically correct, as in the case of the Groningen humic samples. The 28,000 date makes Maisières contemporaneous with the Périgordian IV of France, though Font Robert points are common at Maisières and not known before the Périgordian V in the Périgord itself. Indeed, "si la date C14 est fiable (26.000 BC), il serait contemporain du Périgordien IV et contiendrait donc les premières pointes pédonculées d'Europe" (Otte 1979: 627; but see Djindjian, this volume)[2].

The gravettian sites of Spy and the Station de l'Hermitage at Huccorgne have published ^{14}C-dates in the range of 20 to 23 kyr bp (see Table 2), but the reliability of the measurements based on the used fractions is not high (see Gilot 1984: 120, and Pettitt, this volume, and also: Dewez 1989: 139). The gravettian levels from Grotte Walou have conventional radiocarbon dates of 23 to 26 kyr (Dewez 1992; Draily 1998; see Table 2), while a possibly humanly modified bone from Goyet-Mozet/Gesves has an accelerator date of around 24 kyr bp (Table 2). Accelerator dates on individual mammoth bones from the recent excavations at Huccorgne have led Straus *et al.* (1997) to infer that there

Table 2. Radiocarbon dates (in years bp) for Belgian gravettian sites mentioned in the text (source: Gilot 1971, 1984 and 1993, Dewez 1989, Eloy and Otte 1995, Straus *et al.* 1997; Draily 1998).

Maisières-Canal	Humus findlevel	27,965±260	GrN-5523
Maisières-Canal	Humic extract findlevel	31,080+2040-1620	Lv-304/1
Maisières-Canal	Humic extract findlevel	30,150+1890-1540	Lv-304/2
Maisières-Canal	Humic extract findlevel	35,970+3140-2250	Lv-305/1
Maisières-Canal	Humic extract findlevel	24,100+650-610	Lv-305/2
Maisières-Canal	Humic extract findlevel	25,280+1040-920	Lv-353
Maisières-Canal	Humus below findlevel	30,780±400	GrN-5690
Maisières-Canal	Humic extract below findlevel	24,400+700-600	Lv-306
Maisières-Canal	Humic extract below findlevel	23,160+550-510	Lv-307
Trou Walou	Antler	22,800±400	Lv-1651
Trou Walou	Bone fragments	24,500±580	Lv-1837
Trou Walou	Bone fragments	25,860±450	Lv-1867
Goyet	Bone	24,440±280	OxA-4926
Moha	Fractured *C. elaphus* bone	22,840±420	Lv-1625
Spy	Burnt bone	22,105±500	IRPA-132
Spy	Bone carbonate fraction	20,675±455	IRPA-202
Huccorgne	Bone collagen bulk sample	23,170±160	GrN-9234
Huccorgne	Mammoth bone stratum 4	26,300±460	OxA-3886
Huccorgne	Mammoth bone stratum 4	28,390±430	CAMS-5891
Huccorgne	Mammoth bone stratum 4	24,170±250	CAMS-5893
Huccorgne	Mammoth bone stratum 4	26,670±350	CAMS-5895

were at least two phases of gravettian occupation of that flint-rich location: one around the time of the Maisières-oscillation (28-26 kyr bp) and one around 24 kyr bp, during the Tursac interstadial. However, the mammoth bone accelerator dates from the archaeological stratum display a range of *c.* 24 to 28 kyr bp (see Table 1), and it remains to be established how the dated bones actually relate to the excavated flint material from the site, i.e. whether they have any archaeological significance. In terms of the Maisières discussion, it is useful to know that the new excavations at Huccorgne have not yielded a tanged point yet, though at least one is known from older collections from this site (Otte 1979).

In sum, the British evidence shows various episodes of human presence in the period at stake here, especially at Paviland, even up until 21,000 bp (but see below). The current radiocarbon evidence for Belgium is not unproblematic. After the Aurignacian, gravettian occupation took place, but its chronology is unclear because of the problems mentioned above. Pettitt's (this volume) examination of the distribution of ^{14}C dates in the 30-20 kyr range shows that there is some clustering of dates which might represent various intermittent pulses of occupation on a European scale. Otte's interpretation of the Belgian radiocarbon evidence suggests that this was also the case there (see below), but more research is necessary to test the chronometric solidity of such a suggestion, preferably along the lines of Aldhouse-Green and Pettitt (1998) or Housley *et al.* (1997), whose dating programme focused on samples which unequivocally carried information on human activities, such as bones with cut marks or tools made on antler or bone. Finally, a few more words on the dating evidence from Paviland cave are in order, i.e. the archaeological significance of the AMS dates of round 21,000 bp for worked ivory from the site. According to Aldhouse-Green and Pettitt (1998), this ivory working reflects the last phase of a series of 'pilgrimages' to this important site. However, Street and Terberger, using a large sample of radiocarbon dates, show elsewhere in this volume that there probably was an absence of human occupation of northern and central Europe – one of the source areas for the visits to Paviland – between 23 and 20,000 bp. This strongly suggests that the 21 kyr date on ivory – a notoriously problematic material for ^{14}C dating – may not reflect the age of a human visit to the site: a 23 to 24 kyr bp date for the last pre-LGM activities at Paviland – as suggested by the next to youngest series of dates from the site – fits much better into the wider geographical pattern described by Street and Terberger (this volume).

5. Raw materials

Compared to the Aurignacian, the Belgian Gravettian sees a focus on a variety of high quality fine-grained raw materials, which were necessary for the production of large well-prepared cores typical for these industries (Otte 1979)[3]. Such 'Perigordian' cores are quite common in the Belgian gravettian sites, and many seem to have been transported over quite large distances, of up to 60 km (see Scheer 1993, and this volume, for comparable observations on Southern Germany). While phtanite was commonly used, in the eastern part of the distribution the focus was on gray flint from the Maastrichtien outcrops, while black Obourg-type flint from the Campanien (Hainaut) is dominant in the western occurrences. Phtanite was transported over distances of 40 to 60 km (Caspar 1984) and comparable distances apply to the *silex noir* dominant at Spy and to the Maastrichtien flint in the east. Most materials were obtainable within shorter distances from the sites though, usually within a 10 km range. Interestingly, according to Floss (1994), Belgian raw materials, and especially the western flint, seem to have been transported to gravettian sites in the German Rhineland, over distances of up to 200 km (cf. Bosinski, this volume). The German Rhineland on the other hand may have been the source area for the perforated fossil (Miocene-Oligocene) shells found at Spy (Otte 1979: 302, footnote 50) and the black rock used to produce the pearls also found at Spy (Otte 1979: 300, footnote 47). The (southern part of the) Paris Basin is another possible source area for the fossil shells, at a comparable distance from the Spy location. Finally, Otte (1977) has suggested that two fossil *coquilles* found in the Upper Palaeolithic levels at Spy, were possibly imported from the southeastern part of East Anglia, Britain, the nearest exposure of sediments containing these fossils[4]. The British raw material data have been summarized by Campbell (1977), who does not mention distances comparable to the Belgian ones. The good quality flint used at Kent's Cavern may have been readily available in the English Channel Plain (where according to extant finds mentioned above, a rich faunal community must have been present too – and possibly a comparable archaeological record – see below)[5].

6. The Red Lady of Paviland

The only burial known from the Mid Upper Palaeolithic of northwestern Europe is the Red Lady of Paviland, in actual fact the skeleton of a *c.* 25 years old and 1.70 m tall male individual. It was documented about 175 years ago, remarkably detailed for that period, but insufficient for an actual reconstruction of how it became interred. Though Buckland's (1823) description left little doubt that bone and ivory tools and ornaments were found in very close association with the skeleton, the results of the recent reassessment of the burial and its context show that the bone and ivory objects do not reflect a single activity associated with the interment (Aldhouse-Green and Pettitt 1998). Parts of the skeleton were missing, probably due to erosion, while the remaining bones, "in their natural order of contact", were covered in red ochre, "all of them stained superficially with a dark brick-red colour, and enveloped by a coating of ruddle, composed of red micaceous oxyde of iron, which stained the earth, and in some parts extended itself to the distance of about half an inch around the surface of the bones. The body must have been entirely surrounded or covered over at the time of its interment with this red substance. Close to the part of the thigh-bone where the pocket is usually worn, I found laid together and surrounded also by ruddle about two handsfull of small shells of the *nerita littoralis* in a state of complete decay, and falling to dust on the slightest pressure. At another part of the skeleton, viz. in contact with the ribs, I found forty or fifty fragments of small ivory rods, nearly cylindrical, and varying in diameter from a quarter to three-quarters of an inch, and from one to four inches in length…Both rods and rings [i.e. fragments of a bracelet, see endnote 1, WR] as well as the nerite shells, were stained superficially with red, and lay in the same red substance that enveloped the bones; they had evidently been buried at the same time with the woman" (Buckland 1823: 89).

7. Art

In this domain there are but few traces of the 'Golden Age' of hunter-gatherers – apart from the Paviland Cave material – and the assignment of some of these to the Gravettian is not certain (Otte 1979). At Maisières the excavations yielded an ivory pin and fragments of an ivory *plaquette* with a lozenge-shaped decoration (De Heinzelin 1973), while a decorated antler is known from Huccorgne. Apart from these finds, Otte (1979) formerly ascribed two *art*efacts to the Gravettian, both from Trou Magrite (Pont-à-Lesse), both found during Dupont's extensive excavations there, both in the same level. It concerns an engraved basal part of a shed reindeer antler and the famous ivory anthropomorphic statuette (see Otte 1979: 163-166 and Delporte 1993), uncovered in 1867. As described by Otte (1979), parts of the statuette display a high gloss – especially its face – probably as a result of long and intense manipulation of the small object. The statuette shows some resemblance to the small schematic anthropomorphic figurine from the Vogelherd in Germany, also made of ivory but dating to the Aurignacian (Bosinski 1982; Delporte 1993: 128-129), and to a statuette

Table 3. Presence of characteristic artefact groups in Belgian gravettian sites (data from Otte 1979. The *pointes à retouches plates* are of the Maisières-type).

	Pièces à dos	*Pointes de la Font Robert*	*Pointes à retouches plates*
Maisières-Canal	4	120	119
Spy	124	71	76
Goyet	318	13	5
Huccorgne	2	1	1
Fonds de Forêt	9	2	4
Trou Magrite	13	13	7
Engis	61	0	0
Trou du Chena	0	1	1

from Předmostí – made from a mammoth metapode, one in a series of comparable statuettes (Delporte 1993: 150, fig. 158). On the basis of a re-evaluation of the stratigraphy at Magrite and stylistic arguments, Dewez (1985) has suggested that both finds derive from the aurignacian layer at Magrite, an interpretation now shared by most Belgian workers (Otte 1995; Lejeune 1997; Otte in press).

8. Inter-site comparisons

In terms of their location in the landscape, the Belgian cave and abri sites display a remarkable and probably significant consistency. All eight are very close to a (often small) river, with their entrance at 10 to 40 metres above the present water level. All but one are situated within 1 to 2.5 km from the confluence with a major river: the Meuse, the Vesdre and the Sambre. The small cave of Trou de Moha lies at 4 km north of the confluence of the Méhaigne with the Meuse, and 1 km south of the open air site of Station de l'Hermitage (Huccorgne), in the same river valley. The two open air sites are both near a river, Hermitage on an elevation in a meander bend of the Méhaigne, Maisières-Canal on the right bank of the Haine, an affluent of the Escaut, at a strategic location for the observation of animal movements (De Heinzelin 1973: 42).

The British cave sites appear to have a topographical setting comparable to the Belgian sites: Kent's Cavern lies about 1.5 km east of Torquay harbour, in the western slope of a small valley, which terminates about 0.8 km south of the cavern entrances – interestingly 180 km due north of a rare gravettian site on the other side of the (then dry) Channel, Plasenn-al-Lomm on the northern rim of the Ile-de-Bréha (Brittanny, Monnier 1980), also with a great view over the Channel plain, where the combined Rhine, Meuse and Thames found their way into the sea. Paviland Cave faces south with an excellent view over the (by then dry) Bristol Channel (plain), and lies adjacent to a ravine which provides easy access to the plateau of the Gower peninsula (Campbell 1977). Pin Hole is a narrow fissure-cave in the western end of the northern side of the Creswell Crags, a ravine through which a small stream flows.

As to the size of the British assemblages, Campbell (1977) remarks that the total number of extant artefacts from definite Early and Mid Upper Palaeolithic contexts he was able to trace is 5,860, a totality heavily dominated by 4,464 stone waste products from Paviland Cave (1977: 141). And these numbers apply to the total of aurignacian and gravettian artefacts. Paviland had 554 Early and Mid Upper Palaeolithic stone tools, again both aurignacian and gravettian.

The finds from many of the Belgian sites have since their discovery been distributed over a large number of collections – material from Spy, for instance, over 5 public museums which keep various collections and over at least 8 private collections. Much of the material has disappeared, which makes inter-site comparisons highly problematic (Otte 1979). Moreover, most cave sites also contained aurignacian (and magdalenian) finds and as the stratigraphical position of most finds was not recorded, a comparison of sites in terms of numbers of artefacts is necessarily limited to 'type fossils'. Table 3 gives a survey of the numerical presence of such artefact groups from the Belgian gravettian sites, compiled on the basis of data published by Otte (1979). On the basis of the differences in proportions of tool types and the radiocarbon evidence then available, Otte suggested that the gravettian presence can be divided into three (chronological) facies, with Maisières forming the first one, characterised by pieces with flat retouch, the above mentioned *pédonculisation* and dihedral burins. In the second facies, present in caves (Spy, Trou Magrite), and in the open air (Huccorgne) the techniques of flat retouch and *pédonculisation* persist, parallel to the appearance of backed pieces (gravettes and micro-gravettes) and *burins sur troncature*. The last facies unites the sites dominated by backed pieces (Goyet, Engis, Fonds-de- Forêt and Grotte Walou, cf. Eloy and Otte 1995).

With respect to the radiocarbon evidence discussed above, one could doubt the value of the ^{14}C data on which this three-partition is based. The evidence from Paviland clearly shows that various episodes of occupation took place there, and it is very probable that the Belgian sites document a complexity of recurrent visits which exceeds the Paviland data; simply more chronometic data are needed here in order to reject the possibility that the differences between the Belgian assemblages reflect site context and use[6] rather than anything else, apart from their formation history over the last hundred odd years. With the chronology being unclear, an alternative explanation might be that most to all sites are related, both in terms of chronology and 'settlement-system'. The argument is as follows. At Maisières-Canal, a site situated near a good flint source, the assemblage contains more than 400 cores, most of which have two opposed platforms and are of the Perigordian type as described by Bordes (1967) for the Upper Perigordian site of Corbiac. These opposed platform cores yielded straight blades, according to Bordes (1967) especially suited for the production of Gravette points. Gravette points are absent at Maisières-Canal, but occur at Spy, 60 km to the east, together with 28 cores of the Corbiac-type; some of these are made from black flint, "certainement le même matériau que celui utilisé à Maisières-Canal" (Otte 1979: 204). This imported flint also happens to be the material from which one third of the non-patinated backed pieces (including Gravette points) is made, and half of the identifiable Font Robert points. Likewise, among the heavily patinated material from Goyet, Otte could ascribe Gravette points and points *à face plane* to the Maisières type (Campanien) flint. It is therefore perfectly possible that many sites were links in a chain of (embedded) raw material procurement and production (Maisières-Canal), use, and finally discard in one of the cave/abri sites. In such a scenario Maisières-Canal yielded much of the flint material for the western part of the cave/abri sites, while the flint occurrences exploited at Huccorgne, Station de l'Hermitage, were the beginning of a cycle that ended in the eastern half. This is undoubtedly a too simplistic scenario – easily falsifiable by the establishment of a solid chronology – but Scheer's (1986, 1993) refit data on the actual relationship between gravettian sites in the Ach Valley (Germany), show how brief settlement phases can be, and how site-assemblages may have been produced in actually contemporaneous or at least closely related episodes of use.

9. Discussion

The virtual absence of traces of occupation on the northern plains and the preference for the upland areas on the southern borders of the plains (southern Belgium, the Middle Rhine area, etc.) suggest that environmental and resource arguments played a significant role in the formation of the observed site distribution, both in chronological and geographical terms (the distinct north to south climate gradient in northwest Europe during the period at stake must have been an important factor in this respect [cf. Huijzer and Vandenberghe 1998]). The striking consistency in site location indicates that activities were directed towards preferred pockets of resources: the dissected Meuse valley landscape and the topographical advantages that this landscape offered for hunting activities, combined with the presence of rich, high quality raw materials both to the east and the west of the main distribution. Comparable factors seem to have played a role in the case of the British distribution, where two sites have a dominating view over the formerly undulating plains of the British Channel.

The small number of sites and the small size of most assemblages indicates that the gravettian occupation of the area surveyed here was quite marginal. Art is rare, structures are unknown (though some 'hearths' are mentioned in the older literature), and so are burials, with the notable exception of the 'Red Lady'. Even for one of the most prolific sites, Spy, it has been argued that the gravettian cultural layer was thin, insignificant in both thickness and extension, not testifying to a long occupation or to frequent short intermittent visits (Otte 1979). The meagre record from the area does not seem to indicate that we are dealing with complete adaptive systems, with large residential base camps established in the area itself. Maybe one has to interpret these northernmost traces as the ultimate expansion of far-flung hunting and collecting excursions from base camps located to the south and southeast of the area. However, where then were those base camps? To the south and southeast the record is also pretty meagre, and the refits established by Scheer in the Ach Valley in southern Germany (see above) again stress the short intervals in which much of this archaeology may have been produced. Northern France, including the Paris Basin (Schmider 1990) and Brittanny (Monnier 1980; Allard 1986) are also quite poor, so that in fact one is almost forced to return to the classic 'centres' of Upper Palaeolithic Europe, and in view of the 'western' facies of the gravettian occupation of the north more specifically to the southwest of France. Or is it a matter of being unable to identify a 'base camp' in these marginally occupied northern areas? The long semi-continuity of occupation in the classic centres, including the pavlovian core area, has created an extremely rich palimpsest incomparable to the record produced during the intermittent visits to the north. And indeed, if we omit sites like Pavlov, Dolní Věstonice and Předmostí, the central European record becomes a rather meagre one as well.

At this stage a comparison with the magdalenian occupation history of northern Europe may be of some help. In a paper dealing with the Late Glacial human recolonisation of that area, Housley *et al.* (1997) used a large series of

Table 4. Suggested differences in settlement and archaeology related to a two phase colonisation model for the Magdalenian in Northern Europe (source: Housley *et al.* 1997).

PIONEER PHASE	RESIDENTIAL BASE PHASE
One season use of the region only	More than one season of use of the region
Small faunal assemblages	Large faunal assemblages
Reindeer dominated assemblages	Reindeer, horse and bovid dominated assemblages
Small, medium artefact sites, refitting between sites	Large and small artefact sites, only refitting within sites
Open air hearths, tents	House structures, tents, pits
Art poor	Art rich
Burials in caves, usually male	Open site burials, both sexes

AMS dates to propose a general model of that process at a subcontinental scale. The resulting regular pattern of colonisation showed for each area the timing of the start of the *pioneer* phase and a few hundred years later the start of the *residential* phase, when large residential base camps were established from which the next pioneer phase was launched into previously unoccupied territories. The clear-cut differences in the archaeology of both phases is summarised in table 4, taken from Housley *et al.* (1997). With the obvious absence of data on faunal aspects (and hence inferences on seasonality), the archaeology of the region discussed here fits quite well into the Pioneer phase of Housley *et al.*, with the extra bonus of the lone male burial in Paviland Cave. But in contrast to the magdalenian record, there are no unambiguous archaeological traces of a 'Magdalenian-Style' Residential base phase for the gravettian presence in this area; in fact, to find an area that would classify as such we, again, would have to travel deep south or far to the east. In other words: where were the centres for these northern marginals? It is 750 km – as the crow flies! – from Paviland Cave to Laugerie Haute, to give an idea of the distances we are talking about. In the magdalenian colonisation pattern the distances between residential base areas and the pioneer zones vary from 200 to 400 km, i.e. less than half of the gravettian distances just mentioned. How can this difference be explained?

Obviously, one could evoke differences in taphonomic processes – always a spoiling argument when one finally has an interesting pattern in palaeolithic data, but one that has to be dealt with in the interpretation of prehistoric site distribution patterns. The taphonomy of the gravettian distribution is difficult to assess though. It is obvious that sites have disappeared: the unstable soil surface conditions and erosional processes of the Last Glacial Maximum must have had a detrimental effect, especially on open air sites. Had these processes acted on a dense distribution of sites, however, one would expect more gravettian traces in the stone lines below the Nagelbeek tongued horizon, as discussed above. But apart from the destructive aspects of periglacial processes, we also have to deal with their effects on the visibility and accessibility of gravettian sites: the formation of slope deposits (Kolstrup 1995) and the high rate of loess sedimentation around and after the Last Glacial Maximum (Juvigné and Wintle 1988) must have covered and thus protected sites from erosion, at the same time making them invisible for the archaeologist (but the same applies for the earlier phases of the Palaeolithic, and thousands of Middle Palaeolithic sites are known from Germany, for instance, though from a much longer period!). In the Magdalenian of Northern Europe, occupation was more or less contemporaneous with the last pulses of loess sedimentation, which stopped at the beginning of the Bølling interstadial (Juvigné and Wintle 1988). Hence many open air sites are high in the Holocene soil-profiles. The Holocene erosion has certainly destroyed some magdalenian sites, but at the same time probably increased their overall visibility. So in sum, the gravettian sample has undoubtedly been more severely affected in terms of preservation and archaeological visibility than the Magdalenian. The missing base camps may simply have been situated in specific topographic settings that were either vulnerable to erosion or to coverage by thick layers of slope deposits and/or loess (cf. Bosinski's *Sessellage*, this volume).

Finally, when discussing such map formation processes, we have to realise that a significant part of the Gravettians' territory is missing: the large plains now hidden by the North Sea, and the former coastal areas themselves. These plains must have been filled with animals of the mammoth steppe (cf. Campbell 1977), and sea food procurement must have been an important activity for at least some of the Gravettians in the north: a recent analysis of the "Red Lady" by M. Richards (Aldhouse-Green and Pettitt 1998) showed a ^{13}C value of -18.4, indicative of a marine contribution to dietary protein of 15 to 20%. Together with the faunal remains from the North Sea bottom and the flint artefact recovered from North Sea sediments in a core drilling (see endnote 5), this value illustrates the bias in our site spectrum and the loss of information as a result of sea level rise processes.

Parallel to these taphonomical processes, it is also perfectly possible that the northern Gravettians simply had another way of moving through these landscapes than the Magdalenians: not so much focused on residential bases, but more mobile, without the investment in site structures we know from German magdalenian sites such as Gönnersdorf, Andernach and Oelknitz. In this sense, the gravettian site spectrum may have resembled the aurignacian pattern, and for that matter, also the Middle Palaeolithic record from this area. Hence, our 'magdalenian' definition of a 'centre' simply may not work for the northern Gravettian. Do we indeed need art and structures at Maisières-Canal to qualify that rich (and only partly excavated) site as a residential base? And is Campbell right when he states that Paviland Cave "…can surely be regarded as an Earlier Upper Palaeolithic"base-camp"… the centre of the most intense Earlier Upper Palaeolithic activity known thus far in Wales, if not in the whole of Britain"? (1977:144). Comparable interpretations could be developed for larger sites such as Le Cirque de la Patrie and Bilzingsleben, and indeed Bosinski (this volume) presents such a view for Mainz-Linsenberg. In such an interpretation we can treat the northern record as the traces of far-flung hunting and collecting excursions from base camps just to the south and southeast of the area at stake here.

In such a scenario, the northwest carries the traces of short and intermittent trips to the north, in which marine resources played a role; these trips were carried out from base camps which may have been different from the magdalenian ones, though the differences in processes of erosion and sedimentation between the gravettian and the magdalenian site distribution make this difficult to evaluate.

What we do know for sure is that when the Gravettians disappeared, probably around 23,000 years ago, this northern area became, once again, the exclusive domain of the diverse animals of the Mammoth Steppe, and a long interval of (virtual) human absence ceased about 13,500 years ago, with the arrival of the magdalenian pioneers[7].

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notes

1 That the burial might be gravettian was already assumed by Campbell (1977) on the basis of the similarity of the associated ivory bracelet fragments with three such rare items found at the Magdalenahöhle in the German Rhineland, just east of the area reviewed here, a site with a gravettian assemblage and a conventional radiocarbon date of 25,540 ± 720 bp (Bonn-1568, see Weiss 1978). In regard of this date, Street, Baales and Jöris (in press) remark that the archaeological relationship of the dated sample – a shed reindeer antler present in a concentration of antlers in a fissure in the cave – to the archaeological finds including the bracelets found deeper in the cave needs to be established. Finally, the bracelet from Paviland is both smaller and thicker – with a circular cross section – than the fragments from the Magdalenahöhle.

2 During the completion of this manuscript, Marcel Otte (pers. comm. 1999) informed me that new and yet unpublished ^{14}C dates on bones from Maisières yield an age of around 28,000 bp.

3 Floss (1994) also mentions an increase of raw material transport in the German Gravettian as compared to the Aurignacian and the Middle Palaeolithic, while his provenance studies clearly show that the non-local materials in the German Gravettian were imported from other regions than in both the Middle Palaeolithic and the Magdalenian of the Rhineland.

4 The species are *Nassarius reticulatus* (Linnaeus) and *Trivia coccinelloides* (Sowerby). Both exemplars display a high gloss patina as a result of long periods of manipulation, and both contain traces of red sediment. It is however unclear whether they are to be associated with the aurignacian or with the gravettian material from Spy. In view of the Gravettian 'habit' of 'importing' objects over large distances, an attribution to the Gravettian might be probable (though this is, of course, a nice example of reinforcement!).

5 The remarkable discovery of a scraper fragment in a vibro core drawn from the northern North Sea, at 60.4 degrees north, between Norway and the Shetlands (Long *et al.* 1986), gives a hint of what the Late Glacial and Holocene rise of sea levels must have made inaccessible to archaeologists (cf. Larsson, this volume).

6 Cf. Scheer, this volume, with regard to the presence of Font Robert points in open air sites as opposed to caves.

7 This statement applies to the area at stake here, and until very recently this seemed also the case in Germany. Street and Terberger (1999), however, recently presented a series of AMS dates from the Upper Palaeolithic site of Wiesbaden-Igstadt in the northern Rhineland – southeast of the area reviewed here – which suggests at least a short presence of humans around the Late Glacial Maximum.

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Wil Roebroeks
Faculty of Archaeology
Leiden University
P.O. Box 9515
2300 RA Leiden
The Netherlands

François Djindjian

24 The Mid Upper Palaeolithic (30,000 to 20,000 bp) in France

From 30,000 to 20,000 bp, the hunters of the Mid Upper Palaeolithic (MUP) were adapted to an Ice Age climate which progressively deteriorated. The MUP is represented by aurignacian industries until 28,500 bp and then by gravettian industries from 28,500 to 21,000 bp. The gravettian industries are characterised in the first place by the emergence of the new technique of backed retouch (mainly applied to Gravette points, microgravette points and backed bladelets). Another feature is the chronological succession of typological facies, as recorded in the stratigraphy of Aquitaine rock shelters: early Gravettian with various points, middle Gravettian with special burins, late Gravettian with numerous microgravette and Gravette points, and final Gravettian ('Protomagdalenian') with a particular lateral retouch on blades.
Open air settlements are rare in comparison with rock shelter settlements, but it is possible to deduce from the data the existence of numerous seasonal camps in the northern part of France, showing how well the Gravettians adapted to hunting large mammals, such as mammoths, horses, and reindeer. The oscillations of the deteriorating climate are at the origin of changes in the geographical distribution of gravettian settlements.
The raw material procurement shows movements of up to several hundred kilometres by the Gravettians only within Western Europe, pointing to a geographical barrier with Central Europe due to climatic changes as early as 27,000 bp. Gravettian cave art has only recently been identified due to new accelerator ^{14}C dates. Gravettian mobiliary art is almost entirely known only by female statuettes. In France, no burials can be unquestionably attributed to the MUP, and the physical appearance of the French Gravettians is unknown.

1. Palaeoclimatic changes in France between 30,000 and 20,000 bp

The 30-20 kyr period is a transition period between the Würm interstadial, which ends around 34,000 bp – a concept generally used in Western Europe – or between the Würm Interpleniglacial which ends around 25,000 bp, a concept generally used in Central and Eastern Europe, and the glacial maximum of the late Würm Pleniglacial around 18,000 bp.

1.1 Palaeoclimatic data records

In France, and more generally in western Europe, the palaeoclimatic reconstruction is based on the following records:

- rock shelter stratigraphies, for the following MUP sites, from the north to the south of Europe, including Belgium: Trou Walou at Trooz (Belgium), Grotte du Renne at Arcy-sur-Cure (Yonne), Grotte des Cottès at Saint-Pierre de Maillé (Vienne), the cave of La Grande Roche de La Plématrie at Quincay (Vienne), the Roche à Pierrot rock shelter at Saint-Césaire (Charentes), the La Ferrassie, Le Facteur, Roc de Combe, and Pataud rock shelters in the Périgord, the Duruthy rock shelter at Sorde l'Abbaye in the Landes, and the Salpétrière, La Laouza and Esquicho-Grapaou caves in Languedoc (Delporte 1968; Laville 1975; Bazile *et al.* 1982; Delpech 1983; Bricker 1995);
- loess stratigraphies, particulary the Maisières-Canal open air site in Belgium (Haesaerts and de Heinzelin 1979) and in the Rhineland (Bosinski, this volume);
- palynological core records of Ice Age lakes, essentially the La Grande Pile record from the Vosges mountains (Woillard 1980) and the Les Echets record from the Dombes, near Lyon (De Beaulieu and Reille 1984);
- comparisons with oceanic core records (Golfe de Gascogne), mediterranean core records (KET 8022), or even artic ice core records (Dansgaard *et al.* 1971).

1.2 The validity of the palaeoclimatic reconstruction methods

Palaeoclimatic reconstruction methods are based on various studies, such as sedimentology, pedology, palynology, and palaeozoology. During the 1970's, several stratigraphical syntheses of rock shelter deposits were proposed by H. Laville, mainly based on sedimentology (Laville 1975), and by Arl. Leroi-Gourhan, based on palynology (Arl. Leroi-Gourhan 1968; see also Paquereau 1978). In the last ten years, the validity of these palaeoclimatic conclusions have been criticised with strong arguments, mainly concerning sedimentology (importance of the gaps and relative meaning of the sedimentological events at the origin of a deposit in a rock shelter, see Campy 1982), and palynology (biased sample by local and discriminated trapping, percolation of pollen in the deposits), while the conclusions of palaeozoological studies, mainly rodent and mollusc studies, have increasingly gained the confidence of archaeologists (Puissegur 1976; Delpech 1983; Marquet 1993).

On the other hand, the core records may benefit from an exaggerated confidence due to the impression that they constitute continuous and linear sequences, which could only be ascertained after systematic ^{14}C dating and appropriate mathematical processing. Morever, it is now realised that the core records document palaeoclimatic sequences of several hundred thousand years, with an appropriate sampling, while the Upper Palaeolithic specialists are only interested in the last fifty thousand years and precise palaeoclimatic events, which at present are generally smoothed for this period of analysis.

Consequently, the available palaeoclimatic records must be analysed with a particulary critical approach but without any methodological *a priori*. It is for example possible to find with an erroneous method a real palaeoclimatic event, real because recognised with another valid method, in which case one should not reject an erroneous method, a valid method and a real climatic event.

1.3 Palaeoclimatic signatures between 30,000 and 20,000 bp in France

In France, the large mammals are characteristic of a quite temperate environment with red deer more abundant than reindeer, and the presence of *Equus hydruntinus*, roe deer, *Cervus megaceros*, and boar. During the Pleniglacial the environment is characterised by an overwhelming abundance of reindeer over red deer, and a variable presence of horse, bovines, and ibexes depending on the biotope. North of the Loire basin, mammoth, rhinoceros and great felines are present in significant numbers.

The rodents are represented by extant species during temperate periods (Würm interstadial, Arcy, Maisières). During cold and dry periods, the presence of *Dicrostonyx torquatus* and *Microtus oeconomus/malei* is characteristic. North of the Loire basin, the presence of *Lemmus lemmus* is also characteristic.

Concerning palynology, the scarcity or abundance of deciduous tree species gives an indication of the severity of the climate, but it is the comparison of the general diagram with type-diagrams of the actual environments which can only authorise a palaeoenvironmental diagnosis.

The sedimentology of rock shelters shows that the temperate or wet periods are characterised by chemical changes, erosion, runoff, washing, draining and hiatuses. The cold periods are characterised by cryoclastic events, cryoturbation, and solifluction. The sedimentology of loess sequences indicates that temperate periods are characterised by fossil soils or gleys, while cold periods of the late Würm are characterised by loess deposits.

1.4 Palaeoclimatic events of the begining of the late Würm

The Würm interstadial (Hengelo-les Cottès), located around 38,000 bp is, in cave or rock shelter deposits, at the origin of important hiatuses or modifications. From around 34,000 until 31,500 bp, a cold and dry climate occurs which is characterised by an important cryoclastism, which is easy to point out in rock shelter sequences.

The following temperate oscillation (Arcy-Denekamp), around 31,500 until 30,500 bp, is associated with alteration events, and the presence of a temperate fauna of large mammals and extant species of rodents.

After a brief cold period between 30,500 and 29,500 bp, another temperate and wetter oscillation (Maisières), between 29,500 and 28,500 bp, is often characterised by hiatuses in the sequences due to important erosions which have cleared the underlying archaeological levels. The aurignacian industries end during that period (La Ferrassie, Le Facteur, Pataud, Roc de Combe).

The gravettian industries (early Gravettian) appear at the beginning of the following cold and dry period, between 28,500 and 26,000 bp.

A last and weak temperate (?) oscillation (Tursac), dated between 26,000 and 24,000 bp has been indicated by sedimentology and palynology in rock shelters, but not in palaeozoological data, invoking questions about its real climatic significance (Laville and Thibaud 1967; Arl. Leroi-Gourhan 1968). The Noaillian industries (middle Gravettian) are generally associated with the Tursac oscillation.

A Pleniglacial climate then returns, leading to the Glacial Maximum of the Late Würm around 18,000 bp. A late Gravettian is associated between 24,000 and 21,000 bp in this period.

In the loess sequences, the Arcy and Maisières oscillations have been pointed out in the open air site of Maisières-Canal, where they appear in two dated superposed fossil soils. The Tursac oscillation has not been demonstrated in Western loess sequences but is known in Central Europe (Pavlov II) and in Eastern Europe (Molodova V).

In Central and Eastern Europe, palaeoclimatologists, basing their results on fossil soil sequences, have generally preferred the concept of an Interpleniglacial (IOS 3), which covers the long period from about 45,000 to 25,000 bp. The Interpleniglacial, by definition, finishes around 25,000 bp after the Tursac oscillation in Western Europe, or after the Pavlov II soil in Central Europe, or after the Briansk complex of soils in Eastern Europe (Velitchko 1981).

1.5 Conclusions on climatic changes between 30,000 and 20,000 bp

The differences in the understanding of the last 40,000 years confirm that the period between 38,000 and 25,000 bp is a period of an oscillating climatic deterioration, followed by a cold and dry Pleniglacial period from 25,000 bp until the cold maximun around 18,000 bp.

2. Technical innovations

2.1 Technical types

In France, during the 30,000-20,000 bp period, two successive industries are known: Aurignacian and Gravettian.

Aurignacian industries are based on blade and bladelet debitage. Aurignacian assemblages are characterised by endscrapers more abundant than burins, numerous retouched blades, denticulates, notches, sidescrapers and splintered pieces; carinated and shouldered thick endscrapers, busked and carinated burins, and Dufour bladelets are correlated with temperate oscillations (Les Cottès, Arcy, Maisières).

The bone industry is abundant and particulary the bone points (*sagaies*) are characteristic of the different chronological aurignacian facies. Bladelet debitage is more abundant during temperate periods, while blade debitage is more abundant during cold periods. The aurignacian industries disappear at the end of the Maisières oscillation around 28,500 bp. There is evidence to suggest that the Aurignacian at the beginning appears to be a southern phenomenon, whatever its origin (native or otherwise). The Aurignacians spread towards the north of Europe when the climatic environment became more auspicious, particulary during the Arcy oscillation: northern France, England, Belgium, the Rhineland in Western Europe, Moravia, Hungary, and southern Poland in Central Europe, and the Crimea and the Don basin in Eastern Europe. It flows back to the south when the climatic conditions again became unfavourable (Djindjian 1988, 1991, 1993).

The gravettian industries are present in France between 28,500 and 21,000 bp. Historically, the Gravettian was initially defined as Upper Aurignacian (Breuil 1911), Perigordian (Peyrony 1933), Upper and Final Perigordian (Sonneville-Bordes 1960), and Gravettian (Lacorre 1960). The names of Noaillian (David 1985), Laugerian (Movius 1975), Protomagdalenian (Peyrony 1933), Fontirobertian (Delporte and Tuffreau 1973), and Bayacian (Lacorre 1960) have been proposed as typological facies, with chronological or functional meanings which are still discussed today (Sonneville-Bordes 1960; Bordes 1968b; Laville and Rigaud 1973; Djindjian and Bosselin 1994; Djindjian 1999). Attemps have also been made to compare the Gravettian of Western Europe with the Gravettian of Central Europe (Otte 1981; Kozlowski 1986).

The gravettian industries appear to belong to a northern population. Early sites are dated from 29,000 bp (according to several scholars from 30,500 bp) in Central Europe, along the Danube river, in Austria and Moravia, before diffusing to Western, Eastern or Mediterranean Europe. In the French Gravettian, the lithic industry is based on blade debitage.

Gravettian tools are clearly different from aurignacian tools: flint points are the most characteristic gravettian tools: stemmed points (Font Robert points), symmetrical points (*fléchettes*), backed points (Gravette points), backed micropoints (microgravette points). Morever, the burin technology is the most elaborate burin technology of the Upper Palaeolithic, particulary for two burins which could be in fact two bladelet cores: Noailles burins and Raysse burins. The bone or antler industry is not abundant: bone points are rare and not characteristic, except the Isturitz '*sagaie*' (Noaillian facies).

2.2 Quantitative variability of assemblages in the French Gravettian

The first settlement of the early Gravettian in France is in the cold phase immediately following the Maisières oscillation, around 28,500 bp.

The early Gravettian is characterised by industries where endscrapers are more numerous than burins (as in aurignacian industries) and with the emergence of arrow points: Font Robert points, *fléchettes*, and Gravette points. The corresponding assemblages are described under the name of Fontirobertian (Font Robert points and Gravette points), Bayacian (*fléchettes* and Gravette points), and early Gravettian (Gravette points only).

During the Tursac oscillation, a middle Gravettian is characterised by the disappearance of *fléchettes* and Font Robert points, a decrease in Gravette points, an increase in burins on truncation, and the emergence of Noailles burins, soon followed by the emergence of Raysse burins. The middle Gravettian has been variously interpreted either as a mediterranean arrival of new hunter-gatherers, the Noaillian, or a climatic adaptation of early gravettian hunter-gatherers to the Tursac environment. Analysis of ^{14}C dates from France, the Tyrrhenian coast of Italy and the Cantabrian coast in Spain, all synchronised around 26,000-24,000 bp, seems to favour the conclusion of a climatic adaptation. But the presence of Noailles burins only south of the Loire river in France, and the presence of the Gravettian during the same period north of the Loire river seems also to favour the conclusion of a population moving to northern latitudes due to the climatic changes of the Tursac oscillation. A third theory is based on the proposal of a replacement of the Noailles burin by Raysse burins north of the Loire river. In the absence of more complete data on the Gravettian in northern France and Belgium, it is dangerous to draw definitive conclusions.

After the end of the Tursac oscillation, the cold and dry Pleniglacial climate returns, and becomes progressively more severe until the maximum around 18,000 bp. A late Gravettian is present, which is typologically nearer to the early than the middle Gravettian, with the slight difference of more microgravette points than Gravette points. The corresponding assemblages have been described under the name of Laugerian.

The final Gravettian, also called Protomagdalenian, is characterised by a progressive increase in dihedral burins, retouched blades with the specific protomagdalenian retouch, and the emergence of simple bevelled base bone points.

Thereafter, gravettian industries show a technological transition towards the early Solutrean, with aurignacoïd elements, and decribed generally as the Aurignacian V or final Aurignacian. These transition industries are now considered as Protosolutrean (Djindjian 1999; Zilhão *et al.* 1999).

2.3 Gravettian settlements

In contrast to Central or Eastern Europe, open air settlements are rare and generally not or badly published. Nevertheless, it seems that the Gravettians in France could have abandoned numerous settlements that past and recent surveys of palaeolithic sites have not yet discovered.

The most interesting site is certainly the open air site of La Vigne Brun at Villerest (Loire), unfortunately known only by a few preliminary reports (Combier *et al.* 1982): several sub-circular dwellings have been excavated over a surface of 250 m^2. The more evident structures, depressions of 50 cm in depth, are surrounded with stone rows mixed with rolls of soil, generating a circle around an empty inner space. It has been concluded that this was a settlement of four to five dwellings of 4 by 3 m, for a population of about thirty people.

Similar open air settlements have been observed in the final gravettian site of Plasenn-al-Lomm in Brittany (Monnier 1982) and in the late gravettian site of Corbiac in the Périgord (Bordes 1968a). Late and final gravettian dwellings in caves and rock shelters are also known: the Grotte du Renne at Arcy-sur-Cure in the Paris basin (A. and Arl. Leroi-Gourhan 1964), the Blot rock shelter in the Auvergne (Delporte 1969), and the La Salpétrière cave in the Languedoc (Escalon de Fonton 1966).

It seems that the Gravettians frequently built open air settlements in the open regions north of the Loire valley which are favourable to hunting large mammals, such as mammoths (Paris basin: Arcy-sur-Cure), horse (Saône basin: Solutré), and reindeer (southwestern France). From the available data, it is difficult today to draw conclusions about the importance, the duration or the seasonality of the gravettian dwellings. In France, the gravettian rock shelters are numerous in central-western and south-western areas (Vienne, Charentes, Périgord, Quercy), but rare in the Pyrenees and Cantabria, and in the Languedoc, Catalonia and the Spanish mediterranean coast. The difficulty to survey sites elsewhere than in rock shelters strongly biases the sampling of known open air sites. It is therefore necessary to be cautious in drawing conclusions on (seasonal) population movements between the open country of the northern latitudes and the Aquitaine rock shelters.

2.4 Changes in geographical distribution of gravettian settlements

The geographical distribution of the Aurignacian reaches its maximum during the Arcy oscillation: northern and eastern France, Belgium, northern Germany, and even Great Britain. As the excavations were done a long time ago, it is impossible to be sure of the presence of the Aurignacian in Northern Europe after 30,000 bp, while it appears to be present in the Périgord until 28,500 bp, the end of the Maisières oscillation.

At the same time of the Maisières oscillation, and perhaps earlier (but still to be confirmed), the early Gravettian is certainly known in Central Europe (Austria, Moravia, Bavaria) and in Northern Europe (Belgium, Germany, Great Britain?).

The early Gravettian, in its Fontirobertian facies, appears in France in the cold inter Maisières-Tursac period, probably as a result of a reflux of Gravettians with a stemmed point from Northern Europe (Maisières-Canal, Bilzingsleben), via the Paris basin (Cirque de la Patrie), to the south, flowing down the Loire river towards Aquitaine (Vienne, Charentes, Périgord), or upstream (Vigne Brun at Villerest). In its extension towards the south, the facies is limited to the Charentes (Les Vachons), the Périgord (La Ferrassie, Le Flageolet), the Corrèze (La Font-Robert), but absent in the Pyrenees, Languedoc, the Provence, Italy, Cantabria, Catalonia and the Spanish mediterranean coast.

Apparently, at the same time, an early Gravettian, in its bayacian facies (*fléchettes*) is known only from two sites in the Périgord, La Gravette and Pataud, without any possible stratigraphical link between the fontirobertian and the bayacian facies. Nevertheless, in the Upper Danube valley, in Bavaria and Baden-Württemberg, gravettian levels have the two types in the same level (cf. Scheer, this volume). A diffusion from Central Europe has been proposed by Otte (1981) and Kozlowski (1986) but so far no gravettian sites with *fléchettes* have been discovered between the Périgord and the Upper Danube, a distance of 1500 km. Both the mediterranean and the northern route are also plausible, but not yet demonstrated. It is also possible that the two types in the same facies in Germany were a functional specialisation for the mammal hunt[1]. The following phase of the early Gravettian is characterised by the disappearance of symmetrical points (Font Robert, *fléchette*) and an increase in Gravette points. The geographical distribution of this facies (early Gravettian with only Gravette points) spreads to the south, including the French Pyrenees, Languedoc, and the Provence and apparently Italy[2].

The middle Gravettian, during the Tursac oscillation, is marked by an important change in the geographical distribution in Western Europe, even if the magnitude of the climatic change should not be overestimated as it is an integral part of a general trend towards the Glacial Maximum. The Noailles burin appears simultaneously in numerous sites on the Tyrrhenian coast in Italy, the Provence, Languedoc, and in the French and Cantabrian Pyrenees, as far as the Loire valley. It seems that the Noailles burin did not cross the Loire valley, whilst in the south it has not been demonstrated on the Spanish mediterranean coast. In my opinion, it is not older in Italy (aberrant ^{14}C dates of La Cala)[3] or younger on the Cantabrian coast (mixing of several archaeological levels in Amalda). With the Noailles burin is associated the Raysse (or Bassaler) burin, which appears in the Noaillian levels. The Raysse burin seems to replace progressively the Noailles burin. The sites with the Rayssian typological facies have a more northern distribution, including the Paris basin, Brittany, and Belgium, but on the other hand, the Raysse burin is not known in Spain, Italy and in southern France (Pyrenees, Languedoc, Provence).

The geographical distribution of the late Gravettian seems to continue the northern reconquest and readaptation of the Rayssian facies, despite the progressive climatic deterioration. It is noteworthy to record the maximum geographical distribution of gravettian sites from Southern Europe (Spanish mediterranean coast, Cantabrian coast, Provence, Languedoc, Pyrenees) as far as the Paris basin, the Saône basin and even the Rhine valley (cf. Bosinski, this volume).

The flowing back to the south, despite the remarkable adaptation to the cold and dry climate, seems nevertheless unavoidable and happens for the final Gravettians (Protomagdalenians) first, and then for the protosolutrean industries, when we see the Gravettians in the Périgord (Laugerie-Haute), in eastern Languedoc (La Salpétrière), on the Cantabrian coast (Riera), in Catalonia (Reclau viver), on the Spanish mediterranean coast (Parpalló, Barranc Blanc, Beneito), and in Portugal (Vale Comprido), locally transforming towards the solutrean industries.

In conclusion, the Gravettians in France show the following characteristics:

- sites are located at altitudes lower than 600 m,
- sites are located at various latitudes, perhaps confirming only the insufficiency of present data, but showing nevertheless the good adaptation of the Gravettians to Northern Europe (Great Britain, Belgium, the Rhineland, etc.), better than during the aurignacian period, in areas which will not be reoccupied before the Bölling oscillation (Late Magdalenian, Creswellian, Hamburgian).
- the main movement follows a south to north course along the line Cantabria-Périgord-Charentes-Vienne-Loire. The north-south route of the Rhône valley was apparently not used, taking into account the distance between Solutré and the first sites in the Ardèche of over about 300 km[4]. The west-east movements correspond to a line Liguria-Provence-Languedoc-Pyrenees-Cantabria and a second route following the Loire valley towards the Paris basin (via the Loing river), and the Saône basin (via the Dheune and Bourbince rivers), then towards the Rhine (via the Doubs valley). The course towards the Massif Central from the north ends in a cul-de-sac.
- the Gravettians, on the basis of present data, apparently move into Western Europe from Central Europe, at least by the northern route, during the 29th millennium, the Maisières temperate oscillation. With the progressive worsening of the Pleniglacial climate, from the 24th millennium onwards, the Gravettians flow back to the south where the transformation to the Solutrean occurs.

2.5 Continuity with the earlier period of 35,000-30,000 bp

The earlier period 35,000-30,000 bp is a natural part of the same time scale of this working programme, both as regards the palaeoclimatic unity and the cultural unity of palaeolithic people.

In France (except for the Mediterranan coast and the Rhône valley), the Middle Palaeolithic industries were transformed during the Würm interstadial in châtelperronian industries which disappear with the first cold period of the late Würm, particulary in the western area and the Paris basin (Arcy, Quincay, etc.). A clear and long hiatus thus exists in France of about 8000 years between the châtelperronian and gravettian industries. The aurignacian industries, which appear everywhere by a south to north expansion from the Mediterranean coast, is present in middle and northern Europe between 38,000 and 28,500 bp. Relationships between the Aurignacian and Gravettian seem today to correspond to apparently different people, adapted to different latitudes, contemporaneous through a brief time period between 29,000 and 28,000 bp. It could also be possible that the Gravettians correspond to a northern adaptation of the Aurignacians after the Arcy interstadial.

3. Population movement and demography on a European scale

3.1 ^{14}C dates

The dates given below (Table 1) concern a subset of the published dates of the French Gravettian. The ^{14}C dates of this period prior to 20,000 bp give results with the classic method (without accelerator) of which the precision is generally far beyond the standard deviation. However, more recent datings with the accelerator method certainly give more reliable results, and only they should be considered.

The chronology of the Early and Mid Upper Palaeolithic in France can be summarised as follows:

3.2 First and last populated areas

Gravettian industries belong to a hunter-gatherer culture which has a subsistence mode adapted to the open plains of Northern Europe, with seasonal movements between northern and central areas of Europe, and with easy adaptations to the palaeoclimatic deterioration of the begining of the Late Würm. The Gravettian appears in France with point industries: Font Robert points for facies Ia, *fléchette* points for facies Ib, arriving via a northern route in Western Europe. With the onset of the maximum of the Ice Age, the Gravettian disappears in a general flow towards the south, in refuge areas in the Périgord, eastern Languedoc, the Spanish and Italian mediterranean coasts, and Portugal. In the western part of the Rhône valley, there occurs a transformation into solutrean industries and in the eastern part of the Rhône valley into early epigravettian industries.

3.3 Stylistic areas and territories

The qualitative and quantitative variabilities of gravettian industries in France show a chronological evolution as previously described, which is explained as an adaptation to palaeoclimatic and palaeoenvironmental variations, forcing the hunter-gatherers to adapt their subsistence strategies and consequently their tool kit: apart from a chronological meaning, the different types of points in fact seem also to have a functional meaning, of adaptation to a specialised kind of hunting. Such a feature apparently cannot be used to define territories within the study area. This is certainly not the case at a European scale where it seems possible to define territories limited by geographical barriers, which are more or less impassable at a given chronological period.

During the early Gravettian I, the distribution of Font Robert point industries shows an easy population movement in the northern plains, in France, Belgium, and Germany, as far as Central Europe. The *fléchette* and Font Robert points of the Upper Danube valley are very similar to the equivalent industries in France (cf. Scheer, this volume). However, from the early Gravettian II, and later, such a movement is impossible and Western Europe becomes isolated from Central Europe.

During the middle Gravettian, the distribution of Noailles burin sites, from the Loire valley to the south of the Tyrrhenian coast in the east and to the Cantabrian coast to the west, shows a population movement between the south and north of Western Europe, with an unexpected exception of the Spanish mediterranean coast.

Table 1. Chronology of the Early and Mid Upper Palaeolithic in France.

31,000-28,500 bp: Aurignacian II-III-IV		
28,500-27,000 bp: Early Gravettian Ia (fléchette point facies: Bayacian, Périgordian IV)		
Abri Pataud (Les Eyzies-de-Tayac, Dordogne)		
5	28,400 ± 1100 bp	OxA 169
28,500-27,000 bp: Early Gravettian Ib (Font Robert points facies ('Périgordian Va'))		
Abri de La Ferrassie (Savignac-de-Miremont, Dordogne)		
D2X	27,900 ± 770 bp	OxA 402
D2H	27,530 ± 720 bp	OxA 403
27,000-26,000 bp: Early Gravettian II (Gravette point facies ('Périgordian IV, Vb'))		
Abri Pataud (Les Eyzies-de-Tayac, Dordogne)		
5	26,000 ± 1000 bp	OxA 581
5	26,600 ± 200 bp	GrN 4477
5	27,660 ± 260 bp	GrN 4662
5	28,150 ± 225 bp	GrN 4634
5	26,090 ± 310 bp	GrN 5012
5i	26,330 ± 230 bp	GrN 639
Abri du Flageolet I (Bezenac, Dordogne)		
VI	26,500 ± 900 bp	OxA 579
26,000-25,000 bp: Middle Gravettian I (Noaillian burin facies ('Périgordien Vc'))		
Abri du Facteur (Tursac, Dordogne)		
10/11	24,720 ± 600 bp	OxA 583
10/11	24,210 ± 500 bp	OxA 584
10/11	24,400 ± 600 bp	OxA 585
10/11	24,690 ± 600 bp	OxA 586
10/11	25,450 ± 650 bp	OxA 594
10/11	25,630 ± 650 bp	OxA 595
Abri Pataud (Les Eyzies-de-Tayac, Dordogne)		
4	26,300 ± 900 bp	OxA 374
4	6,900 ± 1000 bp	OxA 168
Grotte d'Enlene (Montesquieu-Avantès, Ariège)		
5	24,600 ± 350 bp	Gif 6656
Abri de La Ferrassie (Savignac-de-Miremont, Dordogne)		
B7	23,800 ±530 bp	OxA 401

Table 1 continued. Chronology of the Early and Mid Upper Palaeolithic in France.

Grotte de Pegourié (Caniac-du-Causse, Lot)		
10	24,200 ± 1100 bp	Ly 1835
25,000-24,000 bp: Middle Gravettian II (Rayssian burin facies ('Périgordian Vc))		
Abri du Raysse (Brive, Corrèze)		
	25,000 ± 660 bp	Ly 2782
Abri Pataud (Les Eyzies-de-Tayac, Dordogne)		
3-4	25,500 ± 700 bp	OxA 687
3-4	26,100 ± 900 bp	OxA 166
4a	26,500 ± 980 bp	OxA 167
Abri du Flageolet I (Bezenac, Dordogne)		
V	25,700 ± 700 bp	OxA 447
24,000-22,000 bp: Late Gravettian (Laugérian facies ('Périgordien VI'))		
Abri du Flageolet I (Bezenac, Dordogne)		
I-III	24,600 ± 700 bp	OxA 448
Abri Pataud (Les Eyzies-de-Tayac, Dordogne)		
3	23,180 ± 670 bp	OxA 163
3	24,250 ± 750 bp	OxA 164
3	24,440 ± 740 bp	OxA 165
3	24,500 ± 600 bp	OxA 686
3	22,780 ± 140 bp	GrN 4506
3	23,010 ± 170 bp	GrN 4721
Station de la Pente des Brosses (Montigny sur Loing, Seine et Marne)		
	22,000 ± 600 bp	OxA 179
	22,500 ± 600 bp	OxA 180
Grotte de la Salpétrière (Rémoulins, Gard)		
30-O	22,350 ± 350 bp	Mc 2450
22,000-21,500 bp: Final Gravettian (Protomagdalenian facies) ('Périgordian VII')		
Abri du Blot (Cerzat, Haute-Loire)		
Jm	21,700 ± 1200 bp	Ly 564
Gj	21,500 ± 700 bp	Ly 565
Abri de Laugerie-Haute (Les Eyzies-de-Tayac, Dordogne)		
36	21,980 ± 250 bp	GrN 1876

Table 1 continued. Chronology of the Early and Mid Upper Palaeolithic in France.

Abri Pataud (Les Eyzies-de-Tayac, Dordogne)		
2	22,000 ±600 bp	OxA 162
2	21,940 ± 250 bp	GrN 1862
2	21,380 ± 340 bp	GrN 4231
2	21,980 ± 250 bp	GrN 1876
21,500-20,500 bp: Protosolutrean (Ex-final Aurignacian)		
Grotte de La Salpétrière (Rémoulins, Gard)		
30ab	20,500 ± 410 bp	Ly 1803
30a	20,630 ± 770 bp	Ly 942
30e	21,760 ± 490 bp	Ly 943
30m	21,380 ± 760 bp	Ly 946
30-0	20,860 ± 460 bp	Ly 945

During the late Gravettian, the distribution of the Laugerian facies industries shows a movement from the Mediterranean Sea towards the areas north of the Loire valley as far as the Rhine valley (cf. Bosinski, this volume), but without following the Upper Danube valley as far as Central Europe.

During the final Gravettian and the Protosolutrean, there emerges a new frontier, the Rhône river, between the western solutrean industries and the eastern early epigravettian industries. Western Europe is then separated from Central Europe until the magdalenian expansion, which starts from Spain and southwestern France around 17,000 bp and arrives in Moravia and Poland around 14,000 bp.

3.4 RAW MATERIAL PROCUREMENT

3.4.1 Flint procurement

The Aquitaine area is a region particulary rich in various good quality flint outcrops. This is the reason why flint procurement is made at a distance from the dwellings of generally less than 100 kilometres (Demars 1982). The best and perhaps only example of a long distance flint procurement is the Auvergne, a volcanic area very poor in flint outcrops. The late and final gravettian flint tools of the Le Blot rock shelter, in the Upper Loire valley, have been knapped on a raw material which comes from the region of Valencay/Selles sur Cher (Indre, Loire-et-Cher), several hundred kilometres towards the north of Le Blot, thereby proving that the Auvergne was populated from the north by following up the Allier and Loire valleys (Masson 1981).

3.4.2 Shell procurement

Y. Taborin's publication (1995) on the shell ornaments of the Upper Palaeolithic shows shell procurement movements.

During the Aurignacian I, the shell procurement shows relationships between the Mediterranean and Atlantic coasts, while during the Aurignacian II, the sites of the Périgord no longer have any shell procurement from the Mediterranean coast.

During the early Gravettian, there is evidence from French sites that there is procurement from the Atlantic coast, while in the middle Gravettian (Noaillian), the same sites show a Mediterranean procurement. These data are in perfect agreement with the previous conclusions concerning the chronological and regional distribution of gravettian industrial facies.

3.5 Gravettian art

Gravettian cave art is not well identified. The recent discoveries in the Cosquer and Chauvet caves, and the new accelerator ^{14}C dates of some paintings, bones or charcoal associated with the paintings have shown the need to revise totally the chronological framework of Early and Mid Upper Palaeolithic cave art (Table 2). This work has only just begun. For example, the negative hands of Cosquer and Gargas seem to be characteristic of the early Gravettian. The caves of Cougnac (*Megaceros*) and Pech-Merle (horse), and the Grande Grotte at Arcy-sur-Cure have paintings with ^{14}C dates which relate them to the Gravettian.

Gravettian art in France is mainly characterised by ivory or stone female statuettes, most of which were discovered in the nineteenth century, and for which the stratigraphical attributions are unknown: Brassempouy, Lespugue, Sireuil, Montpazier. The Venus of Tursac is the only statuette with a clear stratigraphical attribution in archaeological level 10-11 (middle Gravettian of Noaillian facies) in the Le Facteur rock shelter in Tursac.

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Table 2 New accelerator ^{14}C dates of gravettian cave art

Grotte Cosquer (Cassis, Bouches-du-Rhône)		
27,870 ± 430 bp	GifA 92350	Charcoal
27,110 ± 390 bp	GifA 92409	Negative Hand
27,110 ± 350 bp	GifA 92491	Negative hand
26,360 ± 400 bp	GifA 92349	
Grotte de Gargas (Aventignan, Hautes-Pyrénées)		
26,810 ± 410 bp	GifA 92369	Bone
Grotte de Cougnac (Payrignac, Lot)		
25,120 ± 390 bp	GifA 92425	Female Mégacéros
19,500 ± 270 bp	GifA 91324	Female Mégacéros
22,750 ± 390 bp	GifA 92426	Male Mégacéros
23,610 ± 350 bp	GifA 91183	Male Mégacéros
Grande Grotte (Arcy-sur-Cure, Yonne)		
27,950 ± 440 bp	GifA 95620	Burnt bone
26,700 ± 410 bp	GifA 94589	Burnt bone
26,250 ± 500 bp	OxA 5003	Burnt bone
27,630 ±400 bp	GifA 92330	Charcoal
28,250 ± 430 bp	GifA 91370	Charcoal
Grotte de Pech-Merle (Cabrerets, Lot)		
24,640 ± 390 bp	GifA 95357	Right punct. Horse

3.6 Burials and human bone remains

No burials in France can be dated indisputably to the Early and Mid Upper Palaeolithic due to the age of the discovery. The following burials can as a whole be attributed to the Early and Mid Upper Palaeolithic, awaiting confirmation by ^{14}C dates:

- Cro-Magnon burials (5) (supposedly Aurignacian)
- Combe-Capelle burial (1) (supposedly Châtelperronian).

Human bone remains, essentially constituted by teeth, and cranium and mandible fragments, have been discovered in sometimes dubious gravettian stratigraphical contexts (Orban 1988-93):

- Pataud rock shelter (Périgord): disturbed burials or scattered bone remains of three adults, two children, and a baby in the final (protomagdalenian) gravettian level,
- Le Blot (Auvergne): (protomagdalenian) final gravettian level,
- Isturitz (Landes): levels III and IV,
- La Ferrassie (Périgord): levels J, K, L of the Peyrony excavations,
- La Crouzade (Aude),
- Les Vachons (Charentes): level 3,
- Le Marronier (Ardèche).

In conclusion, the human gravettian remains in France are particulary poor, and it is quite impossible to extract some meaningful information on the physical remains of the Gravettians in France. Outside France, the nearest gravettian burials are in Liguria (Grimaldi caves, Arene Candide rock shelter) and in the U.K. (Paviland cave).

3.7 The food subsistence economy

The only known food subsistence resources of hunter-gatherers during the 30,000-20,000 bp period are based on data on hunted animals. The available data however do not allow us to construct a global synthesis of the whole French territory. The best known areas are the Aquitaine (Delpech 1983), and the Languedoc (Bazile *et al.* 1982). Data on the Provence (sites without fauna), Charentes, Indre, Pyrenees, north of the Loire valley, and the east are not known or published.

The different taxa vary with altitude and latitude, but also their geographical distribution follows in time the climatic variations. Several rare species have a temperate climate indication: *Equus hydruntinus, Cervus megaceros*, red deer, roe deer, and boar. The more numerous species during the MUP are reindeer, horse, red deer, bison/ox, ibex, and chamois. In the northern and eastern parts of France, mammoth and rhinoceros are more frequent. The dominant species in the Périgord are reindeer and red deer, in the Languedoc reindeer and horse, and in the Saône basin horse and mammoth.

4. Conclusions

From 30,000 to 20,000 bp in France, one of the larger geographical areas of Western Europe during the Upper Palaeolithic, the gravettian population of hunter-gatherers, accustomed to hunting large mammals in the northern areas of Western, Central and Eastern Europe, is forced, because of the progressive and oscillating climatic deterioration of the late Würm, to numerous adaptations, which are represented by important variations in lithic and bone industries, to cultural speciations due to geographical separations between Western and Central Europe, to migrations from north to south and back, and then to a final withdrawal to the Mediterranean coasts, where a transformation took place into the Solutrean.

notes

1 Both *fléchettes* and Font Robert points are present in the assemblage of the La Vigne Brun open air site at Villerest (Loire valley). (J.L. Porte, pers. comm.).

2 The existence of an early Gravettian with only Gravette points under the Noaillian layers is confirmed in the La Cala rock shelter near Salerne (Campanie) (Boscato *et al.* 1997).

3 New ^{14}C AMS dates of La Cala (26,880 bp, 26,380 bp) for the early gravettian levels confirm the aberrant old dates for the Noaillian levels (Boscato *et al.* 1997).

4 Near Valence, on the right bank of the Rhône river, several open air sites have recently revealed a poor gravettian industry, often associated with hunted mammoths (Lèches, Tayac, Jaulan, Meret), with Font Robert points, proving a northern origin from the Saône river. Nearby, the open air site of Bouzil, with Noaillian features, is indicating a southern origin from the Ardèche (Onoratini and Combier 1998).

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François Djindjian
CNRS/EP 1730, Laboratoire ERS 383
Maison René Ginouvès
21 Allée de l'Université
92 000 Nanterre Cedex
or
Université de Paris I
3 Rue Michelet
75006 Paris
France

Jean-Philippe Rigaud

25 Human adaptation to the climatic deterioration of the last Pleniglacial in southwestern France (30,000-20,000 bp)

For an evaluation of the possible consequences of the climatic deterioration in the period 30-20 kyr on human adaptations, it is necessary to develop a palaeoenvironmental framework based on critical usage of multidisciplinary studies. The climatic sequence established here is used to analyse the character of the relationship between technical and typological innovations of the Aurignacian and the Gravettian and particular climatic phases. No clear-cut correlation can be established, be it that the stability of aurignacian industries corresponds with a period of climatic instability, and that the large variability and creativity of the Gravettians is contemporaneous with the climatic deterioration preceding the LGM.

1. Introduction

The possible consequences of the climatic deterioration preceding the last Pleniglacial for the behaviour of groups of humans cannot be evaluated without an accurate and reliable, and also detailed, knowledge of the palaeoenvironmental data of that period and their geographical variability. This first observation presents some problems that we will tackle below.

On the other hand, we cannot interpret systematically and solely in terms of an adaptive process the synchronic and diachronic variations of the archaeological data that are often of a mainly techno-typological nature. The technical adaptation is a response to the environmental changes, but the search for more accomodating conditions that justify the displacement of groups of humans is another one; local adaptations and exterior influences constitute a complex process that we can only perceive through a limited and partial record of the preserved and archaeologically recorded human activities.

In this paper we will try to establish the character of the relations between the techno-typological characteristics of the industries at the beginning of the Upper Palaeolithic and the significant climatic fluctuations that have marked this period. This approach will here be limited to the lithic industries but it is obvious that it would also be advisable to search in other areas of human activity, such as subsistence and spatial organisation, for adaptive responses to environmental changes, for which we have to date only very little reliable information.

2. Evaluation of the reliability of palaeoenvironmental data corresponding to the climatic deterioration of the last Pleniglacial

Since the 1950's, thanks to the systematic implementation of multidisciplinary studies, we have witnessed the development of chronoclimatic frameworks based on data from geology and biostratigraphy (palynological, palaeontological and micropalaeontological biozonations), and on those of physical-chemical methods (isotope stages and quantitative datings). But when used, these chronoclimatic frameworks very often only have a local value and differences are brought to light, even contradictions, with the result that making syntheses on a larger scale is hazardous, if not impossible. The development of new analytical methods and the emergence of new concepts in matters of environmental sciences have forced us to look critically at the characterisation of the climatic phases contemporary with the first cultures of the Upper Palaeolithic and at the use thereof one can make within the framework of medium and long distance correlations.

The basic data that have enabled us to develop the palaeoenvironmental interpretations relating to climate, flora, and fauna usually derive from stratigraphic sequences that also contain remains of human activities. These stratigraphic sequences have too often been considered as equivalent 'archaeo-sedimentary assemblages', without any special regard for their homogeneity, sedimentary environments and different sedimentary dynamics that directed their accumulation or affected their preservation. Recent work (Bertran and Texier 1995) has shown the importance of this information for evaluating the reliability of palaeoenvironmental data and the representativity of the archaeological assemblages that the sediments contain. It is for this reason, for example, that the climatic interpretation – and the correlations that will be drawn from them – of the pollen spectrum of deposits, which we know moreover to have been disturbed by processes as solifluction or bioturbation, remains hazardous.

The comparison of radiometric dates with data from sedimentology, palynology and palaeontology has led us to demonstrate a certain number of inconsistencies in the palaeoenvironmental sequence of the Upper Palaeolithic of southwestern France (Delpech *et al.* 1994), and therefore to propose extreme caution in the use, if not at times the withdrawal, of terms too often ill-defined, inaccurate or inappropriate ('Kesselt', 'Maisières', 'Laugerie', 'Lascaux', etc.). Furthermore, can we reasonably correlate the cultural stage 'Aurignacian IV' – only known from the rock shelter deposits of La Ferrassie in the Dordogne, with an average age of around 23,500 bp, but which the ^{14}C datings place overall between 31,000 and 21,000 bp (Djindjian 1986: 54) – with the climatic episode 'Maisières' demonstrated in an open air site in Belgium dated to 28,000 bp (Haesaerts 1994)?

Only the major climatic occurrences that are characteristic and have been observed on a larger scale will therefore be taken into consideration in the rest of this paper; the search for arguments that allow us to affirm the real contemporaneity of geological, palaeobotanical, archaeozoological, and anthropological elements within an archaeo-sedimentary assemblage is a prerequisite one can no longer ignore when proposing archaeological correlations on a European scale.

New analytical methods, current reference systems, and a more general notion of palaeoenvironments have shown that many of the old interpretations were based on erroneous postulates (Le Ber 1988; Texier and Le Ber 1988). Thus, for example, an abundance of *éboulis* in a lithostratigraphy can no longer be interpreted as a result of frost processes during an extremely cold phase, as microscopic analysis of the sediments and the investigation of signatures of the sedimentary dynamics lead to different interpretations of these data. Moreover, apart from a few exceptions (Griggo 1996), we are often not able to characterise and quantify the palaeoenvironmental data in climatic terms and to specify whether these observed fluctuations have any significance on the strictly local scale of the site, or whether they apply on a regional or more general scale. We therefore lay ourselves open to serious errors when attempting climato-chronological correlations over a large distance, as stressed by quaternary geologists and quaternary palaeoenvironmental specialists.

Given the above and with the prospect of drawing up a *palaeoenvironmental framework usable on a European scale*, we have collected here data for the period 40-25 kyr, which correspond to the aurignacian and gravettian occupation in southwestern France. These data come largely from recently excavated sites which have been the subject of multidisciplinary studies (l'Abri Pataud, La Ferrassie, Le Flageolet 1, Roc de Combe, Maldidier, la Grotte XVI), but also results from other disciplines such as glaciology, oceanography, meteorology, and palaeontology have been incorporated.

3. Characterisation of the climatic deterioration leading to the last Pleniglacial in southwestern France

Following the severe cold of oxygen isotope stage (OIS) 4, a period called 'Interstadial Würm II/III' or 'Würmian Interstadial' was for a long time characterised by the development of a soil at the time of the climatic optimum, followed by an erosional phase (truncated soil) and by a phase of sedimentation by pluvial run-off or colluvium at the end of the 'interstadial' (Laville 1975). The 'Interstadial of Les Cottès' of the pollen zonation could correspond to the last part of this interstadial, between 36 and 34.5 kyr bp.

The temperature fluctuations deduced from analysis of the isotope curve established from drilling cores in the northeastern Atlantic (Pujol and Turon 1986), and the pollen record of Les Echets (Beaulieu and Reille 1984) show that OIS 3 is characterised by a marked climatic instability, tending towards a general cooling. This instability settles down towards the end of the stage, with a drop in temperatures that accelerates and becomes more pronounced, reaching its climax during OIS 2. But it seems that there is a divergence of opinion between the marine quaternary specialists and those working on continental deposits about the change from OIS 3 to OIS 2. For the former this change would be placed around 29 kyr bp, while for the latter it would be later, around 23 kyr. On the basis of the ice core data, the climatic dynamic of this period is characterised by a series of oscillations that are getting colder and less humid, difficult to correlate though to those recorded in continental deposits (Lorius *et al.* 1988; Jousel *et al.* 1994).

In continental environments this deterioration is also characterised by a first phase of climatic instability during which, in a generally cool context, slightly more humid periods alternate with drier temperate ones. These climatic fluctuations can be represented by the oscillations of 'Arcy', 'Kesselt-Maisières' and 'Tursac', that are demonstrated by palynology, but the rapid rate of these climatic fluctuations, the weak resolution, and the uncertainty of our chronological perception, make it often difficult to establish definite intersite correlations.

The faunal assemblages of this period contain reindeer, horse, red deer, bison, wild boar, *Equus hydruntinus* and mammoth in an open landscape of wooded steppe (Delpech 1993, table I, pp. 76-79).

After 'Tursac', the second phase of this deterioration corresponds to a progressive beginning of colder and drier conditions (Delpech 1993). The percentage of woodland decreases at the same time as the thermophile forest flora declines. The Last Glacial Maximum (LGM) is indicated in southwestern France by the presence of a continuous permafrost in northern Aquitaine and a discontinuous one further south, demonstrating particularly harsh conditions with average annual temperatures possibly below -6^{O} C in the northeast of Aquitaine (Texier 1990).

In the marine environment, OIS 2, corresponding to the Pleniglacial, testifies to extremely harsh conditions; the arctic waters invade the Gascogne gulf, causing a lowering of the average summer temperature in the order of 6° C (Caralp *et al.* 1982; Laville *et al.* 1983).

In view of the reservations expressed above, we can retain provisionally the following climatic sequence as a framework at the beginning of the last glacial maximum:

1. 39-34 kyr: 'Würmian Interstadial' of which the 'les Cottès Interstadial' would represent the final phase, characterised by a temperate and humid climate, with a percentage of woodland of around 45% and a heterogenous fauna where reindeer, wild boar and red deer live side by side, but where also horse, bison, mammoth, woolly rhinoceros, bovid and megaceros are present (Raynal and Guadelli 1990).
2. 34-31 kyr: Return of the cold, accompanied by a drop in the percentage of woodland and by a fauna characterised by reindeer, horse, and bison, ending in harsh and dry conditions.
3. 31-30 kyr: Temperate and not very humid climatic improvement, corresponding with the oscillation of 'Arcy' of the pollen zonation, during which the percentage of woodland rises again noticeably, with bovid, roe deer, red deer and reindeer.
4. 30-29 kyr: Return of a dry cold leading to a fall in the percentage of woodland, with reindeer, bison and horse.
5. 29-27 kyr: Setting in of a period of climatic instability with a generally cool and humid tendency, with a slightly higher percentage of woodland and a dominance of reindeer, red deer, and roe deer. It is during this period that the oscillation of 'Kesselt-Maisières' should be placed, although, given the data from southwestern France, it is impossible to place it with more precision in this climatic context.
6. 27-24 kyr: A period of temperate climatic improvement indicated above all by a much higher humidity, a higher percentage of woodland (40%), with reindeer, horse and red deer. This period corresponds to the oscillation of 'Tursac' of the pollen zonation.
7. 24-20 kyr: Beginning of more stable and harsher conditions, clearly colder with some more humid pulses. The percentage of woodland is generally low and the fauna is dominated by reindeer.
8. 20-19 kyr: Period with a slightly less marked cold and an increase in humidity, causing a rise in the percentage of woodland and the return of red deer with reindeer, which could be the oscillation of 'Laugerie' in the palynological zonation.
9. 19-18 kyr: Period of extreme cold corresponding with the Last Glacial Maximum, with a very low woodland percentage and a fauna with reindeer (of a smaller size), bison, horse, mammoth, saiga antelope and arctic fox.

4. Climatic fluctuations and human adaptations

On the basis of these data we can try to evaluate the impact of the environmental variations on the first populations of *Homo sapiens sapiens* in southwestern France. However, some points merit a preliminary critical reflection:

1. The duration and rate of certain climatic fluctuations and the changes in the biological environment occurred on a scale beyond human perception. A climatic deterioration or improvement on the scale of a millenium (which is what we notice given the results of our analyses) could not be detected as such by humans; it is even possible that technological behaviour and subsistence practices were more influenced by a series of harsh winters or more humid summers than by a slow degradation (or improvement) covering several centuries. However, observations made by analysis of glacial cores show that sometimes important climatic changes took place within a very short interval, in the order of a decade, which were perceptible for humans given the modifications in the environment, even if we admit a certain inertia in the response of the biological environment to climatic changes. Unfortunately our temporal scale does not have the necessary precision to appreciate technical changes over a period of a decade or century. The adaptive responses that we are trying to discern through the study of technical behaviour can therefore only be very general and strongly marked by inaccuracy and we should always take into account the possibility, if not probability, of incorrect correlations. The complexity of former ecosystems and the inaccuracy of our understanding compels us therefore to be extremely prudent on this point. Furthermore, parallel to the process of 'human-environment' adaptation, we should take the technical developments into account which, by a continuous accumulation, but at variable speed, of 'know-how techniques', makes the interpretation of these techno-typological changes difficult in a strictly adaptive sense.
2. The techno-typological analysis of aurignacian and gravettian industries in the Périgord has shown that for the generally contemporaneous cultural sequences, the intrasite variations are systematically lower than the intersite variations (Rigaud 1982). The study of the adaptive process therefore forces us to prefer data coming from sites with *long stratigraphical and cultural sequences* where the environmental parameters specific to each site have been relatively constant (sources of raw material, specific biotopes, geomorphology, hydrography, etc.).
3. Following the studies of Breuil, Peyrony, and D. de Sonneville-Bordes, the Upper Palaeolithic cultures were organised into evolutionary cultural stages on the basis of the appearance or disappearance of type fossils and various typological fluctuations. In this way 6 aurignacian stages were distinguished (from 0 to V), 6 perigordian stages (from I to VI) to which are added the proto-magdalenian (= Perigordian VII), and 7 magdalenian

stages (from 0 to VI). From the 1970's onwards this division into chronological stages has been more and more contested by the discovery of a large quantitative and typological variability in industries within one and the same cultural stage, by the presence of certain type fossils that do not conform to the 'classic scheme' (Rigaud 1982), and by the chronological inconsistencies revealed by absolute dating.

4. The quantitative variations of certain typological categories (endscrapers, burins, etc.) which have long been regarded as culturally or chronologically significant, are only so in particular instances. We have shown that they are very often due to functional causes (specific or majority activities) or to *archaeologically* biased sampling (limited excavations, old non-exhaustive or selective collections, etc.) (Rigaud 1982).

5. Technological innovations contemporary with the climatic deterioration of the last Pleniglacial

The first half of the Upper Palaeolithic was marked by a certain number of technological innovations.

Production of blades and bladelets

Having been practised for a long time by the Neanderthals (Bosinski *et al.* 1966; Combier 1967; Bordes 1977, 1980; Tuffreau and Révillion 1984; Cook 1986; Meignen 1994), blade production developed subsequently, and most notably in the Châtelperronian. But, as Pellegrin (1995) has shown, the châtelperronian blade production is clearly distinct from the blade production of certain much older mousterian facies and can also be distinguished from the aurignacian one. Moreover, with the Aurignacian appears an important bladelet production, in certain aurignacian technocomplexes linked to the abundance of 'carinated' forms and certain busked burins. This bladelet production, which on a European level marks the first phases, or the first aurignacian facies, could indicate amongst others the development of a new technical system in the fabrication of composite weapons as an alternative response to the production of points of organic material (Rigaud 1992). Furthermore, the study of the *chaines opératoires* of blades in the initial Upper Palaeolithic seems to indicate a real difference between the aurignacian and perigordian *chaines opératoires*; the aurignacian blade products being generally heavy, curved and thick, contrary to those of the Gravettian, for which the producers gave particular attention to the forming and the exploitation of cores, in order to produce blades with as little curvature as possible and of a regular thickness, the required characteristics for the fabrication of gravettian points and micro-points (Bordes and Crabtree 1969).

Projectile points

A basic element in the cynegetic equipment of hunters, the projectile point offers the possibility of reaching a prey at a distance of over two metres. In the mousterian tool kit objects offering this possibility are rare, on the other hand in the Châtelperronian the châtelperronian point on a blade support could form an armature with a launched weapon. In the Aurignacian the development of points made from organic material, or the alternative solution mentioned earlier, also confirms the aurignacian ability of reaching more distant prey. In the Gravettian, we witness, beside the gravettian points and micro-points, the appearance of specific projectile points (Font Robert points, truncated elements associated with a composite instrument), as well as a limited use of points of organic material. With the Solutrean the hunting tool kit develops with the implementation of a specific manufacturing technique to attain a bigger effectiveness: bifacial points and shouldered points (Geneste and Plisson 1986). This new capability considerably increased the effectiveness of the hunters in giving the possibility of reaching until then inaccessible prey, with considerable implications for their subsistence strategies.

6. The cultural sequence at the beginning of the Upper Palaeolithic in southwestern France

Established a long time ago mainly thanks to the excavations of D. Peyrony and the work of D. de Sonneville-Bordes (1960), the cultural sequence of the beginning of the Upper Palaeolithic in the Périgord was for several decades considered to be the classic reference sequence. The succession of early Upper Palaeolithic cultures and their 'evolutionary stages' was based on the archaeostratigraphies of a certain number of sites with a long sequence (Le Moustier, La Ferrassie, La Gravette, l'Abri Pataud, Laugerie-Haute) and on the environmental and radiometric data they yielded. Criticised in various ways (Djindjian 1992; Bosselin and Djindjian 1994) and updated in view of the results of recent excavations and work at several sites in the Périgord, amongst which eponymous sites (Movius 1963; Delporte 1968; Delporte and Tuffreau 1973, 1984; Rigaud 1982), it represents in fact less a series of 'stratotypes' than a regional sequence, established in a sedimentary context specific to caves and rock shelters. Though widely documented, this sequence cannot be put forward but with caution as a reference model outside the region where it was established. Nevertheless, as a result of the number, the detail, and the length of the archaeosequences, the 'Aquitaine model' is often quoted and used.

The aurignacian sequence

The first aurignacian occupations known in the Périgord lie, as table 1 shows, between 35 and 32 kyr bp.

Table 1. ^{14}C dates for early aurignacian sites in the Périgord.

Roc-de-Combe	level 7b	33,400 ± 1100	OxA 1262
Roc-de-Combe	level 7c	34,800 ± 1200	OxA 1263
Pataud	level 14	34,250 ± 675	GrN 4507
Pataud	level 14	33,330 ± 410	GrN 4720
Flageolet-1	level XI	33,800 ± 1800	OxA 598
Flageolet-1	level XI	34,300 ± 1100	GifA 95559
Flageolet-1	level XI	32,040 ± 850	GifA 95538
Ferrassie	level K6	33,200 ± 570	Gif 5751
Ferrassie	level K6	> 35,000	Gif 4279
Caminade	level D2i	34,140 ± 990	GifA 97187
Caminade	level F	35,400 ± 1100	GifA 97186
Caminade	level G*	37,200 ± 1500	GifA 97185
Castanet	base level	34,800 ± 1100	GifA 97312
Castanet	base level	35,200 ± 1100	GifA 97313

*a pollution with the underlying Mousterian has been noted (J.-G. Bordes 1998).

The earliest aurignacian industries in the Périgord are characterised by an abundance of objects with a scalar retouch, the so-called 'aurignacian retouch' (generally blades and endscrapers on blades), that become much rarer, even absent, in later industries. The carinated and thick-nosed carinated scrapers are present in variable proportions as are the Dufour bladelets; blade and bladelet production is abundant. These industries constitute the *early Aurignacian in the Périgord*, but we should emphasize that it seemed younger by some five thousand years than the archaic Aurignacian of northern Spain (Arbreda, Castillo) (Bischoff *et al.* 1989; Cabrera-Valdes and Bischoff 1989).

If the early Aurignacian in the Périgord is well enough characterised by the techno-typological equilibrium described above, found in Europe as far away as the Balkans (Kozlowski 1993), the industries that follow it have a different equilibrium: thick endscrapers (carinated and thick-nosed) become more abundant, busked burins are present but in variable proportions, and pieces with an 'aurignacian retouch' become rarer. This new equilibrium has been emphasized and at length described elsewhere (Sonneville-Bordes 1960; Delporte *et al.* 1977; Brooks 1979, 1995; Rigaud 1982; Delporte 1984). We have proposed to include these industries in a '*middle Aurignacian*', relatively homogeneous, the low variability of which does not necessarily have a chronological significance on a regional scale (Rigaud 1982: 389) and which does not seem to be linked to particular environmental fluctuations.

The revision of the Aurignacian undertaken by F. Djindjian (1986), who used more elaborate statistical means (correspondence and cluster analysis), has led him to propose a new structuring of the Aurignacian in the Périgord. The procedure is simple: with correspondence analysis, he demonstrated a certain number of *techno-typological facies* from the industries of sites of southwestern France onwards (Le Piage, Le Facteur, Caminade, La Rochette, La Chèvre, La Ferrassie, Le Flageolet 1, etc.). These facies have been compared, in a chronological perspective, to the palaeoenvironmental and radiometric data (Djindjian 1986, 1992, this volume). The principal results of this revision are as follows:

1 the existence of what has been regarded as the Aurignacian 0 in Aquitaine (Sonneville-Bordes 1960) is called into question; these industries would belong in fact to *facies 1* of Djindjian (*loc. cit.*) (Roc-de-Combe level 9, Caminade-Est G, La Rochette 5D, La Ferrassie K7). Only the industries of levels J and K of Le Piage could belong to a hypothetical *facies 0*, even then only with serious reservations.
2 Demonstrated with an Aurignacian *facies 1*: (La Ferrassie K6 and K5, Pataud levels 14, 12, and 11, Le Flageolet 1 level XI) to which should be added the 'refugees' of *facies 0*. *Facies 0 and 1* of Djindjian come in what we have designated as the *early Aurignacian in the Périgord.*
3 Demonstrated with *facies 2 early and recent* and with *facies 3* essentially represented by the industries of Pataud levels 6, 7, and 8; La Ferrassie levels K4, K3b, K2, K3/1, K2/3, J, and I2; Le Flageolet 1 levels VIII, VIIIa, VIIIb, and IX. (Djindjian *loc. cit.*). They constitute, in our opinion, the *middle Aurignacian in the Périgord.*
4 Demonstrated with *facies 4*, only present in La Ferrassie (G0, G1, F, E1s, E1sa, E1sb). But this facies cannot be very clearly distinguished from *facies 2b* (Djindjian *loc. cit.* p. 48) and the ^{14}C dates that are given for these archaeological levels are very widely dispersed, over nearly 10,000 years (Djindjian *loc. cit.* p. 54).

Generally speaking, these facies to which Djindjian assigns a chronological value (Djindjian *loc. cit.* p. 30), fall short of the expectations of their author and can therefore not serve as a base for a revision of the chronostratigraphy of aurignacian sites in the Périgord based on the single archaeostratigraphical sequence of La Ferrassie. In our opinion, *facies 2, 3*, and *4* in fact do only represent techno-typological fluctuations for which we have proposed a functional and not a chronological explanation. That is the reason why we have preferred to keep these industries provisionally in the group of the *middle Aurignacian in the Périgord.*

The gravettian squence

The emergence of the 'Perigordian' has been extensively described and we shall not repeat here the introduction of this historical perspective (Breuil 1909; Peyrony 1933; D. de Sonneville-Bordes 1960; Delporte 1984; Rigaud 1988;

Table 2. A review of the typological facies of the Gravettian of southwestern France. These 'taxonomical' equivalences do not necessarily imply a chronological significance.

D. PEYRONY	D. DE SONNEVILLE-BORDES et F. BORDES	J.-PH. RIGAUD	H. MOVIUS, H. BRICKER et N. DAVID	H. DELPORTE	F. DJINDJIAN et B. BOSSELIN
Protomagdalénien	Protomagdalénien ou Périgordien VII	Protomagdalénien	Protomagdalénien	Protomagdalénien	Protomagdalénien
Périgordien VI	Périgordien VI (ex-Périgordien III)	Périgordien supérieur final	Périgordien supérieur final ou Périgordien VI	Périgordien supérieur	Laugérien
Périgordien Vc	Périgordien Vc		Noaillien	Périgordien supérieur à burins de Noailles ou Noaillien	Rayssien Noaillien
		Périgordien supérieur			
Périgordien Vb	Périgordien Vb			Périgordien supérieur à éléments tronqués	Gravettien indifférencié
Périgordien Va	Périgordien Va			Fontirobertien	
					Fontirobertien et Bayacien
Périgordien IV	Périgordien IV	Périgordien moyen	Périgordien moyen	Bayacien	
« Périgordien III »					

Rigaud and Simek 1990). The cultural sequence of the Gravettian in the Périgord (= Perigordian) is essentially based on the archaeosequences of the rock shelters of La Ferrassie and Le Pataud and on the intersite correlations from the ^{14}C dates, and in certain cases on palaeoenvironmental data (Table 2).

Identified in La Gravettte and in Abri Pataud, Peyrony's 'Perigordian IV' or Movius' 'middle Perigordian' was characterised, in its early phase, by the presence of *fléchettes*. The term 'Bayacian' was then proposed to designate this cultural stage of the Perigordian. Notwithstanding the absence of a stratigraphic superposition, the radiometric data clearly show that the early middle Perigordian (= early Perigordian IV = Bayacian) of Pataud level 5 (Gr 4634: 28,150 ± 225 bp, OxA 169: 28,400 ± 1100 bp) is earlier than the Perigordian with Font Robert points of La Ferrassie (level D2) (OxA 402: 27,900 ± 770 and OxA 403: 27,530 ± 720). The initial phase of the Gravettian in the Périgord (= Peyrony's Perigordian IV = Movius' early middle Perigordian = Bayacian) preceeds therefore the Perigordian with Font Robert points, contrary to the opinion of Djindjian and Bosselin (Bricker 1976; Djindjian and Bosselin 1994; Bosselin 1996). To this chronological argument we should add the presence of Font Robert points in association with Noailles burins in level VII of Le Flageolet 1, dated to 26,150 ± 600 (LY 2723) and of >/= 25,720 ± 610 (LY 1748) and Les Battuts (Alaux 1973; Rigaud 1978).

The tanged points of La Font-Robert form a 'type fossil' of a phase or facies of the Gravettian, the Perigordian 'Va' of D. Peyrony and D. de Sonneville-Bordes that *succeeds* the Perigordian IV (*cf. supra*) and *preceeds* the Perigordian Vb with truncated elements and the Perigordian Vc with Noailles burins as shown by the stratigraphy of La Ferrassie. According to M. Otte (1974), the Gravettian with Font Robert points appears in Belgium (Maisières) around 28,000 bp, contemporaneous with the local Aurignacian. Its appearance in the Périgord seems to be a little later: in La Ferrassie between 27,900 ± 770 and 26,250 ± 600, and in Le Flageolet 1 between 25,720 ± 610 and 26,150 ± 600. This small chronological discrepancy should, however, be interpreted with caution because of the limited number of available dates. Nevertheless, if the Belgian Gravettian with Font Robert points is contemporaneous with the local Aurignacian, in the Périgord on the other hand it is (to this date) systematically later than the Aurignacian *sensu stricto*, from which it is chronologically separated by the middle Perigordian (= ex Perigordian IV). Finally, beyond the presence of this type fossil (the Font Robert point), the gravettian assemblages concerned present particular techno-typological characteristics, for example the numerical abundance of endscrapers. This prompted H. Delporte to isolate these industries from the gravettian tradition and to place them into the 'Fontirobertian', while emphasizing the important typological differences that exist between the industries with Font Robert points in southwestern France and those of Belgium (Delporte 1984). However, the creation of this taxonomic entity seems superfluous or in any case premature as the gravettian component of these industries is indisputable and extremely strong.

The same applies to the 'Noaillian' that N. David and H.L. Movius have wanted to isolate from the gravettian assemblage, again in view of certain stylistic characteristics. This 'Noaillian', in spite of a particular typological composition (abundance of *burins sur troncature* and in particular of Noailles burins, decline of scrapers on blades), belongs unequivocally to the Gravettian by the presence, in variable quantities, of Gravette points and micro-points. In order to support the hypothesis of 'the independence of the Noaillian tradition', David (in Bricker 1995: 130) regards the industries of level 4 of Pataud either as a geological mixture of the Noaillian and the Perigordian VI (level 4a), or as the result of an acculturation from the Gravettian onwards, of a pure 'Noaillian' (but does this 'Noaillian' exist without a set of characteristics and if so where?).

We have shown elsewhere that these technocomplexes seem to correspond much more to functional facies than to really distinct taxonomical and human entities (Rigaud 1978). In several sites with a perigordian sequence with Noailles burins (for example, Pataud level 4, Le Flageolet 1 levels VII, VI, V and IV), the end of the sequence with Noailles burins is consistently marked by the appearance and development of Raysse burins (David *loc. cit.*) and by a simultaneous decrease in Noailles burins. This typological or stylistic characteristic has led Bosselin and Djindjian to use the term 'Rayssian' to designate these industries (Djindjian and Bosselin 1994; Bosselin 1996). But for the same reasons as those presented above, these industries cannot be separated from the gravettian assemblage. If the terms 'Fontirobertian', 'Noaillian' and 'Rayssian' can be supported then this is only to indicate *techno-typological facies* within the Gravettian, without any cultural implication. These same authors suggest to delete the stage 'Perigordian Vb', proposed by Peyrony, and characterised by 'truncated elements', and to integrate it with the Perigordian IV, as according to them the truncated elements are in fact Gravette points truncated at one or both ends (Djindjian and Bosselin 1994; Bosselin 1996) – especially since the excavations of Delporte at La Ferrassie have yielded only a single truncated element in the level (C4 - D1) where they were abundant at the time of Peyrony's excavations.

These arguments can, however, not be accepted because the truncated elements differ morphologically and technically from Gravette points: thickness of the back, section, type of retouch, and they are not necessarily associated with all the industries with Gravette points. Furthermore, they were relatively numerous at the time of Peyrony's excavations (level K) and their rarity at the time of the limited excavations by Delporte could be due to lateral variations of the facies. And finally, in level Abc in the Grotte XVI (Cénac-et-Saint-Julien) exists a perigordian level in which, in association with a Font Robert point, the 'truncated elements' represent 9% of the tool kit. The truncated elements have therefore a typological existence and they are present, in variable proportions, in certain gravettian industries in association with Font Robert points (Flageolet 1, Grotte XVI) and Noailles burins (Flageolet 1) (Rigaud 1982).

The Perigordian IV and VI have very closely related characteristics that make it difficult to distinguish them without the intermediary stratigraphical presence of the Perigordian V, whether with Font Robert points, 'truncated elements' or Noailles or Raysse burins (Rigaud 1988; Clay *et al.* in Bricker 1995). The main differences lie in the higher proportions of micro-gravettes in the Perigordian VI and also a higher number of dihedral burins. To remove this taxonomic ambiguity, the term 'Laugerian' has been used to designate the Perigordian VI present in Laugerie Haute and at Abri Pataud. According to the proponents, the term 'undifferentiated Gravettian' designates the Perigordian IV (Djindjian and Bosselin 1994; Bosselin 1996). As with the Fontirobertian, the Noaillian, and the Rayssian, this new taxonomic entity does not seem justified to us on advanced typological bases.

If the statistical methods used by Djindjian and Bosselin demonstrate indisputably the typological facies, often detected moreover by more primitive means, then their cultural significance remains, however, to be established before aspiring to undertake a restructuring of the Upper Palaeolithic cultures.

7. Conclusions

Can we demonstrate a correlation between these technical and typological innovations and particular climatic phases? The aurignacian sequence in the Périgord does not seem to show pronounced and reliable correlations between the techno-typological fluctuations and climatic events (*cf. supra*). From the earliest manifestations of this culture in the Dordogne onwards, bladelet production from carinated forms is present (Dufour bladelets), pieces with a lateral retouch are present in very variable proportions, and subsequently, the busked burins often vary in numbers, but independently of climatic fluctuations.

The gravettian industries are without exception indicated by the presence of Gravette points and micro-points, but in proportions that vary diachronically and synchronically. They are in particular present, in variable quantities, in the industries with Font Robert points, with 'truncated elements', with Noailles burins and with Raysse burins (Rigaud 1982). Only the presence, and also the abundance, of Noailles burins and Raysse burins can be correlated with a period of lessening of the climatic deterioration at the end of OIS 3 (biozone 7 of F. Delpech) (= Tursac). It is, however, interesting to note that the period of climatic instability at the beginning of OIS 3 corresponds to a certain stability of aurignacian industries and that on the other hand a large techno-typological variability and a greater creativity in the Gravettian are contemporaneous with the climatic deterioration which preceeds the Last Glacial Maximum.

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Jean-Philippe Rigaud
Institut de Préhistoire et de Géologie du Quaternaire
Université Bordeaux I et Centre National de Préhistoire
(UMR 5808 du CNRS)
Avenue des Facultés
33405 Talence
France

João Zilhão

26 Nature and culture in Portugal from 30,000 to 20,000 bp

The period 30-20 kyr did not see significant environmental changes in littoral Portugal, though landscapes became more open, and the overall land surface increased through lowering of the sea level. The beginning of this period witnessed the replacement of Neanderthals by modern humans, whose adaptations did not change significantly until the LGM, except in the technological domain. It is suggested here that changes in the size of social networks were behind the rapid and large-scale diffusion of new technological traits. The period at stake sees a long-term trend towards a more economic use of raw material, and a concomitant miniaturisation of tool kits.

1. Introduction

Almost everything we know about the Upper Palaeolithic of Portugal is based on the evidence collected since the nineteenth century, and particularly within the last 15 years, in Portuguese Estremadura. Unless where explicitly mentioned otherwise, all characterisations in this text should be taken as referring to this region which, from a structural point of view, corresponds to the portion between the present-day Tagus and Mondego rivers of the Western Border, one of the geotectonic units of the Iberian Peninsula. It is mainly composed of Mesozoic sediments affected by a series of orogenic episodes which produced the rising of several mountain ridges (all culminating around 600 m) that represent the continuation, inflected to the southwest, of the Iberian *Cordilheira Central*. To the south and southeast of these limestone reliefs lies the lower Tagus basin, filled mainly with continental sediments of Paleogenic and Neogenic age; to the west, they are separated from the Atlantic by a littoral platform leveled in Plio-Pleistocene times and continuing beyond the present coast line as an extensive continental platform (Ribeiro *et al*. 1979).

In spite of this internal geomorphological variation, the region is well differentiated from neighbouring regions by significant geographical barriers: to the north, the wide valley of the lower Mondego; to the east, the schist and granite mountains of central Portugal, rising very quickly above 700 m and culminating at 2000 m in the Serra da Estrela; and to the south and southeast, the lower basin and the estuary of the Tagus, the largest river of Iberia. Today, these geographic frontiers represent as many ecological ones: a zone of balance where mediterranean species equal or slightly dominate atlantic ones, the region is surrounded by phytoclimatic zones of markedly sub-atlantic (to the north and northeast) and sub-mediterranean (to the south and southeast) dominance (Albuquerque 1984) and can therefore be more simply described as the region of Western Iberia where the transition between the two worlds (Mediterranean and Atlantic) is realised.

2. Climate and environment

2.1 Interstadial environments

Throughout OIS 3, climatic conditions in Portuguese Estremadura seem to have been temperate. At the cave site of Lapa dos Furos, near Tomar, an archaeologically sterile level underlying a thin mousterian occupation had large amounts of land snails (including *Cepaea nemoralis*) associated with red deer bones. A sample of those snails was dated to *c*. 34.5 kyr bp (Table 1). This faunal association suggests a woodland environment, as is the case with that from layer K of the nearby cave site of Caldeirão, where bones of *Capreolus capreolus*, *Castor fiber* and *Sus scrofa* were recovered (Zilhão 1987, 1995a; Antunes 1989). Bone from the upper part of that layer has been AMS dated to *c*. 28 kyr bp (Table 1).

Direct data on vegetation come from palynological analyses of littoral peat bogs located north of Peniche (Fig. 1a). In accordance with the data collected in the caves from the Tomar region, these analyses indicate a landscape of heathland and pine on the coast and on the sandy soils of the interfluves, with oak woodlands covering the low altitude limestone massifs (Diniz 1993).

The cave site of Figueira Brava is located near Sesimbra, on the southern slope of the Serra da Arrábida, where the continental platform is very steep. It provided evidence related to the conditions prevailing at sea during slightly later times (Antunes 1990-91). *Patella* sp. shells from the mousterian occupation in level 2 were radiocarbon dated to *c*. 31 kyr bp, that is, to the beginning of OIS 2. The only publication available lists the fauna collected at the site without stratigraphic discrimination of the several taxa (levels 3 and 4, which underlie the dated level 2, are also

Table 1. Portuguese Estremadura (a). Radiocarbon dates from archaeological sites (35-20 Kyr bp).

SITE	LEVEL	MATERIAL	ARCHAEOLOGY	LAB no.	AGE bp	OBS.
Anecrial	1b-2a	Charcoal	Proto-Solutrean	ICEN-963	23,450/+1470/-1240	
Anecrial	2b	Erica charcoal	Proto-Solutrean	OxA-5526	21,560±220	
Anecrial	2b	Charcoal	Proto-Solutrean	ICEN-964	21,560±680	
Buraca Escura	C2C	*Equus*	Proto-Solutrean	OxA-5524	21,820±200	
Buraca Escura	C2E	*Capra*	Late Gravettian	OxA-5523	22,700±240	
CPM III	Middle	Charcoal	Late Gravettian	ICEN-423	23,490±280	b)
CPM III	Lower	Charcoal	Late Gravettian	ICEN-541	21,080±850	
CPM III	Lower	Charcoal	Late Gravettian	SMU-2475	22,710±350	
CPM III	Lower	Charcoal	Late Gravettian	ICEN-428	23,050±750	
Caldeirão	Fa top	*Cervus*	Solutrean	OxA-1938	20,400±270	c)
Caldeirão	Fa top	Charcoal	Solutrean	ICEN-295	21,200/+2300/-1800	
Caldeirão	H	*Capra*	Solutrean	OxA-1939	19,900±260	
Caldeirão	H	Bone	Solutrean	OxA-2511	20,530±270	
Caldeirão	I	*Cervus*	Proto-Solutrean	OxA-1940	22,900±380	d)
Caldeirão	Jb (profile)	Bone	Upper Palaeolithic	OxA-5542	26,020±320	
Caldeirão	K top	*Cervus*	Mousterian	OxA-5541	18,060±140	e)
Caldeirão	K top	*Cervus*	Mousterian	OxA-1941	27,600±600	
Caldeirão	K base (K5)	*Capra*	Mousterian	OxA-5521	23,040±340	f)
Casa da Moura	1b	*Canis lupus*	Carnivore den	TO-1102	25,090±220	g)
Columbeira	16	Carbonaceous sediment	Mousterian	Gif-2703	26,400±700	h)
Columbeira	20	Carbonaceous sediment	Mousterian	Gif-2704	28,900±950	h)
Figueira Brava	2	*Patella* sp.	Mousterian	ICEN-387	30,930±700	
Lapa dos Furos	4	Land snail shells	Mousterian	ICEN-473	34,580/+1010/-1160	
Lapa da Rainha	4	Bone	Solutrean	ICEN-789	25,580/+1820/-1490	i)

fossiliferous). It seems reasonable, however, to admit that the marine animals identified – *Pusa hispida* and *Pinguinus impennis* – come from the same level as the *Patella* shells. Given the modern distribution of those species, unknown south of the British Channel, ocean waters off the Portuguese coast must have been colder than at present.

Capra pyrenaica is also reported from Figueira Brava. If it does come from the same levels as the marine taxa, its presence might suggest that, at higher elevations (the Serra da Arrábida culminates at *c.* 500 m), the limestone massifs and mountains were open landscapes, even throughout the interstadial. Alternatively, this evidence may indicate that the trend towards a cooler climate was already well under way in Portugal by 31 kyr bp, in good accord with the presence of the arctic seal and the great auk in the faunal assemblage from level 2. The other large herbivores present (aurochs, horse, red deer) are not very indicative and largely ubiquitous. Although Antunes mentions the presence of mammoth, the anatomical basis for this attribution is not specified. It seems quite likely that the remains in question belong instead to *Elephas antiquus*, which is known to have survived in Portugal until *c.* 30 kyr bp (Cardoso 1993).

2.2 Palaeoenvironmental evidence *c.* 25 kyr bp

Data on the climate of the first part of the Pleniglacial are still relatively scarce. Along the beaches south of Oporto it has been possible to recover stumps and branches of *Pinus sylvestris* in peat deposits exposed during important tides (Fig. 1a). Radiocarbon dates for these remains, of what seems to have been an open pine forest covering the sandy soils of the Portuguese coast between the Douro and the Mondego rivers, range from *c.* 30 to *c.* 20 kyr bp (Granja and Carvalho 1995).

Cave sites with deposits from this time period, such as Salemas (north of Lisbon), Casa da Moura (east of Peniche) and Caldeirão, contain abundant remains of *Rupicapra*

Table 1 continued. Portuguese Estremadura (a). Radiocarbon dates from archaeological sites (35-20 Kyr bp).

SITE	LEVEL	MATERIAL	ARCHAEOLOGY	LAB no.	AGE bp	OBS.
Lapa da Rainha	5	Bone	Hyaena den	ICEN-790	20,330±330	i)
Pedreira de Salemas	2	Bone	Mousterian	ICEN-366	29890/+1130/-980	
Pego do Diabo	2a	Bone	Aurignacian	ICEN-490	23,080±490	j)
Pego do Diabo	2b	Bone	Aurignacian	ICEN-732	28,120/+860/-780	
Salemas	V.S.	Bone	Solutrean	ICEN-376	20,250±320	i)
Salemas	T.V.b	Bone	Mousterian	ICEN-379	24,820±550	i)
Terra do Manuel	2s	Charcoal	Late Gravettian	ETH-6038	21,770±210	
Vale Almoinha	5	Charcoal	Solutrean	OxA-5676	19,940±180	
Vale Almoinha	5	Charcoal	Solutrean	ICEN-71	20,380±150	

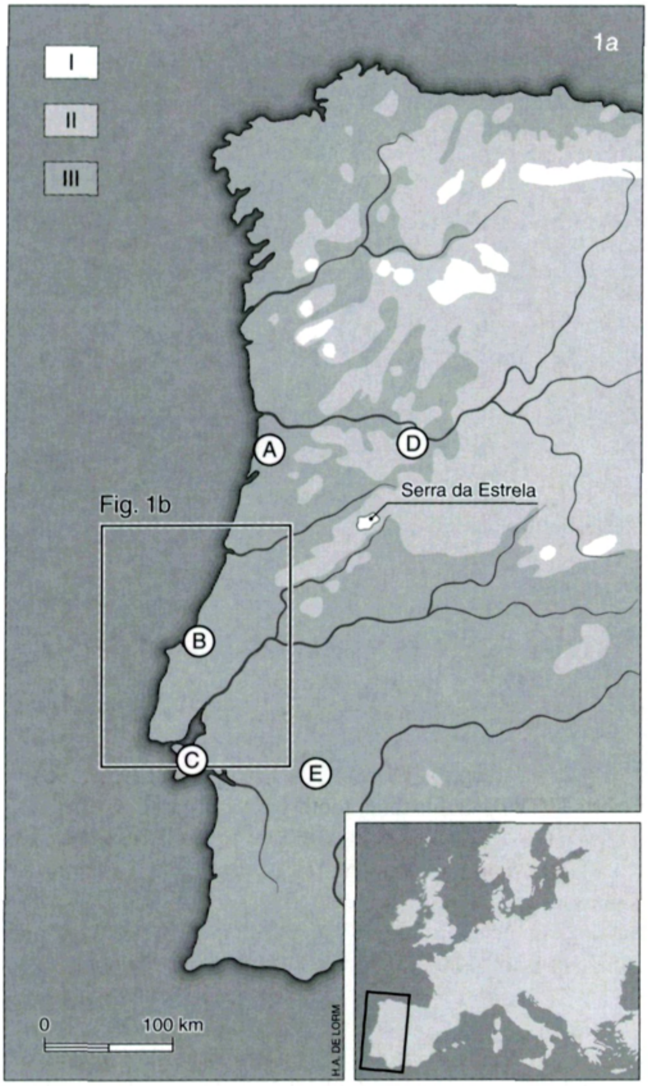
a) Data from: Delibrias *et al.* 1986; Antunes *et al.* 1989; Cardoso 1993; Aubry and Moura 1994; Marks *et al.* 1994; Straus 1989; Zilhão 1995a. CPM = Cabeço de Porto Marinho.
b) Date too old for unknown reasons (should be younger than the underlying Lower Level, whose ^{14}C age is between 22 and 23 Kyr bp).
c) The dated bone was probably a displaced piece, since its age is significantly older than the 18,840 ± 200 bp (OxA-2510) of the underlying level Fc and identical to that of the samples dated from level H.
d) The dated bone was probably a displaced piece, since its age is significantly older than that obtained elsewhere in Portugal for similar contexts.
e) Date too young, possibly due to very low collagen content (0,32%N; 3,66%C; 0,53%H).
f) Date too young, possibly due to very low collagen content (0,32%N; 2,39%C).
g) The sample came from residual deposits excavated by Straus (1989) and its result may be related to a gravettian component recognised in the artefact assemblage from Delgado's nineteenth century excavations (Zilhão 1995a).
h) Date too young, possibly due to the inadequate nature of the sample.
i) The association between the dated bones and the diagnostic archaeological materials is questionable.
j) Date too young, possibly due to contamination by later material (the aurignacian level is surface).

rupicapra, but *Capra pyrenaica* is also present (Zilhão 1987, 1995a; Cardoso and Antunes 1989; Cardoso 1993). Since today chamois lives in mountain woodlands, this association suggests that the climate was wet enough to allow for tree growth, but that forest cover was not as dense as to inhibit the presence of ibex populations, which may have lived at higher elevations or in areas of more rugged terrain.

Geochemical analysis of the Upper Pleistocene sequence from Caldeirão (Cruz 1990, 1993) indicates that the maximum of oceanic humidity is found in layer Jb, radiocarbon dated to *c.* 26 kyr bp. Another indication of relatively humid conditions is given by the fact that the rivers were accumulating extensive deposits of sand and gravel. This process must have begun or, at least, increased, precisely around 25-26 kyr bp, since the deposits in question contain rolled aurignacian and early gravettian artefacts (Zilhão 1995a). Last Glacial mountain glaciers existed in Serra da Estrela and in the northwestern mountains of the Serra da Peneda, Serra do Gerês and Serra da Cabreira (Fig. 1a), but no data exist on when they began to form. The evidence from the littoral lowlands suggests that such a process may have resulted from important snow precipitation in the high mountains of Central and Northern Portugal during the first part of the Pleniglacial.

2.3 Last Glacial Maximum environments

Global palaeoclimatic models predict that in Iberia average annual temperatures should have been *c.* 10°C lower than at present, while precipitation must have been some 50% lower (Gates 1976; Guiot *et al.* 1989). Winter sea surface palaeotemperatures are estimated to have been in the order of 3-4°C off the Portuguese coast (Duprat 1983) and, at Caldeirão, oceanic humidity as measured by the Na/K ratio reaches its lowest level in the sequence at around 18 kyr bp (Cruz 1990, 1993). In the interior Meseta, these changes must have brought about the development of a continental



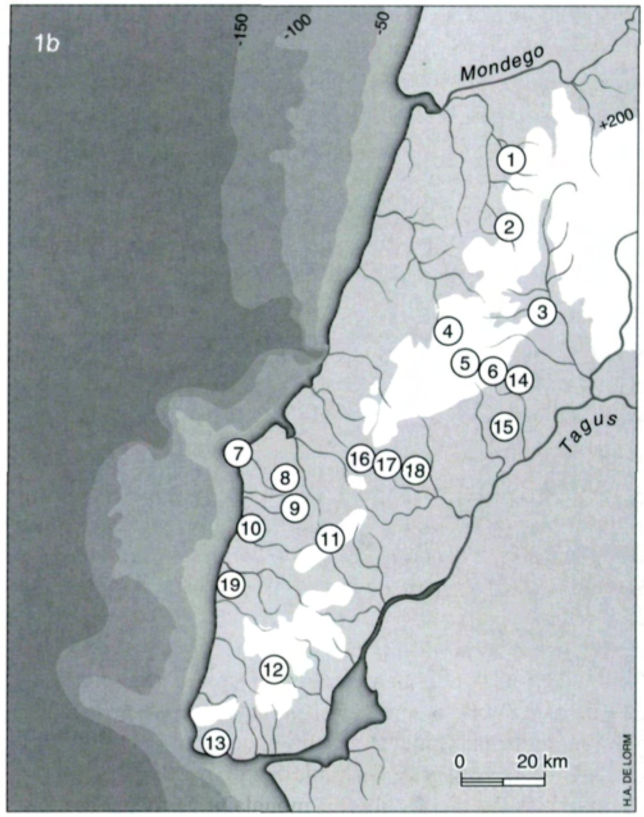


Fig. 1a and b. The sites with pre-20 kyr bp Upper Palaeolithic occupation presently known in Portuguese Estremadura and their paleoenvironmental context.
1a: A. OIS2 *Pinus sylvestris* forest; B. OIS 3 peat deposits with temperate flora; C. Early OIS 2 cold sea fauna; D. Open air sites: Mazouco, Côa Valley; Occupation sites: Salto do Boi (Cardina I); E. Cave art sites: Escoural; Occupation sites: Escoural, Monte da Fainha. I. mountain glaciers; II. > 700 m; periglacial areas (unvegetated mountain slopes; Meseta – continental steppe); III. < 700 m; compression of alpine, subalpine, boreal and temperate vegetation zones.
1b: Cave sites: 1. Ourão; 2. Buraca Grande, Buraca Escura; 3. Caldeirão; 4. Anecrial; 5. Picareiro; 6. Almonda; 7. Furninha; 8. Casa da Moura; 9. Lapa do Suão; 10. Lapa da Rainha; 11. Covão, Fontainhas, Furadouro; 12. Salemas, Pego do Diabo; 13. Poço Velho, Algar de Cascais. Open air sites: 14. Açude do Alvorão, Fonte Santa; 15. Casal do Cepo; 16. Casal do Felipe, Vales, Terra do Manuel, Terra do José Pereira, Vale Comprido; 17. Cabeço de Porto Marinho, Vascas, Gato Preto, Estrada da Azinheira, Vale de Porcos, Picos; 18. Passal; 19. Cova da Moura, Vala Almoinha.

steppe landscape. In the littoral lowlands of Western Iberia, the main climatic factors must have been the strong westerlies and the coldness of sea waters. Sand dunes whose accumulation began around 22 kyr bp are found along the present-day littoral and even in some interior regions, particularly in those with sandy bedrock, such as the Rio Maior basin. Here, the accumulation of eolian sands was also facilitated by extensive slope exposure, brought about by the process of river downcutting caused by eustatic response to lowered sea levels (Zilhão 1987, 1990, 1995a).

Charcoal collected in the solutrean levels from Caldeirão (Figueiral n.d. a) suggests that mixed boreal-temperate woodlands, with a good representation of mediterranean taxa (including *Olea*), existed in the more sheltered valleys of the limestone massifs. The landscape of pine woods and heathlands must have reached its maximum extension by then and the now submerged littoral platform (which extended the present land another 30 km to the west) corresponded, in all probability, to a *lande* (Mateus and Queirós 1993). Evidence from Lapa do Anecrial (located at the heart of the Limestone Massif, some 400 m above modern sea level) and from Cabeço de Porto Marinho (located in the Rio Maior basin, some 80 m above modern

Table 2. Last Glacial Maximum faunas. Species represented in Estremaduran caves (a).

	ARCHAEOLOGICAL SITES			PALAEONTOLOGICAL SITES		
	Caldeirão	Anecrial	Almonda (b)	Salemas	Fontainhas	Cascais
Horse *(Equus caballus)*	•				•	•
Wild boar *(Sus scrofa)*	•		•	•	•	
Red deer *(Cervus elaphus)*	•		•	•	•	•
Fallow deer *(Dama dama)*					•	
Aurochs *(Bos primigenius)*				•		•
Chamois *(Rupicapra rupicapra)*	•			•		
Ibex *(Capra pyrenaica)*	•	•			•	
Hare *(Lepus capensis)*	•					
Rabbit *(Oryctolagus cuniculus)*	•	•	•	•		
Birds	•		•			

a) After Zilhão (1987a, unpublished data) and Cardoso (1993)
b) Gallery of the Cistern

sea level), suggests a marked altitudinal gradient in the composition of the pine woods. Around the former (Figueiral n.d. b), they were made up of *Pinus sylvestris* (an indication of the descent to very low altitudes of the vegetational communities that, in the Iberian mountains of today, are characteristic of the Alpine stage) and, around the latter, of *Pinus pinaster/pinea* (Figueiral 1993).

Last Glacial Maximum faunas (Table 2) are known from archaeological (such as Salemas and Caldeirão) and palaeontological sites (such as Algar de Cascais and Gruta das Fontainhas). They do not differ significantly from those documented in Figueira Brava at the beginning of OIS 2 (Cardoso 1993). Sea mammals are naturally absent from those inland sites and chamois seems to be still abundant, at least at Caldeirão. None of the cold adapted species of large mammals (bison, woolly rhino, musk ox, mammoth, reindeer) found in the Meseta or in the littoral areas north of the Cantabro-Pyrenean mountains has so far been securely identified in Portugal. The same is true of rodents: the assemblage recovered at Caldeirão featured the same species found today in the region (Póvoas *et al.* 1992).

3. Human adaptations

3.1 Population replacement: the Ebro frontier

Radiocarbon dating of mousterian levels in the cave sites of Figueira Brava, Pedreira de Salemas, Caldeirão and Lapa dos Furos (Table 1) indicates that, in littoral Portugal, Middle Palaeolithic industries were manufactured until *c.* 28-30 kyr bp (Antunes *et al.* 1989; Antunes 1990-91; Zilhão 1991, 1993, 1995a). Younger ^{14}C ages, up to *c.* 25 kyr bp, have also been obtained at Columbeira and Salemas (Table 1). The laboratory considers the Columbeira results unreliable (Delibrias *et al.* 1986), due to the nature of the sample, and it has been shown that level T.V.b of Salemas lacks stratigraphic integrity (Zilhão 1995a). Raposo (1993, 1995) reports U/Th dates for three tooth samples from the mousterian open air site of Foz do Enxarrique (located at Ródão, on the Tagus, near the Spanish border): averaging 33,600 ± 500 bp, these results independently confirm the existence of Middle Palaeolithic industries in Portugal after 35 kyr bp. A similar late survival of the Mousterian has been suggested for Southern Spain, based on sedimentological and biostratigraphic arguments (Vega Toscano 1990; Villaverde and Fumanal 1990), derived from the sites of Cova Negra (Valencia) and Cariguela (Andalucia). This idea was recently confirmed at Zafarraya cave, also located in Andalucia, where a mousterian sequence containing Neanderthal remains has been dated by ^{14}C to 29.8 ± 0.6, at the top, and by U/Th to 33.4 ± 2 kyr bp, at the bottom (Hublin *et al.* 1995).

The earliest Upper Palaeolithic is the Aurignacian. In the region of Valencia (Spain), an aurignacian level has been radiocarbon dated to *c.* 30 kyr bp at the cave site of Mallaetes (Fortea and Jordá 1976). In Portugal, the only date available is that obtained for the base of level 2 at the cave site of Pego do Diabo, north of Lisbon: *c.* 28 kyr bp (Table 1). The material culture also indicates that these occurrences pertain to a late Aurignacian. In Iberia, no split-based bone points or other items typical of the early Aurignacian have so far been found south of the Ebro. Its chronostratigraphic position must be occupied, therefore, by the Late Mousterian, as is also suggested by the long and rich cave sequences spanning the

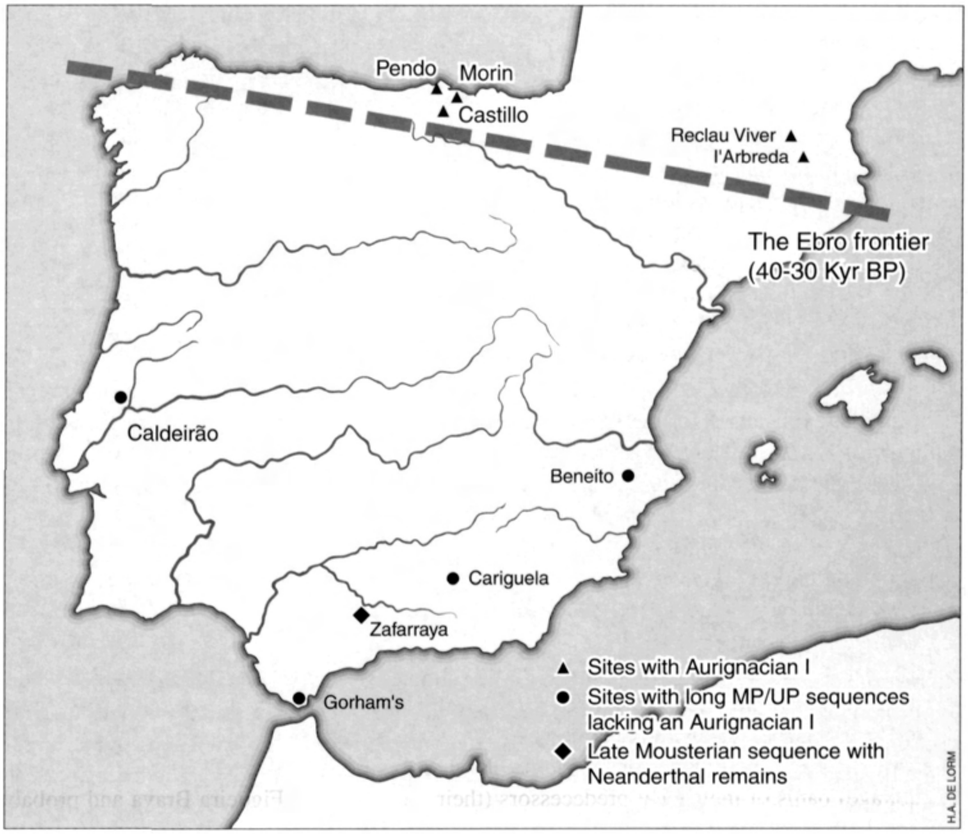


Fig. 2. The Ebro frontier. Aurignacian I assemblages with split based bone points are unknown south of the Cantabro-Pyrenean mountains, where the corresponding stratigraphic position is occupied by a late Mousterian manufactured by Neanderthals. This spatial segregation may have lasted for as much as 10,000 years, until *c.* 28-30 kyr bp, when late aurignacian tool kits appear in Portugal and Southern Spain.

Middle/Upper Palaeolithic divide (Cariguela, Beneito and Caldeirão; Vega Toscano 1990; Iturbe *et al.* 1993; Zilhão 1993, 1995a) which all lack 'Aurignacian I' deposits.

In these circumstances, it would seem that the valley of the Ebro functioned for more than 5000 years as a major bio-cultural frontier (Fig. 2): to the north, Western Europe was occupied, since at least *c.* 36.5 kyr bp, and maybe as early as 40-38 kyr bp (as suggested by the dates obtained for El Castillo and Arbreda: Cabrera and Bischoff 1989; Bischoff *et al.* 1989), by anatomically modern humans with an Upper Palaeolithic material culture; to the south, the rest of Iberia continued to be occupied, until *c.* 30-28 kyr bp, by Neanderthals with a Middle Palaeolithic material culture. Biocultural replacement seems to have taken place quite suddenly (at least in comparison with the previous millennia of apparently stable geographical segregation), although recent finds suggest that local Neanderthals were absorbed, rather than driven into extinction, by the modern immigrants (Duarte *et al.* 1999).

This pattern raises several important questions:

- why did anatomically modern humans, whose East-West spread over North and Central Europe was almost instantaneous (at the available scale of resolution), stop at the Ebro?
- why did they finally cross the border and why did they do it at that specific time?
- why was the replacement of Iberian Neanderthals by anatomically modern humans so fast (as it had been the case everywhere else in Europe before)?

Simplistic models of a biologically based intellectual superiority of anatomically modern humans (Stringer and Gamble 1993) cannot explain this punctuated process. On the other hand, the fact that Iberian Neanderthals maintained their traditional culture so long after modern humans had reached the Pyrenean region, falsifies the explanation of the Châtelperronian and similar Central European cultures put forward by such models – that they were a byproduct of the inevitable acculturation of Neanderthals brought about by their contact with contemporaneous groups of moderns occupying neighbouring territories. Thus, on present evidence, it would seem that the most parsimonious way of interpreting those cultures is that, in West and Central Europe, at the time of contact, Neanderthals were already going through their own 'Upper Palaeolithic revolution' (Gilman 1984).

In this framework, the fact that Neanderthals did not have parietal art, if confirmed by future research, may have a socioecological rather than a biological basis, since such has also been the case with previous, coeval and subsequent modern populations in many parts of the world. For the same reasons, the fact that Iberian Neanderthals, living south of the Ebro, never became Upper Palaeolithic can be interpreted as a simple manifestation, in the realm of human adaptations, of the laws of unequal development. A similar situation occurred in the African Magreb, where the Middle Palaeolithic aterian complex, a product of anatomically modern humans (Genet-Varcin 1979: 244-248; Phillipson 1985: 92-93; Stringer and Gamble 1993: 130-131), survived until after 30 kyr bp (Texier *et al.* 1988 report a TL age of *c.* 28 kyr bp for the Moroccan site of Chaperon-Rouge I).

A possible explanation for the Iberian pattern, with implications for the rest of Europe, is that:

- modern humans entered Europe and rapidly replaced the local Neanderthal populations (in all probability with occasional interbreeding), due to factors related to population biology (greater fertility of the moderns, or lack of immunity of the Neanderthals against new diseases, for instance);
- in the process, moderns adapted to the tundra/steppe/boreal forest environments of interstadial Central and Northern Europe, following essentially the same economic (large herbivore hunting) and technical (blade debitage) paths of their local predecessors (their Neanderthal cousins);
- moderns stopped at the Ebro because, during the interstadial, it represented a major geographical and ecological barrier (judging from the little evidence available, environments to the south, in most of Iberia, would have been dominated by temperate woodlands);
- the different environmental conditions (and their social correlates, for instance as far as population density is concerned) and the relative isolation of Iberian populations located south of the Ebro, also explain why local Neanderthals did not become 'Upper Palaeolithic', contrary to what had been the case with their biological brothers to the north a few millennia earlier;
- moderns crossed the frontier as the trend towards colder conditions began to compress the human range at its northern end and as it began to extend southwards, into Iberia, the kinds of environments to which they had previously become adapted;
- once the border was crossed, the replacement of Neanderthals followed at the same rapid pace and for the same reasons as 10,000 years before in the rest of Europe.

3.2 Settlement and subsistence

The geographical distribution in Portugal of late Middle Palaeolithic, early Upper Palaeolithic and solutrean sites is broadly identical. Almost all the sites are located in Estremadura, but the interior regions were also settled. South of the Tagus, such a settlement is documented by the cave site of Escoural, which contains a mousterian/aurignacian/solutrean sequence (Araújo and Lejeune 1995; Zilhão 1995a). North of that river, it is documented, for the Mousterian, by Foz do Enxarrique and, for the Last Glacial Maximum, by the cluster of open air art sites recently found in the Côa valley, which include gravettian, solutrean and magdalenian occupations (Zilhão 1995b, 1995c, 1997; Zilhão *et al.* 1995). Thus, the present dearth of sites from this chronological range in the interior regions of Portugal and in the Meseta in all likelihood results from a combination of factors related to differential preservation and history of research.

Archaeozoological studies of Upper Palaeolithic faunas are now under way, but no results are yet available. In caves, the number and species diversity of carnivores decreases markedly between 30 and 20 kyr bp, which may reflect either a more intensive use of the sites and their vicinity by humans, or a slow process of extinction, in particular as regards the large species (hyena and cave lion, for instance). Herbivore remains accumulated by man seem to comprise horse, red deer and aurochs in broadly similar proportions, with ibex and chamois also well represented at particular sites. Exploitation of aquatic resources is documented at Figueira Brava and probably continued throughout the early Upper Palaeolithic, but is not apparent in the sites known due to their distance from coeval coast lines.

Based on the characteristics of lithic assemblages, most sites can be grouped, functionally, into three major categories (Zilhão 1995a):

- large open air sites located close to raw material sources, where byproducts of debitage (cores, decortication blades) predominate and endproducts of blade debitage and finished tools on blade/bladelet blanks (non-cortical blades and bladelets, retouched bladelets, points on blade blanks) are vastly underrepresented;
- small cave sites with low density occupation deposits, where byproducts of debitage are almost entirely absent and discarded retouched tools are overrepresented (and, sometimes, are even more abundant than debitage and residues);
- large open air sites located at varying distances from raw material sources, but where practically every single step of the lithic production system (acquisition of raw cobbles, debitage of prismatic cores for blank production, abandonment of unfinished or used tools) is well documented.

In the Aurignacian and the early Gravettian, only the first and second categories have been recognised; in the late Gravettian and the Solutrean, the first category disappears and is replaced by the third. At present, it would seem that the best way to explain this change is that, to a great extent, it is a consequence of changes occurring not at the level of settlement-subsistence strategies but at the technological level. The earliest Upper Palaeolithic industries are based on a large blade technology and it would seem that, as a consequence, raw material tended to circulate essentially as blanks. Late gravettian and solutrean industries are based on blade/bladelet technologies, in the framework of which certain kinds of blank production and transformation could still be spatially separated (which seems to be the case, for instance, with particular point types such as the solutrean foliates) but, more often, raw material (particularly when destined for bladelet tool production) would tend to circulate as cores. As a result, specialised 'workshop/production for export' sites, like those known in earlier times, would not make sense any longer and are indeed not found in the archaeological record. On the other hand, it cannot be excluded that some kind of residential activity was also taking place in the predominantly workshop sites of the Aurignacian and the early Gravettian. The more rigid dichotomy between production and consumption that seems to have characterised them implies that residential sites from these periods, located at significant distances from raw material sources, should be characterised by assemblages mostly made up of discarded blades and blade tools and where both cores and residues from their preparation and decortication should be entirely lacking or be present only in very small numbers. However, the prediction that such a hypothetical fourth category of sites must exist has not yet received empirical confirmation.

In the framework of this model of raw material circulation, the large majority of open air sites known can be interpreted, particularly in the later part of the period under analysis, as residential camps. Those that have been the object of modern excavations (such as Cabeço de Porto Marinho or Fonte Santa) presented a pattern of small separate concentrations forming a more or less extensive archaeological surface or level. Whether these palimpsests correspond to the remains of contemporaneous occupations by several individual social units (families) or a horizontal stratigraphy of several contiguous penecontemporaneous occupations is not yet clear. The general impression, however, is one of discrete occupations by small groups over a long period of time. Thus, settlement-subsistence strategies, although having a clear logistic component, may have been more forager-oriented than among today's arctic or subarctic hunter-gatherers such as the Nunamiut studied by Binford (1983). A closer ethnographic parallel may be that of the Selk'nam (Ona) from Tierra del Fuego (Chapman 1986). These guanaco hunters lived under environmental conditions analogous to those reconstituted for Last Glacial Portugal, and are known to have preferred to move the camp to the kill instead of moving the kill to the camp. The fact that human bones belonging to children and adolescents have been found at several Portuguese Upper Palaeolithic cave sites also indicates, on the other hand, that the uses given to at least some of those sites may not have been exclusively logistic: as well as functioning as shelter for task groups temporarily away from the residential camp, or for occasional refuge during long-distance trips, they may also have served, for instance, as single family summer camps.

3.3 TECHNOLOGICAL TRENDS

Apart from a trend towards thinner blanks and, concomitantly, a more economic use of raw material, which will culminate in the Magdalenian (Fig. 3), no other clear directional changes seem to exist. Bone tools (only preserved in cave environments) are scarce and not much can be said about them other than stating that massive sagaie points, some made on the penian bones of carnivores, were recovered in the early Upper Palaeolithic deposits of Casa da Moura and Salemas, and that slender points, some with lateral grooves, have been found in the Upper Solutrean (Aubry and Moura 1994; Cardoso and Gomes 1994; Zilhão 1995a).

Culture-stratigraphic units dated to the Last Glacial Maximum tend to be characterized by weapon systems containing lithic points. In three of those units, the points (Fig. 4) are virtually identical in size (4-5 cm long) and weight (2-3 g) and were probably used as sagaie tips (broken specimens often show typical impact fractures). The differences between them relate to the technology of blade extraction and the mode of retouch, allowing the recognition of as many index fossils: the Casal do Felipe point typical of the *Fontesantense* (which probably dates to *c.* 23 kyr bp); the *pointe à face plane* typical of the Middle Solutrean (around 20.5 kyr bp); and the two kinds of shouldered points (mediterranean and franco-cantabrian) typical of the Upper Solutrean (which, on present evidence, seems to begin around 20 kyr bp). Other lithic point types (the Vale Comprido point, of the Proto-Solutrean, *c.* 21.5 kyr bp: Zilhão and Aubry 1995, and the laurel leaf of the Middle Solutrean) were larger, and may have been used to arm the tip of more robust pieces of thrusting equipment (spears, for instance). Terminal gravettian (proto-magdalenian) industries, dated to *c.* 22 kyr bp, however, seem to represent a temporary comeback to a weaponry system identical to that used in earlier Upper Palaeolithic times (exclusively based on bone/wood points armed with lithic barbs).

The Aurignacian and the Gravettian are characterised by pointed microliths. They are obtained:

- through alternate semi-abrupt retouch of blanks extracted either from prismatic cores or from thick dihedral, truncated and carinated 'burins' in the Aurignacian

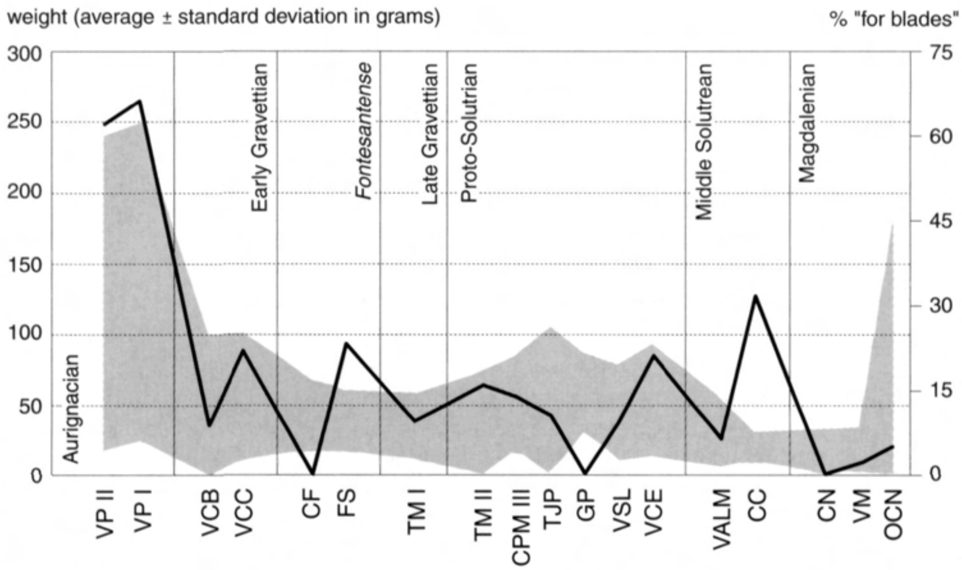


Fig. 3. The trend towards a more economic use of flint in the Portuguese Upper Palaeolithic, as illustrated by prismatic cores. The size of abandoned cores decreases markedly after the Aurignacian, as does the percentage of those where scars of blade-size removals are observable. This trend culminates in the Magdalenian. (Grey dotted area: weight (average ± standard deviation); solid black line: % of cores 'for blades')

VPII= Vale de Porcos II; VPI= Vale de Porcos I; VCB= Vale Comprido-Barraca; VCC= Vale Comprido-Cruzamento; CF= Casal do Felipe; FS= Fonte Santa; TMI= Terra do Manuel I; TMII= Terra do Manuel II; CPMIII= Cabeço de Porto Marinho III; TJP= Terra do José Pereira; GP= Gato Preto; VSL= Vales da Senhora da Luz; VCE= Vale Comprido-Encosta; VALM= Vale Almoinha; CC= Casal do Cepo; CN= Cerrado Novo; VM= Vale da Mata; OCN= Olival da Carneira.

(Dufour bladelets of the Dufour subtype, as defined by Demars and Laurent 1989);
- through unilateral direct abrupt retouch of blanks extracted either from prismatic cores or from thick multiple truncated 'burins' in the Gravettian (microgravettes).

These points are generally associated with several types of obtuse microliths which, in the Aurignacian and in the Proto-Solutrean, are often made on blanks extracted from carinated or nosed 'endscrapers':
- Dufour bladelets of Roc-de-Combe subtype (Demars and Laurent 1989), in the Aurignacian;
- backed bladelets in the Gravettian;
- backed and truncated bladelets in the late Gravettian;
- marginally, unilaterally, retouched bladelets in the Proto-Solutrean.

Lithic points in the size ranges documented for the culture-stratigraphic units mentioned in the preceding paragraph are not known in well-dated or well-defined aurignacian and gravettian assemblages, although a few isolated finds of larger Gravette points are known from cave sites excavated in the nineteenth century. They may be characteristic of an as yet undifferentiated phase (Middle Gravettian?) or, instead, correspond to a type commonly used and discarded only at logistical sites. Whether the morphological difference between obtuse and pointed microliths of the Aurignacian and the Gravettian had any functional content is not yet clear. They may have been used to arm different types of weapons or different parts of the same weapon (pointed as perforating tips, obtuse as tearing barbs), but it may also be that, more simply, they were all interchangeably used only as barbs for sagaie bone/wood points.

In industries with lithic points and lacking retouched bladelets (such as the *Fontesantense* and the Middle Solutrean), the role of lithic barbs was probably played by unretouched bladelets and chips. In other words, the bone point plus lithic barbs component was also present in the weapon systems of those times, although it is not visible when analysis is restricted to the typology of retouched tool kits. The deliberate extraction of such unretouched barbs from different types of quartz cores represents, for instance, a major industrial activity in the Proto-Solutrean (Fig. 5). This popularity of quartz in assemblages from such a flint-rich area as the Rio Maior basin can only be interpreted as a cultural preference, which was also manifested in the use of rock crystal, always present in the same assemblages, albeit in very small numbers.

Symmetrically, in the late gravettian and proto-solutrean assemblages excavated at Salto do Boi, in the Côa valley, rock crystal was common but flint was rare and heavily economised, suggesting that, in this part of the country, it represented a scarce and valued raw material obtained from very distant, probably Estremaduran, sources (Zilhão *et al.* 1995). This pattern may also indicate that the onset of the Last Glacial Maximum brought about an intensification of

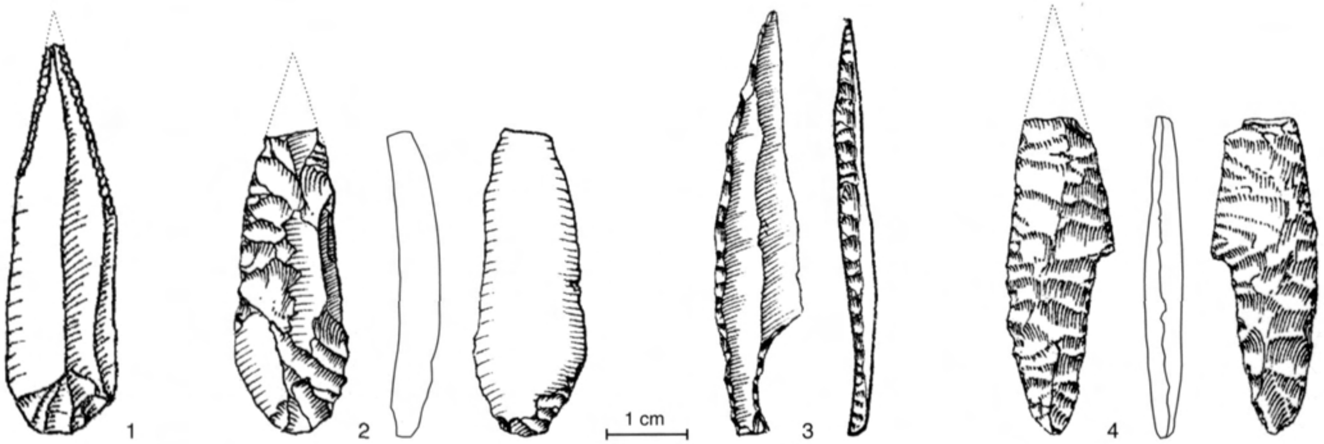


Fig. 4. Last Glacial Maximum lithic points from Portugal. Although varying in overall morphology, retouch and technique of blank extraction, their modules remain essentially stable, suggesting a similar function. Broken specimens often show typical impact fractures indicating a use as sagaie tips. Changes in the characteristics of the lithic points and the nature of inferred hafting methods do not seem to support the notion of an increased efficiency of the weapon system (an Ice Age 'arms race'). 1. Casal do Felipe point (index fossil of the *Fontesantense, c.* 23 kyr bp); 2. *pointe à face plane* (Middle Solutrean, *c.* 20.5 kyr bp); 3. Mediterranean shouldered point and 4. Franco-Cantabrian shouldered point (Upper Solutrean, 20-18 kyr bp).

exchange relations between the littoral limestone areas, rich in flint, and the granitic areas of the interior, where rock crystal is abundant.

Heat pretreatment of the flint is documented for the production of foliates in the Middle and Upper Solutrean, but not as a technique of core preparation for ordinary blade debitage. It is not known in subsequent magdalenian industries.

3.4 Territories

Data on ethnographically documented hunter-gatherers (such as the Selk'nam; Chapman 1986) and on the carrying capacity of Last Glacial environments in Cantabrian Spain (Straus 1986) and in Greece (Bailey *et al.* 1986) suggest that, in Portuguese Estremadura, Upper Palaeolithic population densities probably were in the range of 0.05 inhabitants per km^2. Individual bands made up of the magic number of 25 individuals would have exploited territories of some 400-500 km^2 each, corresponding broadly to the area of each of the drainages of the main rivers that, from the central spine of limestone hills, mountains and plateaus, flow southeast into the Tagus or northwest into the sea (Fig. 6a). The number of bands inhabiting this geographically homogeneous region (whose surface area, including the now submerged littoral platform, would have been of some 12,000 km^2; Fig. 6b), might have allowed, therefore, the development of large and cohesive social networks, possibly representing one or more differentiated ethnic groups.

Preliminary data on the circulation of raw materials and the distribution of certain material culture features suggest that it may be possible, at least for the later part of the period under analysis (22-20 kyr bp), to discriminate more circumscribed territories (Fig. 6a). Flint from the littoral area of Cambelas, for instance, has so far been found only in the southern part of the region, between Lisbon (as shown by finds from Salemas) and Rio Maior (where it was present at Terra do Manuel). The use of flat schist pebbles as blanks for foliate production seems to be restricted to sites in the Almonda drainage, further to the north. At Caldeirão, a particular type of adornment (perforated deer phalanxes) was found in great numbers in the solutrean levels, but is unknown in all other cave sites of Portuguese Estremadura. The social significance of these distributions, however, remains to be clarified.

The existence of long-distance exchange networks connecting Portuguese Estremadura to the rest of southwestern Europe is implied by the temporal coincidence of basic technological changes: from Aurignacian to Gravettian and from Gravettian to Solutrean. Particular developments (such as the *Fontesantense*, with its characteristic Casal do Felipe points), however, are clear evidence that such parallel developments should be

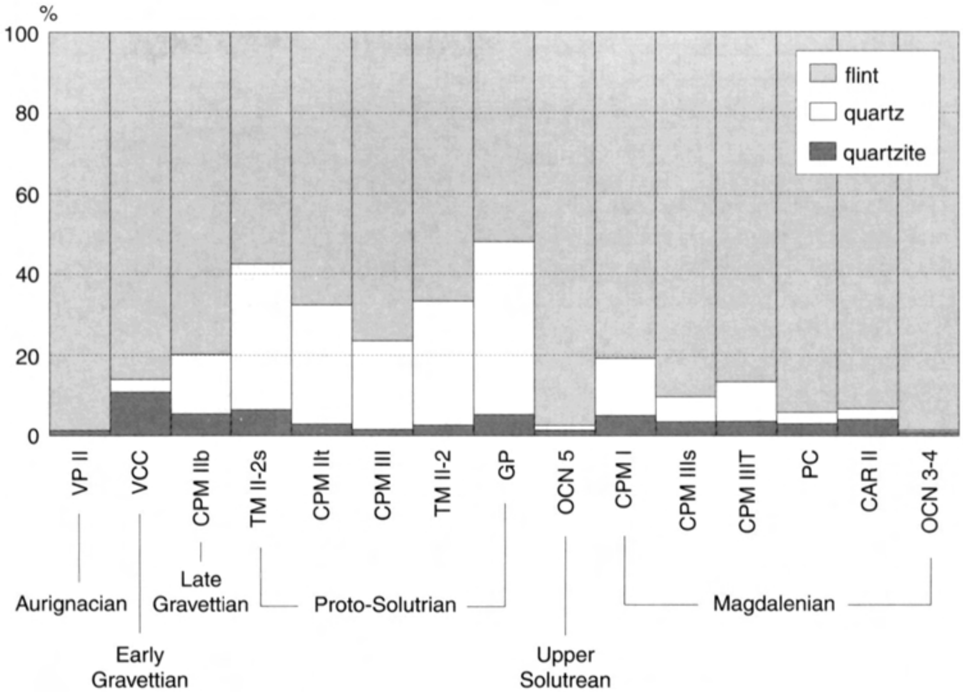


Fig. 5. The use of quartz in the Upper Palaeolithic of the Rio Maior basin. In such a flint-rich area, the weight of this raw-material in proto-solutrean assemblages can only be interpreted as a cultural preference and is of a level of magnitude that enables its use as a distinctive chronostratigraphic marker.
A similar preference is documented in contemporaneous sites from other areas of Estremadura, such as Lapa do Anecrial and Açude do Alvorão.

VPII= Vale de Porcos II; VCC= Vale Comprido-Cruzamento; CPMIIb= Cabeço de Porto Marinho II base; TMII-2s= Terra do Manuel II, level 2s; CPMIIt= Cabeço de Porto Marinho II top; CPMIII= Cabeço de Porto Marinho III; TMII-2= Terra do Manuel II, level 2; GP= Gato Preto; OCN5= Olival da Carneira, level 5; CPMI= Cabeço de Porto Marinho I; CPMIIIS= Cabeço de Porto Marinho IIIS; CPMIIIT= Cabeço de Porto Marinho IIIT; PC= Pinhal da Carneira; CARII= Carneira II; OCN3-4= Olival da Carneira, levels 3-4.

understood as resulting from the interaction of local historical trajectories, not as the manifestation of large-scale population movements (migrations). The intermediate geographical position of the region also explains well the co-occurrence of upper solutrean lithic types that, elsewhere in Iberia, are mutually exclusive: the backed and shouldered and barbed and tanged points typical of Valencia and Andalucia, on the one hand; and the elaborately retouched shouldered points typical of Cantabria and Aquitaine, on the other.

3.5 Art

Adornments (marine shell beads, for the most part) are the only items of mobiliary art that have been recovered, so far, in secure contexts of early Upper Palaeolithic and solutrean age.

The cave site of Escoural (Glory *et al.* 1965; Santos *et al.* 1980; Lejeune 1995) features a parietal art containing black and red animal paintings that are stylistically archaic. These paintings are themselves covered by thin, as yet undated, stalagmitic films. Given that the only archaeologically documented Upper Palaeolithic uses of the cave date from aurignacian and solutrean times (Zilhão 1995a), it seems likely, therefore, that this parietal art was executed between 30 and 20 kyr bp.

All other manifestations of palaeolithic rock art known in Portugal are in the open air. They are located in the Douro basin, the most important being the recently found cluster of sites in the Côa valley. Stylistically, a significant proportion of the petroglyphs found here could date to the early Upper Palaeolithic period (Baptista and Gomes 1995; Lorblanchet 1995; Zilhão 1995b, 1995c, 1997).

4. Conclusion

Available evidence can be summarised as indicating that, in littoral Portugal, the global trend towards colder and more arid conditions did not bring about significant changes in vegetational communities and animal populations during the period between 30 and 20 kyr bp. The most important environmental change must have been the increase in territory caused by the marine regression. Landscapes may also have become more open, with extensive heathlands representing the dominant type of vegetation cover. For groups of hunters whose economy relied on the exploitation of large herbivores that, in these conditions, found improved pasture and space, the *global climatic deterioration* may have turned out to represent, thus, a *local environmental amelioration.*

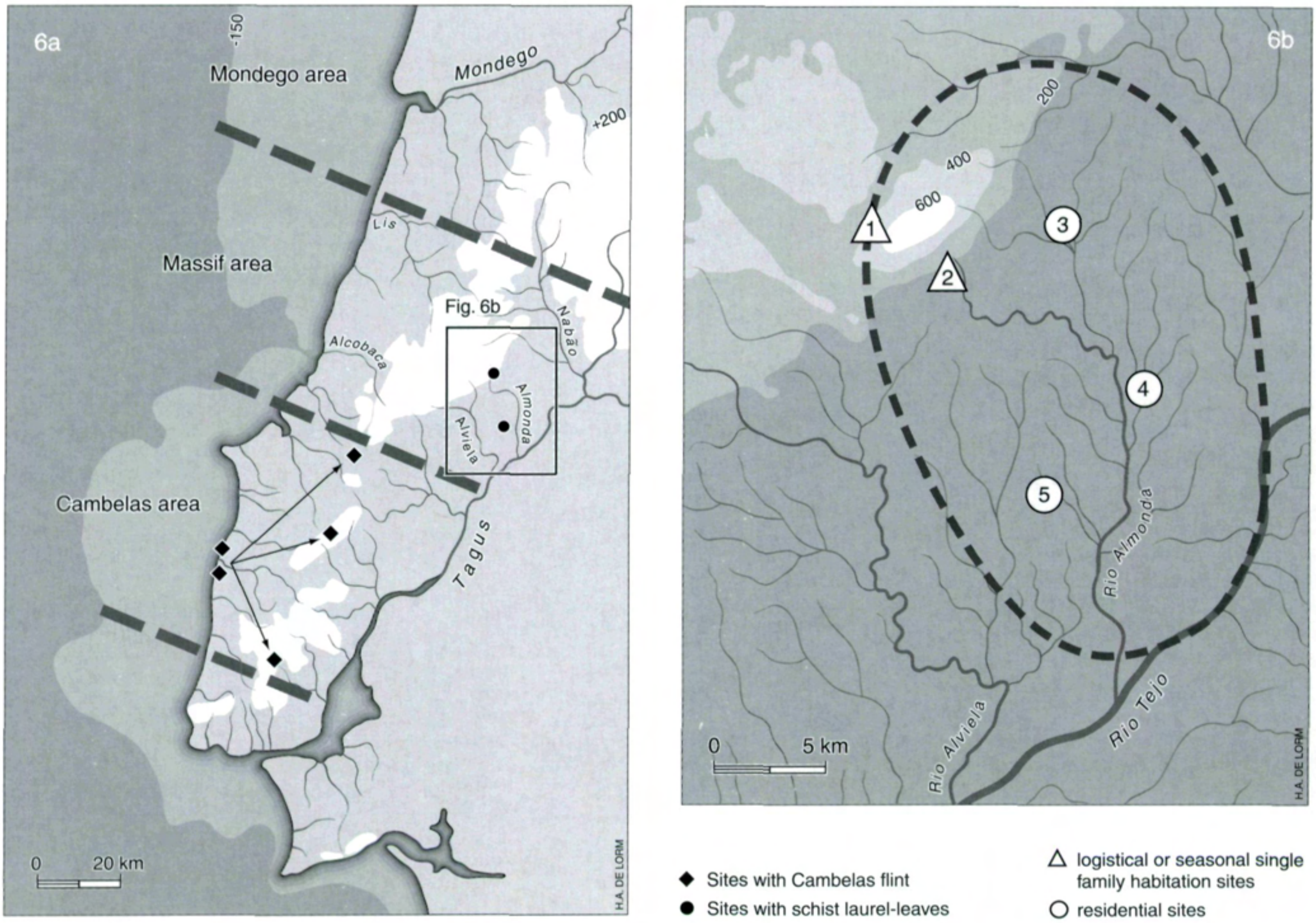


Fig. 6a and b. A model for the organization of the human settlement of Portuguese Estremadura in Last Glacial Maximum times, based on ethnographical information from Tierra del Fuego and on paleoecological data from Last Glacial Cantabria and Epirus. The frontiers between the three hypothetical raw material procurement areas in figure 6a could represent ethnical boundaries. Individual bands would exploit smaller territories, in the size range of the Almonda drainage, foraging from camp sites located in the lowlands and using caves in the central spine of limestone mountains and plateaus as logistical or seasonal shelters. The hypothetical territory of the 'Almonda band' (*c.* 450 km^2) in figure 6b is identical to that of the *haruwen* of the Selk'nam and Haush of Tierra del Fuego (1= Lapa do Picareiro; 2= Gruta do Almonda; 3= Açude do Alvarão; 4= Fonte Santa; 5= Casal do Cepo).

The beginning of the period coincides broadly with a population replacement event involving the absorption or extinction of the autochtonous Neanderthal populations. The settlement and subsistence strategies of the anatomically modern human groups that succeeded them do not seem to change significantly until the Last Glacial Maximum. At the technological level, however, important changes do occur. Since they are simultaneous to and follow parallel lines with those occurring elsewhere in ecologically very different regions of Western Europe, it does not seem possible to explain such changes as a direct response to climatic and environmental change. It also does not seem possible to explain them as the outcome of selective pressures favouring an increased efficiency of the hunting technology – the Ice Age arms race imagined by Straus (1991). That solutrean points would, in this regard, behave better than those from the Gravettian, is something that remains undemonstrated and does not seem likely in the first place.

An alternative approach to the Portuguese pattern and, more broadly, to southwestern Europe as a whole, conceives of natural selection as acting, during the Upper Palaeolithic, mostly through the mediation of the social realm (Zilhão 1995a). In this analytical framework, it is the expansion and shrinking of exchange networks, as well as the modifications that eventually occur in their composition, that are invoked as the main explanations for the wide and rapid diffusion and adoption, over vast geographical areas, of new technological traits that are in themselves, from the point of view of adaptation, essentially neutral. At the level of direct interaction with the natural environment, however, it also seems possible to identify, at least in Portugal, a long-term trend towards a more economic use of raw materials, bringing about, as a consequence, an increasing miniaturisation of tool kits that will culminate later, in the Magdalenian.

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João Zilhão
Instituto Português de Arqueologia
Av. da India, 136
1300-300 Lisboa
Portugal

Margherita Mussi

27 Heading south: the gravettian colonisation of Italy

The gravettian settlement of Italy started at 28-26 kyr, after the Aurignacian had disappeared from the record. During the following millennia, new human groups entered again and again into the sparsely populated peninsula, settling into some regions, and avoiding other ones. Evidence of intense ritual activity and of highly developed symbolic capacity are embodied in the many, formalised burials, as well as in complex works of art, many of which are female figurines. The hypothesis is discussed that this allowed keeping in touch with distant bands, and integrating into local network groups newly arriving from over the Alps. As a final result, the gravettian settlement was a lasting one, which successfully solved the demographic pitfalls that had not been overcome during the aurignacian phase.

1. Introduction

The gravettian settlement spans mainly over continental Europe, with a limited extension south of 43° latitude, i.e. in the peninsulas beyond the Pyrenean, Alpine and Balkan ridges. This can be seen in the limited Iberian and Greek record (Straus 1992; Perlès, this volume; Zilhão, this volume). Italy is no exception, with two or three dozen sites more or less firmly related to the Gravettian (Mussi 1990, 1992). Major sites, however, also occur, and as far as burials and portable art is concerned, the Italian record overwhelms the evidence from any other West European country.

After a review of the current understanding of the general environment, I will briefly summarise and discuss the archaeological evidence. A hypothesis related to the adaptation to a different environment by people coming from much further north will then be put forward. This will be related to the symbolic activity embodied in ritual activity and art.

2. The environment between 30 and 20 kyr

2.1 The continental shelf

At the end of OIS 3 and around 30 kyr, the sea level was approximately 20 m lower than the present level on the Italian coasts (Alessio *et al.* 1994; Antonioli *et al.* 1994). As the seafloor gradient is generally sharp, the coastal strip was then overall no more than 1-2 km broader than today. Even at the LGM, when the sea level assumedly dropped 120 m, most of the coastal plains were only enlarged by some 10-20 km. Here and there larger expanses of now submerged land came into existence – as for instance next to the island of Elba, by then a promontory – the only major exception being the northern Adriatic: in lieu of a shallow sea, a wide plain extended as far south as the modern town of Ancona, doubling the size of the present Po valley, and linking Italy to the Balkans (Fig. 2). This area, however, was subjected to marked subsidence during most of the Upper Pleistocene (Ciabatti *et al.* 1987). Therefore, as the marine shelf was subsiding at a rate greater than the sea level was falling, even around the glacial maximum the rivers were not eroding but depositing coarse alluvia. The north-south gradient of the Great Adriatic Plain was then probably very low. Most of the area was characterised by rivers with a poorly defined bed, as well as by swamps and bogs, with muddy flats alternating with gravel bars, and by lagoons close to the seashore. In the eastern piedmont of the Apennines, the rivers flowing in a west-east direction deposited coarse sediments within braided river beds and under a scarce vegetation cover (Coltorti and Dramis 1995).

Even if most of the coastland was not dramatically different from today's, a major difference existed in another resource central to palaeolithic life, i.e. caves. Cliffs and rocks are ubiquitous in Italy. During the Pleistocene, a mix of physical and chemical agents, including tectonics, karstism and wave action, resulted in the opening of strings of cavities at fairly constant levels, which are often related to past marine stands (Mussi 1999). Archaeological excavations have focused on residual deposits in caves a few metres above the present sea level, which generally correspond to the Eutyrrhenian level of OIS 5e. Besides the excavated caves, submerged caves, however, are also known to exist. At Capo Palinuro, where Grotta La Cala, Grotta La Calanca and Cala delle Ossa are all located (Fig. 1 n. 25-27), more than 30 such caves are recorded, occurring at two well-defined levels: within the first 20 m below sea level and between –45 m and –60 m (Antonioli *et al.* 1994). The higher level of now submerged caves would have been available for settlement at 30 kyr bp, the deeper one during the following millennia. While it can be ruled out that human groups only settled at the known archaeological caves, which

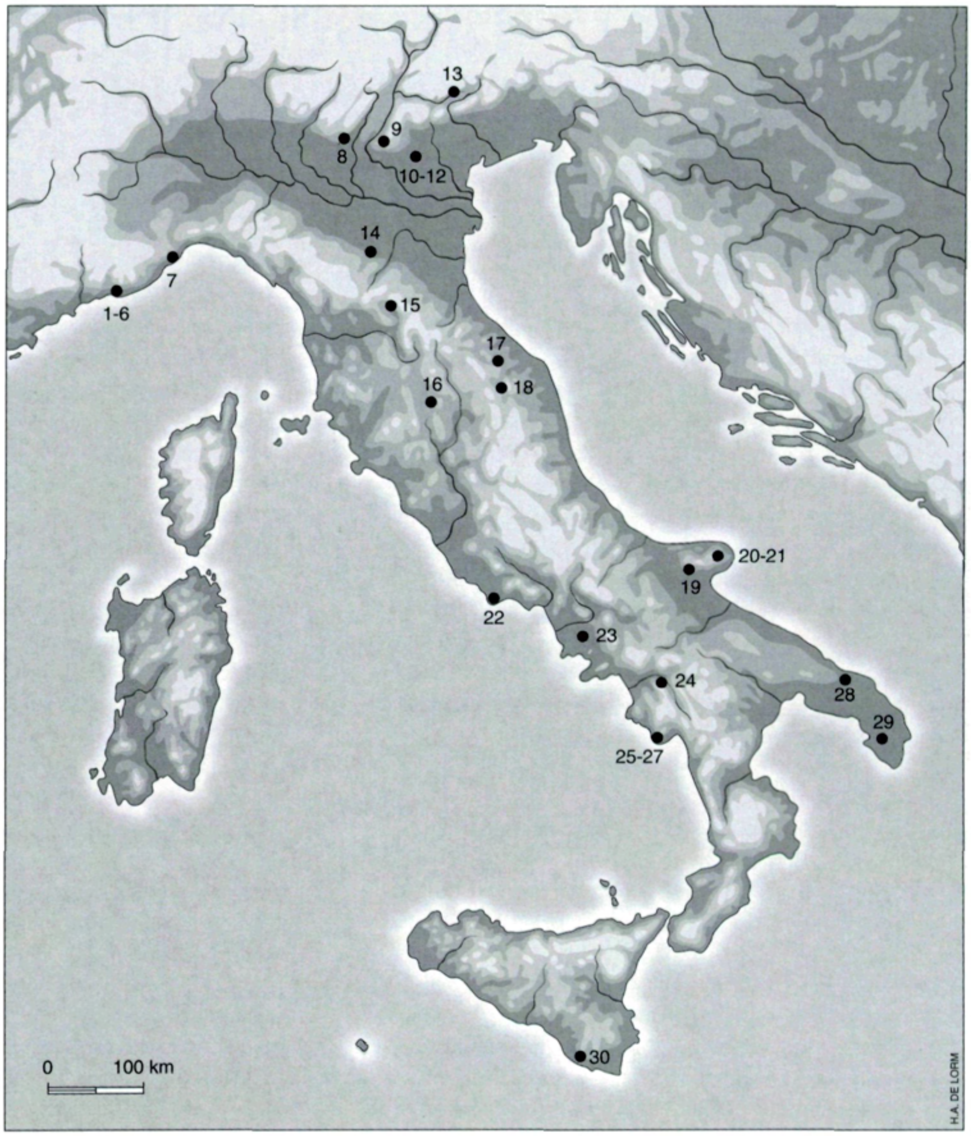

Fig. 1. Location of the aurignacian, gravettian and epigravettian sites mentioned in the text.
1-6 Balzi Rossi (Gr. dei Fanciulli, Gr. del Caviglione, Rip. Mochi, Rip. Bombrini, Barma Grande, Gr. di Baousso da Torre); 7 Gr. delle Arene Candide; 8 Büs dei Lader; 9 Rip. di Fumane; 10-12 Gr. del Broion, Gr. di Trene, Gr. di Paina; 13 Monte Avena; 14 Savignano; 15 Bilancino; 16 Trasimeno; 17 Ponte di Pietra; 18 Fosso di Pagliano; 19 Gr. Paglicci; 20-21 Vico del Gargano, Foresta Umbra; 22 Gr. del Fossellone; 23 Serino; 24 Gr. di Castelcivita; 25-27 Gr. La Cala, Gr. La Calanca, Cala delle Ossa; 28 Gr. di S. Maria di Agnano; 29 Gr. delle Veneri; 30 Rip. di Fontana Nuova.

stood at an elevation of over 100 m at the LGM, the extent of information loss can only be guessed at.

2.2 Glaciated areas

During the cold phases of the Pleistocene, glaciers developed both on the Italian versant of the Alps – where today they still number nearly one thousand – and on the Apennines, which split the peninsula in two from north-west to south-east, and where only a single tiny glacier is now left. There is no evidence of any glacial expanses in Sicily or Sardinia.

Details are not available on the elevation and position of glacier fronts at the end of OIS 3. By then, however, the top of Monte Avena (eastern pre-Alps), where good quality flint outcrops at 1450 m a.s.l., was settled by aurignacian groups. Monte Avena was subsequently encircled by tongues of ice 1000 m thick, which flowed tens of kilometres to the south, documenting a substantial glacial advance after 30 kyr (Lanzinger and Cremaschi 1988; Broglio *et al.* 1992). At the LGM, glacier fronts stood at the piedmont of the pre-Alps, that is at *c.* 300 m a.s.l. just east of Turin, and down to *c.* 200 m a.s.l. south of the modern town of Verona. Remnants of huge moraines still encircle the southern shores of the pre-alpine lakes, such as Lago Maggiore, Lago di Como, and Lago di Garda (Fig. 2).

On the Apennines, dozens of small glaciers, rarely exceeding 5-6 km in length, developed on the highest ranges

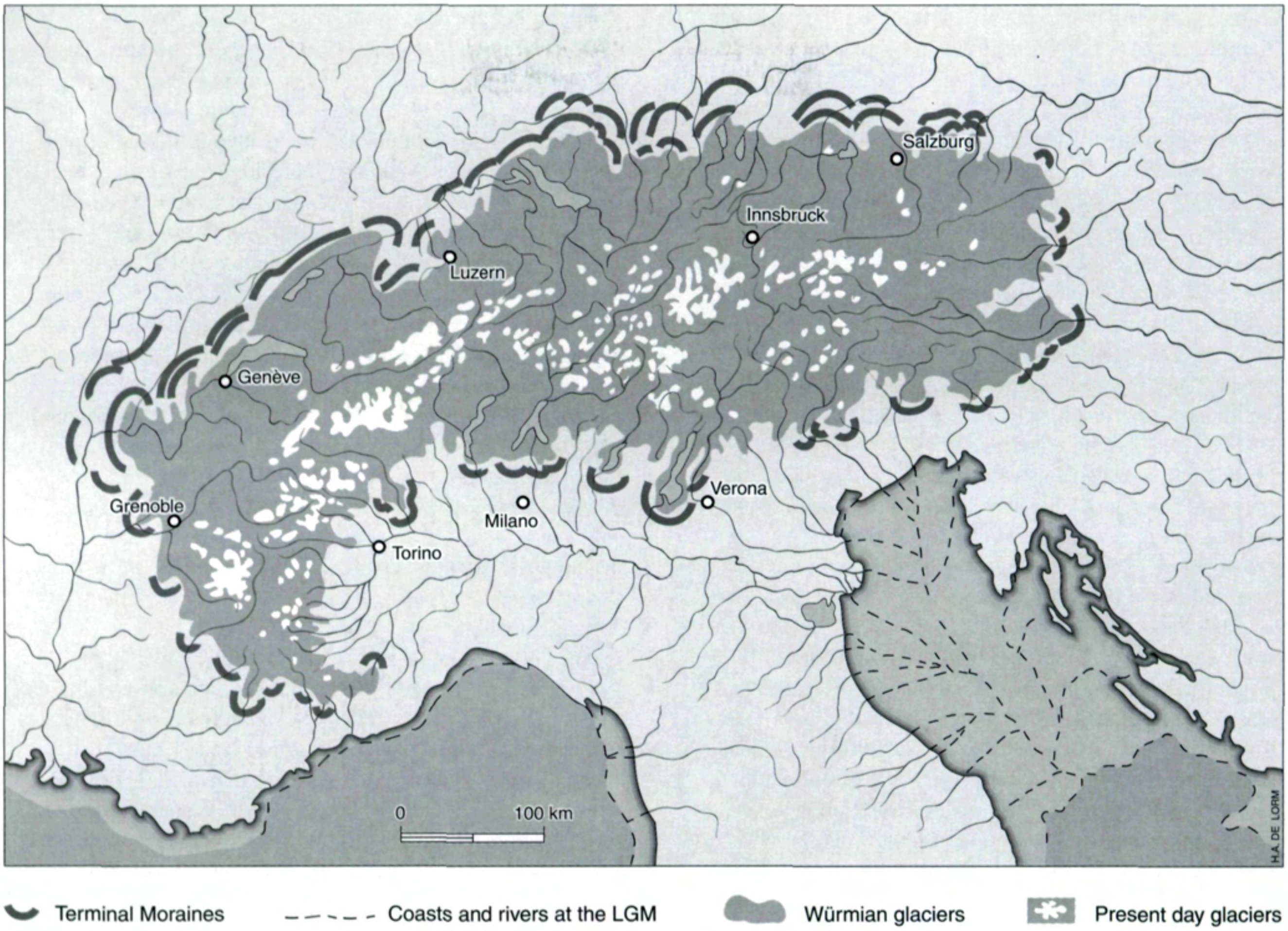

Fig. 2. Palaeogeography of northern Italy at the LGM (after Dainelli 1960).

as far south as Calabria (Desio 1973; Federici 1979; Giraudi and Frezzotti 1997). They expanded down to a minimum of 6-700 m a.s.l. on the northern Apennines, and to 900-1000 m in the central Apennines. In the southern Apennines, the glacier front was down to 1250 m a.s.l. on Mt Sirino, and to 1500-1550 m a.s.l. further south on Mt Pollino, both in Calabria (C. Giraudi pers. comm. 1999). In addition to this north-south gradient in maximum development, there was also a west-east gradient: because of meteorological factors, precipitation mostly occurs on the western slopes of the Apennines, where more ice accumulated than on the drier eastern versants.

2.3 Volcanism and pedogenesis

During the whole Pleistocene, volcanoes were active in Central and Southern Italy. At the end of OIS 3, South-Central Italy was affected by a spectacular eruption centred on the Phlegrean Fields, the largest such event to occur in the Mediterranean region during the last 200,000 years (Barberi *et al.* 1978; Narcisi and Vezzoli 1999). It led to the deposition of the so-called Campanian Ignimbrite – i.e. pumice and lithic fragments in an ashy matrix – presently outcropping in the vicinity of the Gulf of Naples over an area of *c.* 500 sq. km. This is only a fraction of the originally estimated extension of a minimum of 7-8000 km^2, which formed a continuous cover of 0.8 m to 50-60 m in thickness (Barberi *et al.* 1978; Thunell *et al.* 1979; Rosi *et al.* 1983).

The eruption – better seen, in fact, as a series of eruptions – also affected the atmosphere with the formation of probably both a Plinian eruption column and high-altitude clouds of ashes (Cornell *et al.* 1983). The ensuing ash deposit, distributed over a much wider area than the ignimbrite, has been correlated with the so-called Y-5 tephra layer documented in piston cores of the eastern Mediterranean as far away as Cyprus and at over 1500 km from its source. The Campanian Ignimbrite has also been identified at

Kostenki on the Russian plain (Sinitsyn and Praslov 1997). A minimum of 14,000,000 km^2 of land and sea were affected, not to mention the consequence of a reduced global insolation.

Dating of some 60 samples of Campanian Ignimbrite by single-crystal, laser-fusion $^{40}Ar/^{39}Ar$ technique indicates an age of 36.2 ± 0.4 kyr, while many radiocarbon dates, obtained in the 1970's and later, range from >40 to 28 kyr, often with a huge standard deviation (Deino *et al.* 1992). The central ^{14}C values have a mean of *c.* 29 kyr, i.e. approximately 20% younger than the $^{40}Ar/^{39}Ar$ ones. This compares well with a difference of 18% between ^{14}C and U/Th observed at 20 kyr on coral dates. Argon dates would seem to compare better with calibrated ^{14}C dates.

At *c.* 32-30 kyr (in uncalibrated ^{14}C conventional chronology), soil development, due to a moister and more temperate climate, is also documented in the open as well as in caves and rock shelters, at elevations ranging from sea level to 1500-1700 m. Pedogenesis altered volcanic tephras deposited in the centre and the south of the peninsula (and the Campanian Ignimbrite), as well as other sediments of the same general area (Blanc 1937; Messeri and Palma di Cesnola 1976; Frezzotti and Giraudi 1992; Frezzotti and Narcisi 1996). Further north, loesses were similarly affected (Bartolomei *et al.* 1982; Accorsi *et al.* 1990; Cremaschi *et al.* 1990; Cremaschi and Lanzinger 1992; Broglio and Improta 1994-1995). Some of the pedogenised deposits have been found to include aurignacian implements.

Later, between 30 and 20 kyr, there is neither evidence of volcanic activity as intense as before, nor any major phase of soil formation. Narcisi (1996), however, tentatively identifies the oldest Plinian eruption of Vesuvius at 25 kyr, while an age of 20 ± 2 kyr is suggested by Paterne *et al.* (1986) for a tuff originated by an explosion of the Ischia volcano. Some pedogenesis is also observed in the mountains of Central Italy at 27-25 kyr bp, and possibly even later (Giraudi and Frezzotti 1997; Giraudi and Mussi in press).

2.4 Fauna and flora

Mammal assemblages at archaeological sites generally include equids (*Equus caballus* sometimes accompanied by *E. hydruntinus*), bovids (both aurochs and bison) and red deer. In rocky environments, even in the south and at sea level, ibex is often found, indicating a dry and cool climate with an open vegetation. Chamois and roe deer are less frequent, and the markers of more wooded surroundings. Elk only lived in Northern Italy. Reindeer and mammoth are very rarely documented, and not outside the western part of Liguria, adjacent to the French Provence (where they are also quite uncommon). It is not clear if any of the few occurrences of woolly rhino belongs to this final part of the last glacial age, or if they are earlier. Saiga antelope apparently never passed into Italy.

Bear and wolf, as well as hyena, leopard, lion and smaller carnivores were dwelling in caves. Big cats and hyenas, however, were probably represented by dwindling populations, and would have disappeared in later glacial times. Brown bears were also replacing cave bears, which survived in Northern Italy as late as the Glacial Maximum.

The vegetation is best documented in Central Italy, where several long pollen cores have been studied. Fluctuations in vegetation cover characterise the so-called Lazio Complex, recorded on the western side of the peninsula and at low elevation, which encompasses OIS 3 and is characterised by 6 or 7 weak tree expansions (Alessio *et al.* 1986; Follieri *et al.* 1986; Follieri *et al.* 1998). *Pinus* and *Juniperus* are the most frequent taxa, but deciduous and evergreen oak, *Corylus*, *Betula*, *Fagus*, *Tilia*, *Ulmus*, *Carpinus betulus*, *Picea*, *Abies alba*, and even *Zelkova* (now extinct in peninsular Italy) are all recorded, even if in decreasing percentages. There is a general trend from an open woodland to a woodland-steppe, with the last arboreal peak dated at *c.* 30 kyr.

After 30 kyr, only *Pinus*, sometimes accompanied by *Juniperus* and *Ephedra*, is still almost continuously recorded, while angiosperm trees occur just sporadically and some species, such as *Carpinus betulus* and *Tilia*, simply disappear. Harsh steppe conditions prevail, with *Artemisia* generally dominant, and accompanied by Gramineae and, most of all, by Chenopodiaceae. A period with a particularly low arboreal percentage is centred around 22 kyr, while there is a further, weak spread of trees (mainly oaks and *Picea*) at *c.* 20 kyr.

2.5 Climatic inferences

A broad characterisation of the climate around the Glacial Maximum can be deduced from general models of the Mediterranean (Thiede 1978; Thunell 1979; Newell *et al.* 1981). The surface temperature of the sea, on the western coasts of Italy, was between 13° and 19°C in summer (presently 22°-24°C), and between 7° and 13°C in winter (modern average 13°-15°C). Summer temperatures, accordingly, diminished more than winter temperatures. Winds were stronger, especially in summer. The thermic gradient, due to a cooler western Mediterranean basin, produced in winter a high pressure ridge between the Iberian Peninsula and the Maghreb. The cyclonic depressions from the Atlantic, which bring winter rains to Italy (the summer is mostly dry outside the mountain ranges), deviated further south (Rognon 1981).

More precise knowledge can be gained from geomorphological studies which allow a detailed reconstruction of the unstable environment in the central Apennines (Giraudi 1996; Giraudi and Frezzotti 1997; Giraudi and Mussi in press). Long-distance correlations are made available by the

Table 1. Climatic fluctuations in the Central Apennines. Temperatures are compared to the present ones in the same area (adapted from Giraudi and Mussi in press).

TIME RANGE (bp)	DIFFERENCE IN MEAN TEMPERATURE	CLIMATE
17,500 - 21,000	-5.7° to -6.7° C	Very cold and dry
21,000 - 25,500	-7.3° to -8.3° C	Very cold and wet (LGM)
25,500 - 27,000		Mild (?) and wet
27,000 - 28,500		Cold(?) and dry
28,500 - 31,500		Transitional
Before 31,500		Mild and wet

deposition of distinct volcanic tephras, while differences in temperature, compared to the present, were calculated after the altitude of terminal moraines, rock glaciers and past snow limits (Table 1). Correlations established at a global level – namely with the 'Heinrich events' of the Northern Atlantic at *c.* 21 kyr – suggest that the inferred climatic change had more than just local value. The climatic variations are also in good accordance with the data derived from palynostratigraphic studies in the same general area, but at lower elevation (see above).

3. The archaeological record

At 30 kyr bp and earlier, aurignacian industries are documented all over Italy. They are later followed by gravettian ones, which then give way, at *c.* 20 kyr, to the Early Epigravettian. As suggested by the prefix 'Epi-', the latter ones display continuity both in technology and in typology.

3.1 Long stratigraphic sequences

Not many stratigraphic sequences are known which span the period between 30 and 20 kyr, partially or totally encompassing the final Aurignacian, the Gravettian and the Early Epigravettian. The relevant sites are Riparo Mochi, Grotta delle Arene Candide, and Riparo di Fumane in northern Italy; Grotta La Cala and Grotta Paglicci in the South. Other important sequences either were excavated too early – as at Grotta dei Fanciulli (*Grotte des Enfants* in the French literature) and Barma Grande, both at the Balzi Rossi, or are not yet properly reported – as at Grotta La Calanca and Grotta delle Veneri in southern Italy. However, even at the other sites most of the data are preliminary or incomplete. The available evidence is synthetically listed in table 2.

As mentioned above, the Aurignacian ends around 30 kyr. Later dates at Grotta La Cala are not totally reliable because of the rather contradictory radiocarbon chronology of this site. The lowermost part of the stratigraphy of Grotta Paglicci – in contrast with higher levels – similarly displays inconsistencies, even more so if one takes into account that a volcanic ash was identified in level 24, i.e. in the upper aurignacian layer. A preliminary attribution to the Campanian Ignimbrite has been put forward, for which a greater age would be expected, even with ^{14}C analysis (as opposed to Ar/Ar ones) (Cremaschi and Chiesa 1992; Palma di Cesnola 1992). At both sites, the Aurignacian is followed by gravettian industries dated at 26-28 kyr, not without internal contradictions.

3.2 Other dated sites

Not many comparatively late aurignacian sites have been radiocarbon dated, other than those of table 2. Our short list will include Serino, an open air site south of Naples at 31,200 ± 650 bp (F-108) (Accorsi *et al.* 1979), and Grotta di Castelcivita, in the same region: the last archaeological level of this long Early Upper Palaeolithic sequence is an aurignacian one with an age of 32,390 ± 490 bp (Beta-58184) (Gambassini 1997). Elsewhere, substantially earlier AMS dates, as well as tephra deposits, pedogenesis and other climatic indicators, also point to a pre-30 kyr chronology (Mussi in prep.).

As far as gravettian sites are concerned, the evidence from sites with restricted stratigraphic sequences is slightly more comfortable, as summarised in table 3. The listed radiometric results were all processed in the last few years, part of them by AMS.

3.3 The aurignacian and gravettian records contrasted

A discussion of differences in lithic technology and typology is outside the scope of the present paper, and will just be taken for granted. Instead, I will briefly outline site typology, hunting choices, aspects of the record which can be linked to the ritual and symbolic sphere, and the geographical distribution of human settlement. Inescapably, some of the Aurignacian considered below will have an age in excess of 30 kyr.

The number of sites is roughly similar, with some 40 aurignacian locales, and some 30 gravettian cave and open air sites. In both instances, a 'site' encompasses anything

Table 2. The main stratigraphic sequences at 30-20 kyr. M = many archaeological remains; F = few archaeological remains; O = no archaeological evidence. Sources. Riparo Mochi: Hedges *et al.* 1994; Laplace 1977. Grotta delle Arene Candide: Bietti and Molari 1994; Cassoli and Tagliacozzo 1994. Riparo di Fumane: Broglio and Improta 1994-1995; Cassoli and Tagliacozzo 1991. Grotta La Cala: Benini *et al.* 1997; Boscato *et al.* 1997. Grotta Paglicci: Boscato 1994; Palma di Cesnola 1988; Palma di Cesnola 1993.

Years bp	Riparo Mochi			Gr. Arene Candide			Riparo di Fumane			Grotta La Cala			Grotta Paglicci		
	Lev		C14	Lev		C14	Lev		C14	Lev		C14	Lev		C14
Epigr.				P8	*F*	19,630±250							17e	*M*	19,600±300
20 ka				P9	*F*	20,470±320							18b2 18b3	*M* *M*	20,200±305 20,160±310
Grav.	C	*M*		P10	*F*								19a 20b	*M* *M*	20,730±290 21,260±340
22 ka				P11	*F*	Cave bear den							20ca 20cb	*M* *M*	22,220±360 22,110±330
Grav.				P12	*F*	23,450±220				QI	*M*		20de 21a	*M* *M*	22,630±390 23,040±380
24 ka										QII QIII QIV	*M* *M* *M*	27,530±2360 28,230±2460	21b 21c	*M* *M*	23,470±370 23,750±390 24,210±410
Grav.				P13	*O*	25,620±200 25,620±220				QV QVI	*M* *M*	27,400±1720	21d 22b	*M* *M*	24,720±420 24,800±300
26 ka							D1d	*F*		GL GB1	*?* *M*	 26,380±260	22c	*M*	
Grav.	D	*M*					D1c	*F*		GB2 GB3	*M* *M*	 26,880±320	22d 22e	*M* *M*	
28 ka	E	*O*											22F4 23A 23B	*M* *M* *F*	28,300±400 28,100±400 26,300±400←
Aur.										AU10 AU11	*F* *M*		23C 24A1	*O* *F*	Hyena den 29,300±600
30 ka	F	*F*								AU12 AU13	*M* *M*	 27,050±850←	24A2	*F*	
Aur.							D3a	*M*				29,850±870			
32 ka	G50	*M*	32,280± 580				D3b	*M*	32,300±400						

from a find spot and a surface scatter, to a large open air settlement or a multi-layered stratigraphic sequence in a cave.

Together with restricted archaeological assemblages, both aurignacian and gravettian 'rich' sites also occur – i.e., as a rule of thumb, with lithic implements in their thousands. Riparo Mochi level G, Riparo di Fumane, Grotta del Fossellone, are aurignacian examples, while Riparo Mochi level D, Grotta Paglicci level 18 to 22 and Grotta La Cala are gravettian ones. Open air sites with dwelling structures – namely hearths – are known both in the first case (Serino) and in the second (Monte Longo). Quarry sites at flint outcrops were similarly discovered at Monte Avena (Aurignacian), and at Foresta Umbra and Vico del Gargano (Gravettian).

The available evidence on hunted species is listed in table 4. Here I only take into account dominant herbivore species, i.e. those which make up at least one-third of the total number of identified specimens in the ungulate sub-group. The assemblage of Grotta dei Fanciulli (or *Grotte des Enfants*) level F, with a gravettian industry, for which detailed faunal analysis is not available, is also tentatively included.

The small number of assemblages does not allow any detailed statistical analysis. All the same, red deer can be confidently taken as having been staple food for most human groups. Horses and ibexes were hunted with both aurignacian and gravettian tools – maybe the hydruntine horse (*Equus hydruntinus*) more frequently by the Aurignacians, and the ibex more often by the Gravettians. Aurochs is rarer, and apparently only consistently preyed upon during the deposition of some of the layers of Grotta Paglicci. One suspects that part of the not many differences are linked to

Table 3. Radiocarbon dates from sites not included in Table 2. Sources: Aranguren and Revedin 1997; Bietti 1994; Broglio and Improta 1994-1995; Calderoni *et al.* 1991; Vacca and Coppola 1993.

Gr. del Broion str. D	24,700 ± 400 bp (UtC-2694)
Gr. del Broion str. E	25,250 ± 280 bp (UtC-2693)
Gr. Azzurra str. 7	20,200 ± 240 bp (UtC-2697)
(Gr. di Paina)	
Bilancino	24,990 ± 110 bp (Beta-93271)
	24,220 ± 100 bp (Beta-93272)
	25,410 ± 158 bp (Beta-106549)
Fosso di Pagliano	23,500 ± 400 bp (ROM-144)
Gr. di S. Maria di Agnano	24,410 ± 320 bp (Gif-92471)
Gr. di Cala delle Ossa	23,780 ± 350 bp (ROM)

environmental constraints. Overall, the picture is quite similar for the two groups of sites.

Human remains are a different class of bones, which allows observations related to the symbolic and ritual sphere. Those discovered in association with aurignacian implements are just a few: deciduous teeth from Riparo Bombrini (Formicola 1989) and Riparo di Fumane (Bartolomei *et al.* 1992); permanent teeth and bone fragments from Grotta del Fossellone (Mallegni and Segre-Naldini 1992) and Riparo di Fontana Nuova (Chilardi *et al.* 1996). There is no evidence of any intentional deposition or arrangement.

The gravettian record is totally different. Not taking into account loose remains, 16 inhumations with 21 individuals have so far been discovered in Liguria and Apulia, including double and triple burials (Table 5).

The depositions were found to have a distinct position and orientation within the caves, with burial pits and often a lot of ochre. They are also endowed with rich grave goods. Examples are the huge blade tools in the burials of Barma Grande and Grotta delle Arene Candide – the largest ever discovered in Italy – (Fig. 3); the richly decorated caps or bonnets of most individuals; the ornaments on the chest of the deceased, possibly fixed on elaborate garments. Perforated canines of deer, a variety of marine shells, fish vertebras, and ivory pendants were subtly interwoven to create decorative patterns. In short, every aspect of the funerary record points to the display of sophisticated items, and to highly formalised rituals, shared by individuals and groups living at a substantial distance from each other (Mussi 1986, 1995).

Ornaments are also found outside the funerary context, both at Early Upper Palaeolithic (EUP) and at Mid Upper Palaeolithic (MUP) sites, sometimes with some abundance, but again with a better representation, if any, at gravettian sites.

The contrast between a 'poor' Aurignacian and a 'rich' Gravettian is also evident in the artistic record (Mussi and Zampetti 1997, with references). Actually, it can be contended that there is any such evidence at all in the Aurignacian, unless one is satisfied by a grand total of four items with a row of notches or small incisions from three sites (Riparo Bombrini, Riparo di Fumane and Riparo di Fontana Nuova). The Gravettian, on the other hand, is associated with some naturalistic and geometric incisions on bones (Grotta delle Arene Candide, Grotta Paglicci), as well as with paintings and figurines. The dating of the last two entries is admittedly less secure, but there are distinct clues pointing to an age not later that 25-18 kyr.

In the rear of Grotta Paglicci, a panel of red horses is associated with positive and negative hand prints, some lacking thumbs (Zorzi 1962). Stylistic features, including the vertical position of one of the animals, suggest comparisons with the French Gravettian and Solutrean (Mussi and Zampetti 1997). A slab with part of another red horse, which had fallen from the roof at the entrance of the cave, was found buried in level 14a, radiocarbon dated at *c.* 16 kyr (Palma di Cesnola 1988), suggesting a minimum age for the rear panel.

Ivory, bone and soft stone figurines, totalling 19 specimens, were discovered at four widely dispersed sites: Balzi Rossi (Mussi *et al.*, this volume), Savignano (Mussi 1996), Trasimeno (Zampetti 1995), and Grotta delle Veneri (Radmilli 1966). None was found by professional archaeologists. However, in addition to typological and technological aspects relating them to the classic gravettian imagery, at each and every site there is circumstantial evidence pointing to the MUP. Not only are the Balzi Rossi the site of western Europe with the most numerous of such assemblages (15 specimens), but the Italian record is overall the largest of any region west of the Rhine-Adriatic geographical divide of the continent, as, after H. Delporte's inventory (1993), 15 specimens in all were discovered in France and Germany (Fig. 4).

Another sharp difference between the EUP and MUP can be identified in the geographical distribution: aurignacian evidence is found with some substantial settlement practically everywhere, from the Italian Riviera to the area of Naples and, further south, to the Cilento; as well as from the pre-alpine piedmont to the Salento, i.e. the heel of the 'Italian boot'. Even in the pre-Alps and the Apennines, at elevations of 1300-1600 m a.s.l., as well as in Sicily across an arm of the sea, were distinct traces of the Aurignacian discovered.

The later, gravettian record, is much more sparse: the Riviera, Apulia and the Cilento, as well as West-Central Italy between the Arno and Tiber valleys, are regions with some kind of repetitive and planned settlement. Elsewhere, the evidence is best described as sparse or intermittent. This can

Table 4. Dominant ungulates at aurignacian and gravettian sites: • means species' presence, with NISP percentages, when available. Sources: Grotta delle Arene Candide: Cassoli and Tagliacozzo 1994. Grotta La Cala: Benini *et al.* 1997; Boscato *et al.* 1997; Sala 1983. Grotta La Calanca: Sala 1983. Grotta di Castelcivita: Gambassini 1997. Grotta dei Fanciulli: De Villeneuve *et al.* 1906-1919. Grotta di Fontana Nuova: Chilardi *et al.* 1996. Grotta del Fossellone: Alhaique *et al.* 1998. Rip. di Fumane: Cassoli and Tagliacozzo 1991. Grotta Paglicci: Boscato 1994; Sala 1983.

	AUROCHS	RED DEER	HORSE	HYDR. HORSE	IBEX
AURIGNACIAN SITES					
Riparo di Fumane					• 47
Gr. del Fossellone		• 36		• 53	
Gr. di Castelcivita			• 40		
Gr. La Cala lev. 10-13		• 57			
Gr. Paglicci lev. 24				• 46	
Rip. di Fontana Nuova		• 93			
GRAVETTIAN SITES					
Gr. dei Fanciulli lev.F		•			•
Gr. delle Arene Candide					• 68
Gr. La Cala lev. Q		• 86			
Gr. La Cala lev. GB		• 75			
Gr. La Calanca		• 67			
Gr. Paglicci lev. 18-20			• 34		• 40
Gr. Paglicci lev. 21					• 54
Gr. Paglicci lev. 22-23	• 33				

Table 5. Inventory of the gravettian burials in Liguria (above) and Apulia (below dashed line). Tot. A: total number of burials. Tot. B: total number of buried individuals. Sources: Coppola 1992; Coppola and Vacca 1995; Mezzena and Palma di Cesnola 1989-1990; Mussi *et al.* 1989.

	SINGLE BURIALS	DOUBLE BURIALS	TRIPLE BURIALS	TOT. A	TOT. B
Gr. dei Fanciulli	1	1		2	3
Gr. Caviglione	1			1	1
Barma Grande	3		1	4	6
Gr. B. da Torre	3			3	3
Gr. Arene Candide	1			1	1
- - -	- - -	- - -	- - -	- - -	- - -
Gr. Paglicci	2			2	2
Gr. S.Maria Agnano	1	1		2	3
Gr. delle Veneri		1		1	2
Total				16	21

be seen in Italy north of the Apennine range, with a handful of lithic implements in the upper, undated part of the sequence of Grotta di Fumane, as well as at Grotta del Broion at *c.* 25 kyr. Later, there are a few backed points discarded around 20 kyr during distinct episodes of frequentation at Grotta di Paina, and other similarly restricted assemblages at 18 kyr at Grotta di Trene, and at 17 kyr at Büs dei Lader (Biagi 1976; Broglio and Improta 1994-1995). Even more cogent is the evidence of the Marche region in East-Central Italy: the only archaeological remain is a hearth in the open at Fosso di Pagliano, radiocarbon dated at 23.5 kyr (Table 3), at which not a single tool was discovered (Calderoni *et al.* 1991). The first substantial settlement in the area would have been the large open air site of Ponte di Pietra at 19-18 kyr (Broglio and Lollini 1982).

Accordingly, archaeology suggests a diluted aurignacian settlement spanning the whole country and including an island, i.e. Sicily, as well as mountains. Later, gravettian sites occur only outside high mountain ranges – which, however, is no surprise, given the glacial re-advance soon after 30 kyr (see above). Parts of the country, such as the northern and central part of the Adriatic region of Italy – and maybe Sicily as well (Zampetti 1984-1987) – are scoured again and again by small parties which, however, never chose to return and settle there for good. Accordingly, there is ground to believe that human groups focused on some regions only – i.e. on most of the Tyrrhenian or western side of the peninsula, and on Apulia as well – because the adjacent pieces of land had been explored and found unfit.

3.4 Intrusive evidence and local adaptations

The MUP archaeological record of Italy also includes items which are better described as intrusive. A first case in point is ivory, which occurs in Liguria, if rarely, carved into sophisticated figurines and pendants. The meaning of the ivory finds has already been discussed at length elsewhere (Bolduc *et al.* 1996; Mussi *et al.*, this volume). They can be considered either as exotic – i.e. northern – goods ending up on the Mediterranean shores at the end of exchanges linking distant groups, or as locally manufactured objects, carved by people who had acquired elsewhere skills allowing them to perform the task, possibly on pieces of imported raw material. The human groups living in the Salento of southern Apulia, however, apparently could not turn to fresh supplies of imported material or items; neither could they find any of the soft coloured rocks which were usually used as an alternative in regions lacking ivory (Mussi 1996, 1997): the flat, calcareous Salento is devoid of any of the metamorphic rocks which are the source of serpentine, steatite, chlorite and the like. For their figurines, they ended up using a thick piece of bone shaft – a poor solution which left the trabecular structure of the inner bone visible on the left side of a female statuette discovered at Grotta delle Veneri (Fig. 5).

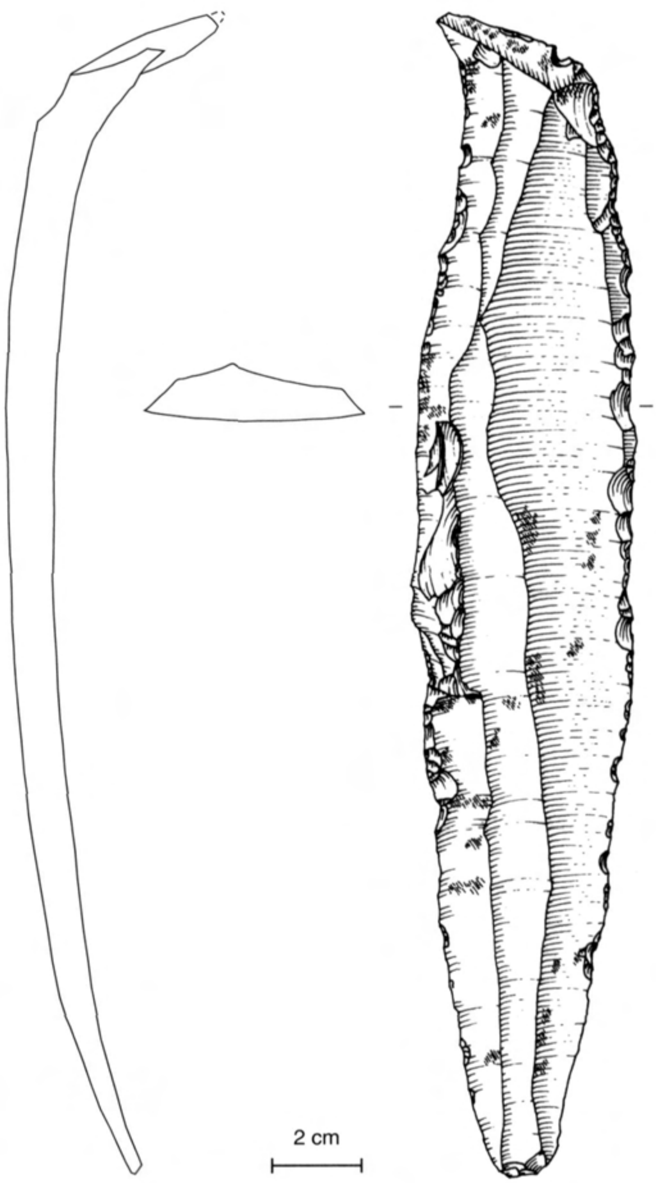

Fig. 3. A spectacular ochre-stained and retouched crested blade from the Triple Burial of Barma Grande (Liguria). Scale in cm (drawing by M. Mussi).

Western Liguria is remembered not only for ivory, but also as an area where *bâtons à trous*, otherwise not known in Italy, where discovered at two distinct sites. One was unearthed at Grotta del Caviglione (or *Grotte du Cavillon*,

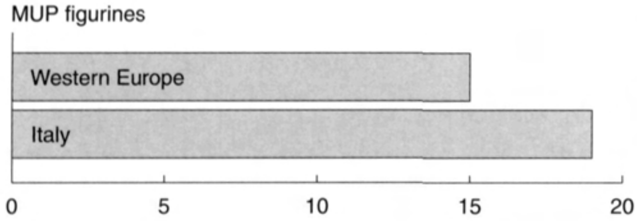

Fig. 4. The record of Italian MUP figurines compared to the rest Western Europe.

one of the Balzi Rossi caves), in the level of the gravettian burial, while four more surrounded the body of a boy in the MUP grave of Grotta delle Arene Candide (Rivière 1887; Molari 1994). *Bâtons à trous* are usually linked to reindeer antler, which was the material commonly used both to make them, and to prepare the projectile points supposedly to be straightened with the help of the *bâtons* themselves. Their scarcity south of the Alps is no surprise, as reindeer never lived in Italy, or nearly so. The Ligurian specimens are not made of reindeer antler, however: the Caviglione one was prepared, instead, by drilling a hole through a horse metacarpal, while elk antler was used at Grotta delle Arene Candide. Either because the results were eventually found not truly satisfying, or because the tools were not needed at all, the *bâtons* are neither known at other sites further south, nor in later deposits.

A more pervasive evidence of adaptation to a different country – to the 'red deer country' instead of to the 'reindeer country' – is also suggested by a common type of pendants, i.e. by perforated teeth. A variety of other pendants actually also exists. However, when it comes to teeth, during the MUP and later, inside as well as outside burials, the selected ones are invariably red deer canines. Certainly, deer canines were also widely used all over Eurasia, but possibly not with the same exclusive enthusiasm as in Italy. A much larger variety of pendants and perforated teeth is described, for instance, in the Aurignacian of Central Europe, and in the French Upper Palaeolithic, while in northern Spain perforated deer canines become quite common for the first time in magdalenian levels (Hahn 1972; Desbrosse *et al.* 1976; Straus 1992). I suspect that, in Italy, their exclusive use was a result of the adaptation to a more restricted variety of game. Not because people were directly obliged to do so – after all, bovids, foxes etc. were available, and their teeth had been actually used by the local aurignacian groups – but because MUP groups had to focus on a species which was much less important north of the Alps, and to rearrange their symbolic activity accordingly.

Lithic industries of the time are not totally devoid of odd adjunctions either. In the Barma Grande (Balzi Rossi), the amateur excavations of L.A. Jullien in the late 19th century led to the discovery of the well-known figurines (Bolduc *et al.* 1996; Mussi *et al.*, this volume), but also to the unearthing of a lithic industry now kept in different museums. The collection of the Peabody Museum (Harvard University) includes a truncated backed blade, with an invasive flat retouch, without any counterpart elsewhere in Italy (Fig. 6:1). Comparisons, if any, can tentatively be established with the *lamelles à dos avec retouche plate sur un côté* of the Upper Solutrean (Smith 1966). Another item with a distinct 'solutrean blend' is the crude *feuille de laurier* discovered at Grotta di Trene in northeastern Italy in an apparently undisturbed layer, now radiocarbon dated to 17,640 ± 140 bp (UtC-2691) (Leonardi *et al.* 1958-1959; Broglio and Improta 1994-1995) (Fig. 6:2). This small inventory of unique finds can be completed with the 20 or so points with a distinctive flat retouch, shouldered or not, which were discovered in levels 18 and 17 of Grotta Paglicci, with AMS dates of 20 to 18 kyr (Palma di Cesnola 1988) (Fig. 6:3-6). I suspect that the fashion of implements mimicking solutrean ones was linked to an influx of people and ideas from across the Alps.

The best evidence of somebody travelling all the way from, perhaps, Franco-Cantabria to Apulia is actually to be found at Grotta Paglicci. The panel with horses and hands discussed in the previous paragraph is a unique discovery in Italy, where paintings only reappear in the final Palaeolithic with non-zoomorphic imagery. Just as ivory carving, cave wall painting is not an improvised skill, and the replication of stylistic patterns better exemplified in distant areas is no chance occurrence. As it can be ruled out that, in contrast to Venuses, cave walls can be exchanged from hand to hand, travelling over the countries, the only alternative left to explain the panel of Grotta Paglicci is an artist coming from across the Alps.

3.5 Population dynamics

Taking both AMS and conventional ^{14}C dates at face value, the Aurignacian would last in Italy from 37-36 kyr to 30 kyr, and the Gravettian from 28 to 20 kyr (Broglio and Improta 1994-1995; Hedges *et al.* 1994). That is, the time range is approximately the same, and the number of identified sites is also roughly similar, even if there are more aurignacian locales (see above). As said, I assume that the submersion of coastal caves affected fewer aurignacian than gravettian sites, accounting for the minor frequency of the latter ones.

The lack of evidence between 30 and 28 kyr is a different problem. Even accepting that, at Grotta Paglicci, the Aurignacian was as late as 29 kyr, and followed by the Gravettian at 28 kyr – which means dismissing the date of

26 kyr from level 23B (Table 2) – there is no continuity in human settlement. During the intervening millennia the archaeological evidence is at best sparse, with hyenas denning in the cave (Table 2). The same holds true at the other sites with a continuous stratigraphic record: either a scatter or lack of aurignacian implements is followed by sound gravettian evidence (Mochi, La Cala – with a sedimentary lacuna at the latter site, after Boscato *et al.* 1997), or, vice versa, a dense aurignacian deposit gives way to a much smaller gravettian presence (Fumane). One gets the same discontinuous picture taking into account sites with a record including only one of the two lithic assemblages: as said, the Aurignacian is invariably dated at >30 kyr, while the Gravettian starts at 26-25 kyr (Table 3).

I have discussed in detail elsewhere the characteristic of the diffuse aurignacian, compared to the much more selective gravettian settlement (Mussi in prep.). It will suffice here to underline that chronic underpeopling must have been a serious problem for prehistoric bands, and more so in the Italian territory, geographically much partitioned because of mountain ranges and sea arms. While small isolated populations are not viable on demographic grounds (Wobst 1976), to keep in touch with distant groups would have been quite a challenge.

The symbolic mode of communication, as embodied in works of art and ornaments, helps to transmit information through time and space, whenever a shared culture allows the recipient(s) to decode the message (cf. Wobst 1977). The archaeological record suggests, however, that amongst aurignacian groups, scattered over distant islands, mountains and plains, a behaviour related to symbolic and ritual activity left scanty traces and might have been poorly developed. On top of that, at some point, over vast stretches of South-Central Italy the gigantic eruption(s) leading to the deposition of the Campanian Ignimbrite became a serious threat to animal and human survival.

Different dating methods do so far not allow a strict correlation of archaeological sites and geological events. However, thick deposits of volcanic ashes are known to exist all over the upper part of the EUP sequence of Grotta di Castelcivita, eventually capping it and contributing after 32 kyr to fill and close the cave (Gambassini 1997). At Serino, in the same region, the aurignacian open air site was discovered under a thick cover of volcanic ashes (Accorsi *et al.* 1979). These ashes had totally filled a small lake basin in which the temporary camp had once been established. Volcanic deposits have also been mentioned at Grotta Paglicci (see above), similarly marking the end of the Aurignacian.

Thick tephra deposits blanketing a whole region would have made disappear the vegetation, springs and other landmarks, as well as flint outcrops and other resources.

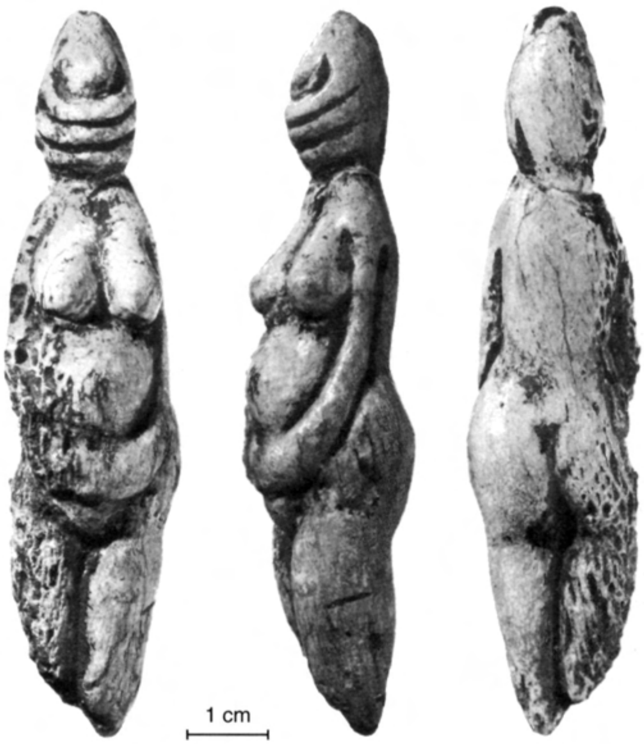

Fig. 5. Figurine from Gr. delle Veneri, with the trabecular structure of the bone in evidence on the right side. Scale in cm (after Radmilli 1966).

While some recovery possibly happened, this ecological catastrophe would have been an added stress to the fragile balance of human population. Lacking an effective "artifact mode of communication" (Wobst 1977) via curated items, and maybe without much collective ritual activity, in the end distant local bands would no longer have been in touch with each other. Sparsely populated Italy would have turned into a kind of demographic trap, with a sheer stochastic imbalance in sexes and classes of age disrupting one group after another and leading to extinction.

The gravettian assemblages seem to have been produced by new human groups entering the peninsula after some gap in the peopling of the country. The geography suggests that this might have happened from both the east and the west, that is from the Balkans and from France. The dearth of MUP sites in northeastern Italy and adjoining former Yugoslavia, as well as in Greece (Perlès, this volume), however, contrasts with the sound archaeological evidence from the Provence (Onoratini 1982), Liguria and other areas further south. While groups might well have entered the

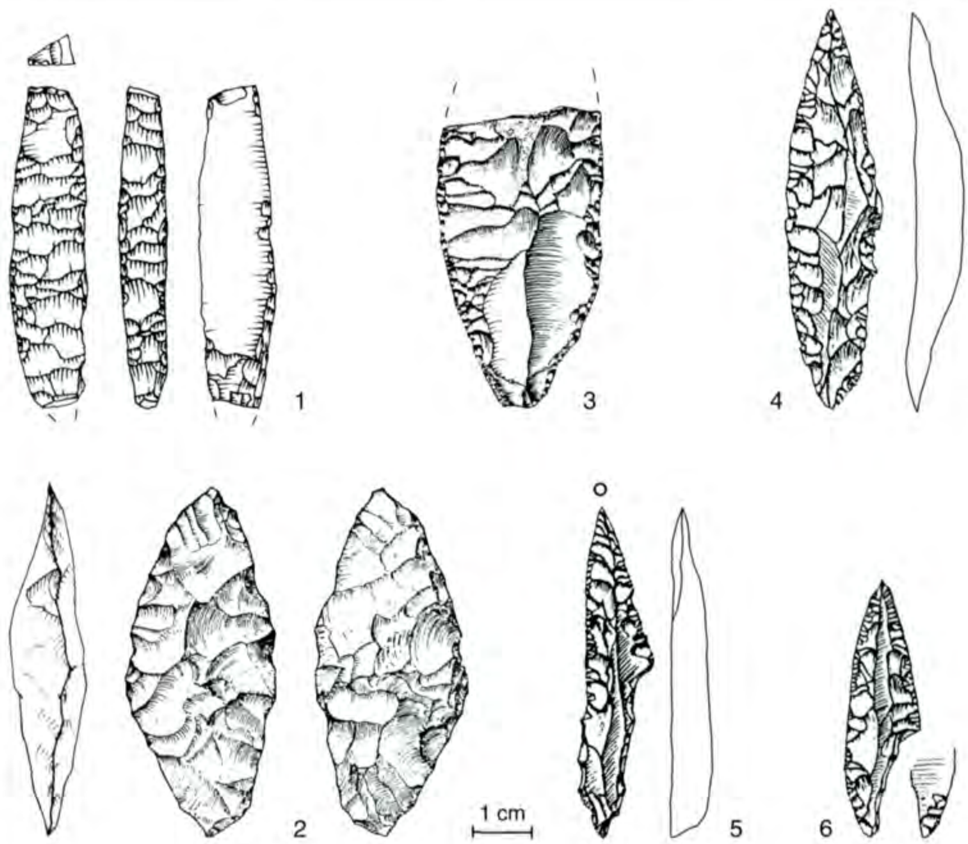

Fig. 6. Tools with an invasive flat retouch, which are only exceptionally found in Italy. 1) Barma Grande (unpublished – drawing by M. Mussi); 2 Gr. di Trene (after Leonardi *et al.* 1958-1959); 3- 6) Gr. Paglicci lev. 17-18 (after Mezzena and Palma di Cesnola 1967; Palma di Cesnola 1975). Scale in cm.

peninsula from both the eastern and the western 'gate', I suspect that, as also documented by stylistic and technical ties, the influx was mostly from the west. Human groups then concentrated in some regions. While most of the Po valley, by then merging into the flatlands of the northern Adriatic, cannot be investigated because of the thick cover of alluvium, or because of the rise in sea level, the rocky areas encircling it are nearly devoid of any settlement. There is ground to believe that this area was deliberately avoided, as denuded slopes merging into marshy areas and bogs were not found suitable for settlement.

Sparse as MUP population was, it coped successfully with the difficulties encountered in a southern, different environment. As the continuous sequences of Grotta La Cala and Grotta Paglicci, as well as the overall archaeological record suggest, they gave rise to an uninterrupted settlement, spanning the whole final Pleistocene.

4. Conclusive remarks

The MUP settlement of Italy is spatially discontinuous. Just as in other parts of Eurasia, small concentrations of humans were surrounded by vast depopulated stretches of land. The first gravettian groups perhaps entered the peninsula as early as 28 kyr bp – in an uncalibrated ^{14}C chronology – when the climate had already markedly deteriorated, settling, as it seems, in the south. More sites came into existence at 25-24 kyr, possibly testifying to the arrival of a new human contingent just at the onset of the LGM. Again and again, and maybe as late as 20 to 18 kyr, when the climate was still much colder than today, exotic items are also recorded in small numbers. They give a clue to movements of people and ideas, and to new arrivals from the north, who succeeded into infiltrating the southern territories, strengthening bands established there long before. This scenario is in good accord with the analysis of human remains, which stresses homogeneity in physical characters all over Europe (Churchill *et al.*, this volume).

Gravettian adaptation to the novel Mediterranean environment was possibly promoted by the steppe-like conditions prevailing at arrival on the Italian scene, which by 28 kyr was sufficiently akin to more northern landscapes. All the same, human groups displayed great care in choosing the areas best befitting them, considerable flexibility focusing on local animal species, and remarkable ingenuity turning to new raw materials. Their lasting and successful colonisation was then characterised by the capacity of both keeping in touch with distant bands, and of allowing new people to enter the region, accommodating and integrating them into the already settled territories. In doing so, they avoided isolation and demographic imbalance which had not been overcome by aurignacian groups. While formalised depositions and spectacular grave goods fit into the frame of well-established, communal ceremonies (Mussi 1988-1989, 1990, 1991, 1992, 1995, in prep; Mussi and Zampetti 1997; Mussi *et al.* 1989), the sophisticated set of values and beliefs embedded in the so-called 'Venuses' is just starting to be grasped, unveiling an enormously complex cultural background (Mussi *et al.* in press; Mussi *et al.*, this volume). The ultimate tool of the MUP demographic achievement is probably to be found in this unprecedented development of symbolic capacity and ritual activity.

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Margherita Mussi
Dipartimento di Scienze dell'Antichità
Università di Roma "La Sapienza"
Via Palestro 63
00185 Roma
Italy

Catherine Perlès

28 Greece, 30,000-20,000 bp

The earlier part of the Upper Palaeolithic in Greece (Aurignacian and Gravettian) is characterised by an extreme scarcity of archaeological data. It will be argued here that this situation is not solely due to insufficient research, but that it also reflects very sparse occupations, in an increasingly dry environment.

1. Introduction

The basic problem we were asked to address in this workshop was 'coping with climatic deterioration in the period 30-20 kyr bp'. But even a cursory look at the literature reveals that the data pertaining to the Early and Mid Upper Palaeolithic in Greece are scanty to the point of being almost nonexistent. We are thus faced with a straightforward alternative: is the poverty of the database due to adverse preservation conditions or to research biases? Or is it, more significantly, the result of 'deteriorating climatic conditions' and very sparse human occupation?

However, before this problem is addressed in detail, a presentation of the environmental and archaeological data is necessary, since none have been published in an easily accessible format. In addition, it will soon be apparent that, in Greece, a meaningful approach to the question requires that one considers the late Middle Palaeolithic as well as the early Upper Palaeolithic.

2. Climatic changes and environment, 30-20 kyr bp

2.1 The sources

The most comprehensive environmental data are provided by four pollen cores, taken in three different lakes: Ioannina 1 in Epirus (Bottema 1974, 1979, 1991; van Zeist and Bottema 1982), Ioannina 249 (Tzedakis 1993)[1], Xinias I in Thessaly (Bottema 1979, 1991; van Zeist and Bottema 1982), Tenagi Philippon in Macedonia (Wijmstra 1969; Bottema 1979, 1991; van Zeist and Bottema 1982). By analogy with the above mentioned sequences, the basis of the lake Kopaïs diagram, though not dated, can be broadly attributed to the Late Glacial and added to the list (Turner and Greig 1975; Allen 1986).

Although a broad climatic outline can be drawn, precise correlations between the different cores are rendered difficult by the scarcity of absolute datings and the specificity of each lake's environment: Ioannina and Xinias are both located in mountainous surroundings (respectively at 470 and 500 m a.s.l.), but Ioannina corresponds to the well-watered western side of the Pindus range (present-day mean precipitation of *c.* 1200 mm), whereas Xinias is located on the drier, eastern side, and receives only half this total. Rainfall at Tenagi, in the low-lying Macedonian plain, is comparable to that of Xinia (mean present-day precipitation around 500 mm), whilst Kopaïs, in Boeotia, receives only 300-400 mm of rain annually[2].

The Ioannina data can be extrapolated to the archaeological sites of Epirus, and those of Kopaïs can serve as a basis for the nearby Seïdi rock shelter. On the other hand, there are no diagrams from Southern Greece, where the topographical and hydrometric contexts are very different. The only information that can be gathered for Southern Greece is provided by the macrobotanical and faunal remains from the Franchthi Cave, since no data have been published from the important sequence of Kephalari[3] or from the small Arvenitsa cave, also in the Argolid (Table 1). Finally, important data are awaited from the newly excavated site of Theopetra in Thessaly, but preliminary reports only have been published (Kyparissi-Apostolika 1994, 1999).

2.2 Evidence for climatic change: the pollen diagrams of Northern and Central Greece

All available pollen diagrams indicate a decrease in tree cover after *c.* 30 kyr bp, which marks the onset of a long period of dry and cool climate.

However, even during the preceding millennia the tree cover was not extensive. The last widespread forests had disappeared from the Ioannina and Xinias areas by *c.* 40 kyr/38 kyr bp (Zone T in Ioannina, V in Xinias) or even earlier in the drier Macedonian plain. From *c.* 38 kyr to *c.* 30 kyr bp important variations of the AP values are recorded in all diagrams, but they seldom reach 50% and more usually lie between 20 and 40%, with a decreasing gradient from west to east. In addition, the tree cover decreases through time: the percentage of the better represented trees, *Pinus* and *Quercus* cf. *cerris*, decreases irregularly from the beginning to the end of the period, when they hardly amount to 10% each. Thus, as early as *c.* 37 kyr bp, all sites were surrounded by a dominant steppe vegetation, characterised by abundant *Artemisia*,

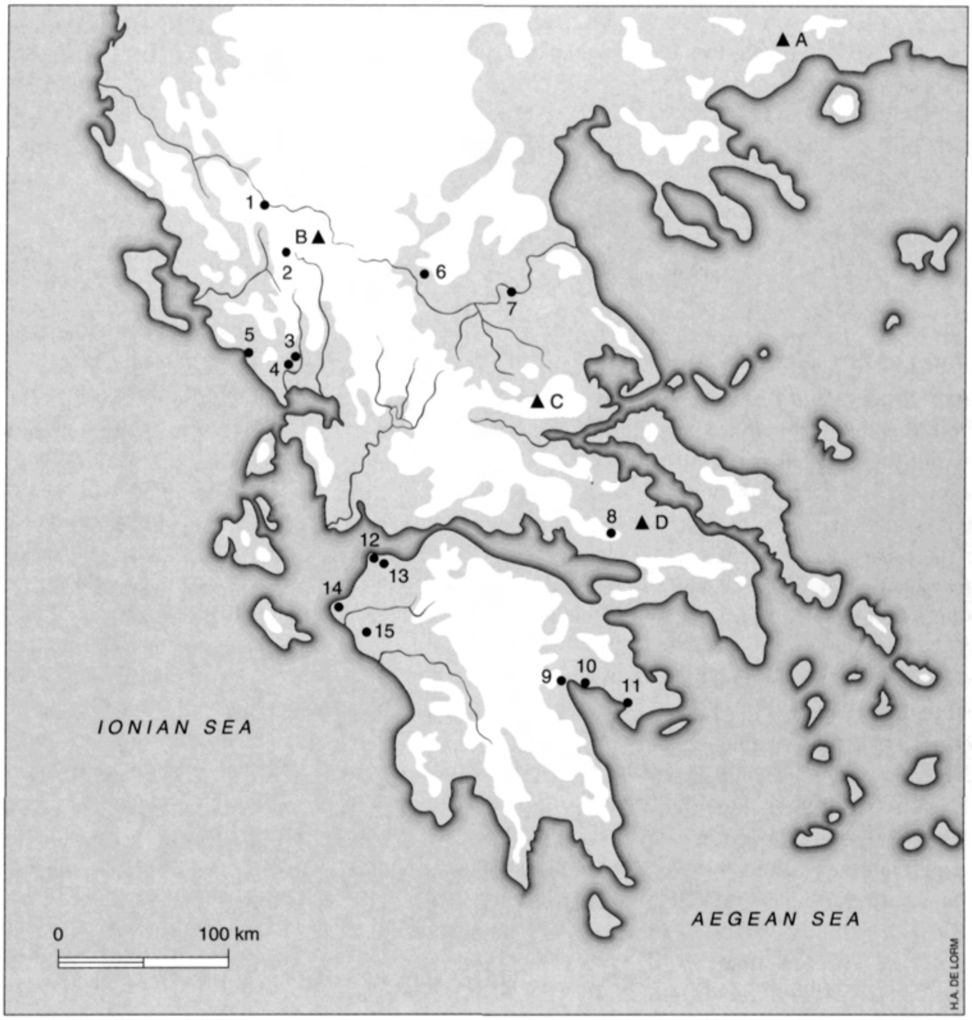

Fig. 1. Map of Greece showing the main locations quoted in the text. Triangles: pollen cores – A. Tenagi Philippon; B. Ioannina; C. Xinias; D. Kopaïs. Dots: archaeological sites – 1. Klithi; 2. Kastritsa; 3. Asprochaliko; 4. Kokkinopilos; 5. Spilaion; 6. Theopetra; 7. Group of sites from the Penios terraces; 8. Seïdi; 9. Kephalari; 10. Arvenitsa; 11. Franchthi; 12. Mavri Myti; 13. Elaiochori; 14. Group of sites from the Kastron region; 15. Group of sites from the Amalias region.

Chenopodiaceae and Gramineae; the steppic character of the vegetation increased through time.

A small 'peak' in AP pollen marks, however, the beginning of our period of study. At about 30 kyr bp, tree pollen again reach a value of *c.* 40% at Ioannina (zone V2), with *Quercus* and *Pinus* dominant, scarce *Ulmus*, *Carpinus betulus*, *Acer* and *Juniperus* at medium elevations, *Abies* and *Fagus* at higher elevations (Bottema 1974). But aside from Ioannina, where the trees that had found refuge on the higher, more watered western slopes of the Pindus could more rapidly recolonise the lower-lying areas, this brief episode of higher precipitation did not radically modify environmental conditions in Greece: at Xinias (zone W3/X) and Tenagi (zone P7?), AP values (mostly *Quercus* and *Pinus*) barely reach 20%.

This 'peak' is markedly asymmetrical, and the tree cover decreased rapidly after *c.* 30,000 bp. Between *c.* 30 and 20 kyr bp, all three regions appear to have been almost devoid of trees (see Fig. 2). The slight variations marked by the pollen diagrams do not significantly alter what Bottema qualified, even at Ioannina, as "extreme conditions" (Bottema 1974). At Ioannina (zone V3-7) the dominance of the steppe vegetation in the valley and on the slopes is indicated by NAP values of 60 to 80%. At higher elevations, deciduous oak, *Acer* and *Juniperus* may have formed open forests or steppe-forests. The very low values of other tree pollen may be taken as an indication of long-distance transport (Bottema 1974). At Xinias (zone X), NAP values are consistently above 80%. *Quercus*, *Pinus* and possibly *Betula* may have been growing in favourable habitats (van Zeist and Bottema 1982), or transported from further away (Bottema 1979). At Tenagi and Kopaïs (Zone K1), the tree cover was even more restricted, with AP values barely reaching 10% (Turner and Greig 1975: 175-176).

Thus, a steppe vegetation with *Artemisia*, Chenopodiaceae, Gramineae and a wide range of herbs constituted the dominant, if not exclusive vegetation in all four regions. The countryside was open and dry, with trees restricted to small refuges and to the exposed higher slopes of the Western Pindus (Willis 1992a, b, c). AP values tend to decrease slightly between 30 and 28 kyr bp, but they were already so low at the start of the period that this further deterioration could hardly have had any significant impact on animal and human groups. Stability, not change, is what characterises the climate and environment of northern Greece between 30 and 20 kyr bp.

2.3 Faunal data: Northwestern Greece

Theoretically, the faunal sequences from the rock shelters of Asprochaliko and Kastritsa, near Ioannina, should reflect both the long-term environmental changes and the overall stability within our period of study. But Asprochaliko was excavated by E. Higgs more than twenty years ago (Higgs and Vita-Finzi 1966; Higgs 1968), and the stratigraphic notations proved insufficient when the material was revised for publication. So few identifiable specimens could be securely attributed to the Late Middle Palaeolithic ('Micromousterian')[4] and to the Upper Palaeolithic, that it proved impossible to subdivide each period according to the stratigraphy (Bailey *et al.* 1983a). At Kastritsa, on the contrary, faunal remains are listed for each stratum, but the figures are extremely small prior to 20 kyr bp (stratum 9).

In these conditions, the overall ungulate spectrum appears remarkably stable over the *c.* 90 kyr years of the Asprochaliko sequence (Table 2). Long-term climatic trends may, nevertheless, be reflected by the progressive decrease of *Dama* and the increase of *Ibex* from the mousterian to the Upper Palaeolithic strata; this would accord with the decrease in humidity, temperature and tree cover.

Neither species is present at the basis of the Kastritsa sequence, dated to > 22 kyr bp. *Cervus* is heavily dominant, *Equus* and *Bos*, which are absent in the Upper Palaeolithic of Asprochaliko, are here represented by a few bones; conversely, *Capreolus* and *Ibex*, present at Asprochaliko, are absent from strata 9 and 7 at Kastritsa. Hunting specialisation as well as diachronic trends have been suggested to account for these differences (Bailey *et al.* 1983a; Bailey and Gamble 1990). However, the Asprochaliko and Kastritsa faunal assemblages are palimpsests of occupations covering several millennia (more than ten at Asprochaliko): it is thus impossible to establish which faunal changes, if any, occurred between 30 and 20 kyr bp. Nevertheless these data, considered as a whole, suggest important differences with Franchthi and the other Peloponnesian sites.

2.4 Botanical and faunal data from Southern Greece

The environmental conditions in Southern Greece before 30 kyr remain unknown: the Middle Palaeolithic levels at the basis of the Franchthi cave have not been excavated (Perlès 1987), and the long Middle to Upper Palaeolithic sequence from Kephalari is not yet published in any detail. The situation is hardly more satisfactory for the Early Upper Palaeolithic, but the available evidence seems to reflect even drier conditions than in Northern Greece.

No pollen were recovered from the Upper Palaeolithic sequence at Franchthi. Carpological data are rich, but difficult to compare with the pollen data of Northern Greece. The entire time span between *c.* 30 and 20 kyr bp is comprised in Botanical zone I (Hansen 1991), characterised by abundant uncarbonised remains of Boraginaceae (*Buglossoides arvensis* [*Lithospermum arvense*], *Alkanna* sp. and *Anchusa* sp.), none of which appears in the pollen diagrams. Since all three species can be found in steppic environments, a constantly cold, dry climate is inferred. An inversion between the proportions of *Alkanna* and *Buglossoides* allows for a division into two subzones, which correspond to the (undated) limit between lithic phases I and II. A temporal hiatus is probable, but it is not possible to state whether this inversion corresponds to environmental transformations (Hansen 1991: 104). *Juniperus* is dominant in wood charcoals (Hansen 1994: 176), which confirms an open environment, with sparse trees. The presence of many tiny seashells, in particular *Bittium* spp. (Shackleton 1988), probably windblown, also supports the absence of an extensive tree cover.

Unfortunately, the faunal remains corresponding to Botanical zone Ia, i.e. to the earliest Upper Palaeolithic, have not yet been published. The earliest available data (faunal phase A) correspond to Botanical zone Ib and to Lithic phases II and III, i.e. to *c.* 25-20 kyr bp (Table 3). *Equus* cf. *hydruntinus* is the most abundant species in the trench recovery (*c.* 70%); it is accompanied by the ubiquitous *Cervus elaphus* (*c.* 30%), hare and tortoises (and a single bone of *Sus*), but also by abundant lizards and birds and scarce rodents such as *Microtus*, *Mus* and *Spalax* (Payne 1975, 1982). This assemblage suggests again a dry and open environment that did not change significantly during the millennia under consideration. Interestingly, *Equus* cf. *hydruntinus* and *Cervus elaphus* are also well represented in the minute faunal sample from Seïdi in Boeotia and at Kephalari, in natural environments comparable to that of Franchthi (Schmid 1965; Reisch 1976). This probably indicates that *Equus* cf. *hydruntinus*, a species adapted to open and dry steppes (Payne 1975), was more abundant in the plains of Central and Southern Greece (where it may have been the dominant ungulate species) than in the mountains of Northern Greece.

2.5 The potential impact of climatic changes

All available data suggest that environmental changes around 30 kyr bp and between 30 and 20 kyr bp were of limited

Table 1. Main sites and regions quoted in the text.

SITE	REGION	NATURE OF SITE	SEQUENCE
KOKKINOPILOS	Epiros	Open air	Early phase of Upper Pal. ? Backed blades and bladelets; apparently no shouldered points, microburins or geometrics
ASPROCHALIKO	Epiros	Shelter	Middle Palaeolithic (Mousterian and "Micro-mousterian"), Upper Palaeolithic (phase with microgravettes followed by phase with microburins and geometrics), Bronze
KASTRITSA	Epiros	Cave	From the 23rd/22nd mill. to the 14th mill. bp. Phase with backed bladelets, phase with shouldered points, phase with microburins and microgravettes (without geometrics)
KLITHI	Epiros	Shelter	From the 18th to the 11th millennium bp. Archaeological sequence soon to be fully published. Upper levels with backed bladelets and microburins (without geometrics)
KATSIKA	Epiros	Open air	"Long backed blades", backed bladelets. Occupation earlier than the lake's transgression
KONITSA	Epiros	Cave	"Upper Palaeolithic" industry with bladelets (probably backed bladelets) and small endscrapers in brecchiated sediments. No excavations
SPILIAION	Epiros	Open air	Attributed to the Aurignacian
THEOPETRA	Thessaly	Cave	Middle Palaeolithic, Upper Palaeolithic, Mesolithic (burial), Neolithic
Valley of the PENEIOS	Thessaly	Open air	Late Middle Palaeolithic with foliate points and Aurignacian elements
Region of the KOPAÏS lake	Beotia	Caves and shelters	Upper Palaeolithic ? (cf. mentions of what seem to be backed bladelets)
SEÏDI	Beotia	Shelter	Two thick Upper Palaeolithic strata. Carinated endscrapers, shouldered point, gravettes (successive levels not distinguished in the publications). Seemingly no geometrics
ULBRICH	Argolid	Cave	Upper Palaeolithic ("Aurignacian" and "Magdalenian"), Mesolithic ("Azilian" and "Azilo-Tardenoisian"), Neolithic
ARVENITSA	Argolid	Cave	Aurignacian
KEPHALARI	Argolid	Cave	Mousterian, Upper Palaeolithic (strata with gravettes and microgravettes. No details published), Neolithic, Historical
KLISSOURA	Argolid	Shelter	Upper Palaeolithic (Aurignacian, Gravettian), Mesolithic

Table 1. Main sites and regions quoted in the text.

SITE	^{14}C DATES bp	FIELDWORK	MAIN REFERENCES
KOKKINOPILOS	None	S. Dakaris and E. Higgs, 1962	Dakaris *et al.* 1964, Higgs 1968
ASPROCHALIKO	26,600 ± 900 for C.9 or 10 (phase with gravettes)	E. Higgs 1964-1966	Higgs and Vita-Finzi 1966, Higgs 1968, Bailey and Gamble 1990, Bailey *et al.* 1983b, 1992, Huxtable *et al.* 1992, Adam 1989
KASTRITSA	5 dates from 21,800 ± 470 to 13,400 ± 210 BP	E. Higgs 1966-1967	Higgs *et al.* 1967, Higgs 1968, Bailey and Gamble 1990, Bailey *et al.* 1983a, 1983b, 1992, Adam 1989
KLITHI	6 dates, from 17,400 ± 400 at the basis, to 10,420 ± 150 at the top	G.N. Bailey 1984-1988	Bailey 1992, Bailey and Gamble 1990, Bailey (ed.), 1997a and 1997b
KATSIKA	None		Higgs 1965: 368
KONITSA	None		Higgs and Vita-Finzi 1966: 22
SPILIAION	None	Discovered by C. Runnels *et al.* (survey of the Preveza region)	Runnels *et al.* in press
THEOPETRA	Numerous dates from > 34,000 bp to the present	Ongoing excavations by N. Kyparissi-Apostolika	Preliminary reports: Kyparissi-Apostolika 1994, 1999
Valley of the PENEIOS	c. 45,000 à 30,000 bp	Surveys by V.L. Milojcic *et al.* in the 60's, then by C. Runnels *et al.* in the 80's	Milojcic *et al.* 1965, Runnels 1988
Region of the KOPAÏS lake	None	Survey T. Spyropoulos	Preliminary report: Spyropoulos 1973
SEÏDI	None	R. Stampfuss 1941, E. Schmid 1956	Stampfuss 1942, Schmid 1965
ULBRICH	None	A. Markovits, c. 1920	Markovits 1928
ARVENITSA	None	E. Deïlaki	Preliminary report: Protonariou-Deïlaki 1975
KEPHALARI	None	R. Felsch 1972, L. Reisch 1975-1976	Felsch 1973, Reisch 1976, Reisch 1980, Reisch 1982
KLISSOURA	Not yet published	Surveys C. Runnels and B. Wells, c. 1988-1992. Ongoing excavations by J.K. Kozlowki	Koumouzelis *et al.* 1996

Table 1 continued. Main sites and regions quoted in the text.

SITE	REGION	NATURE OF SITE	SEQUENCE
FRANCHTHI	Argolid	Cave	Middle Palaeolithic (unexcavated), Upper Palaeolithic (early and late), Mesolithic, Neolithic, Classical
LOUKAITI	Argolid	Open air	Considered as Upper Palaeolithic
ELAIOCHORI	Achaïa	Open air	"Archaïc Aurignacian" (including a Middle Palaeolithic component)
MAVRI MYTI	Achaïa	Open air	In situ Middle Palaeolithic: Typical Mousterian and numerous pebble tools
Region of AMALIAS	Elis	Open air	Series of loci in alluvial sediments. Middle Palaeolithic and Early Upper Palaeolithic tools, usually found in association
Region of KASTRON	Elis	Open air	Series of loci in alluvial sediments. Middle Palaeolithic and Early Upper Palaeolithic tools, usually found in association

magnitude. Conditions were already extreme in all but the most exposed regions, and climatic deterioration after 30 kyr bp would have mainly restricted the development of trees on the higher mountain slopes. The vegetation in the valleys and plains, already dominated by the *Artemisia* steppe, remained fundamentally unchanged (see pollen diagram from Ioannina I). In spite of a long time gap, there is no faunal turnover at Asprochaliko between the 'Micromousterian' and the Upper Palaeolithic. The shift in hunting strategies was not drastic: the same species are present in both periods[5], and *Cervus* and *Dama* altogether constitute more than 50% of the total assemblage in each case. At Franchthi, the three earliest Upper Palaeolithic phases (lithic phases I to III) are inscribed within one Botanical zone and one Faunal phase only. This comes as a further confirmation of the overall climatic and environmental stability, already indicated by the pollen diagrams.

The real contrast is not here: the most drastic environmental changes had occurred much earlier, around *c.* 40 kyr bp. Before *c.* 40 kyr bp, extensive forests covered all the mountains of Northern Greece, with AP values reaching 90% or more in the well-watered Western Pindus, and 50% in the Eastern Pindus. Interestingly, regional contrasts are revealed even more sharply: in the plain of Drama (Tenagi), the steppe was already the dominant vegetation (Fig. 2). From then on, and until the Tardiglacial, "forests or tree stands decrease or even disappear with the passage of time, sometimes recovering during short fluctuations but on the whole constantly losing terrain" (Bottema 1979: 36).

Consequently, the impact of climatic changes on human settlement and subsistence patterns must be viewed against a wider framework, encompassing the Late Middle Palaeolithic as well as the Early Upper Palaeolithic. In particular, if tree growth was progressively impeded by the lack of precipitation more than by low temperatures, as stated by Bottema (1979), the lack of water may have become a limiting factor to the spread of large mammals and human groups away from permanent lakes or perennial rivers. It may even have been the cause of the disappearance of the Middle Palaeolithic Neanderthal groups, who settled preferentially in territories where water sources were plentiful (Runnels 1995). By *c.* 30 kyr bp, Middle Palaeolithic groups had vanished, and Greece appears to have been quasi-deserted, with only a few aurignacian groups remaining in localised areas. A most fundamental and original feature of the Greek Palaeolithic is, indeed, the drastic decrease in the number of sites from the Middle Palaeolithic to the Aurignacian and the 'Gravettian'.

3. Human occupation: from the Middle Palaeolithic to the early Upper Palaeolithic

3.1 THE ARCHAEOLOGICAL SEQUENCE: AN OUTLINE

The archaeological sequence that needs to be considered here can be summarised as follows (Kourtessi-Phillipakis 1986; Perlès 1987; Runnels 1988; Darlas 1994):

– (a) Middle Palaeolithic assemblages are very varied in their composition. Several facies are represented, including chronological and functional ones (Darlas 1994, 1995). Kozlowski (1992) tentatively assigns the lowest occupational level at Asprochaliko, TL dated at *c.* 100 kyr bp (Bailey *et al.* 1992; Huxtable *et al.* 1992), and the industries from Elea in the Peloponnese, to a 'charentoïd' Mousterian. Later Mousterians are generally characterised by Levallois and discoïd cores, Levallois flakes, blades and points, well-made sidescrapers and Mousterian points, scarce Quina retouch. Some, however, include a fair component of tools made on pebbles (Darlas 1994), others, like the 'Micromousterian' from Asprochaliko, presented an original method for the production of triangular flakes (Papaconstantinou 1989).

– (b) These 'typical mousterian' or 'levalloiso-mousterian' industries are succeeded by assemblages containing a mixture of Middle and Upper Palaeolithic (aurignacian)

Table 1 continued. Main sites and regions quoted in the text.

SITE	^{14}C DATES bp	FIELDWORK	MAIN REFERENCES
FRANCHTHI	More than sixty altogether (cf. Jacobsen and Farrand 1987)	T.W. Jacobsen 1967-1978	Hansen 1991, Jacobsen and Farrand 1987, Payne 1975, Perlès 1987, 1990a, Shackleton 1988, van Andel and Sutton 1987, Wilkinson and Duhon 1990
LOUKAITI	None		Bintliff 1977: 236-237 Jacobsen 1976: 78
ELAIOCHORI	None	A. Darlas	Darlas 1989
MAVRI MYTI	None	A. Darlas	Darlas 1995
Region of AMALIAS	None	Surveys A. Leroi-Gourhan, J. and N. Chavaillon, F. Hours, during the 60's	Chavaillon *et al.* 1967, 1969
Region of KASTRON		Surveys A. Leroi-Gourhan, J. and N. Chavaillon, F. Hours, during the 60's	Chavaillon *et al.* 1967, 1969

elements, most often found in fluviatile contexts; they are regularly associated with bifacial foliate points which recall szeletian ones (Runnels 1988: table 1; Darlas 1994).

These 'mixed assemblages', with Middle Palaeolithic components, a rare use of the Levallois technique, bifacial points and/or aurignacian elements, have been found repeatedly in Greece. They are characteristic, for instance, of alluvial deposits in Elid and Achaïa (Chavaillon *et al.* 1967, 1969), in Thessaly (Milojcic *et al.* 1965; Runnels 1988; Runnels and van Andel 1999) and of the various findspots of the Preveza area (Runnels *et al.* 1999). They are also found in the basal Upper Palaeolithic levels (levels 21-26) of Kephalari in the Argolid (Reisch 1980), but contaminations from the underlying mousterian deposits cannot be ruled out. However, the association is too recurrent to be attributed to systematic contaminations. In Thessaly in particular, Runnels and van Andel (1999) underline the fact that the findspots correspond to temporary camps or kill sites on the gravelbars or interfluves of the braided channels of the river, and not to the reworking of material coming from upstream.

Foliate points appear to cover a long time span, and to evolve through time from bipointed to oval-based types. The oldest dated ones go back to 50,000 bp (Pope *et al.* 1984) and might be associated with a 'pure' Middle Palaeolithic component. Most, however, are found in 'transitional' assemblages, containing both Middle and Upper Palaeolithic components. They have been dated in the alluvial sediments of the Peneios (Thessaly) from *c.* 45 to 30 kyr bp (Runnels 1988, 1995).

They may be also occasionally associated with aurignacian industries: Darlas mentions two fragmentary points in the "archaïc Aurignacian" of Elaiochori in Achaïa (Darlas 1994: 323). This industry includes a definite Middle Palaeolithic component (Levallois flakes, flat discoïd cores, sidescrapers), but it is largely overrun by aurignacian elements (endscrapers on blades, carinated endscrapers, dihedral burins and busked burins). Darlas attributes this industry to a late "Transitional" phase (Darlas 1989, 1994). Another possible fragment of a foliate point from an aurignacian context is illustrated in level 23 of Kephalari (Reisch 1980, fig. 26:8).

The varied contexts associated with the foliate points recall the general situation of the 'final micoquian' and 'szeletian' assemblages of Central and Southeastern Europe. In Greece, as elsewhere, it would appear that a variety of 'Late Middle Palaeolithic' or 'transitional' industries covered the time span between 40 and 30 kyr bp. Contacts between Middle Palaeolithic and aurignacian groups are suggested by the presence of typical aurignacian tools[6].

– (c) 'Pure' aurignacian assemblages have yielded no split-based points, but carinated endscrapers, nosed endscrapers, Dufour bladelets, and aurignacian blades are well-represented and typical.

No ^{14}C date from the aurignacian sites or levels has been published so far, and none of the sites that were occupied during the Middle to Upper Palaeolithic transition has yet been published in detail[7]. The aurignacian tools in the Peneios late mousterian assemblages argue in favour of an aurignacian presence between *c.* 40 and 30 kyr bp. At Franchthi the aurignacian level rested on an ash level, identified as the tephra Y-5 of the Adriatic cores; curiously, the widely differing dates suggested for this tephra vary within the same time range: 40 to 25 kyr bp (Vitaliano *et al.* 1981). Thus, the Aurignacian from Franchthi may also be older than 30 kyr bp, a hypothesis that would explain the

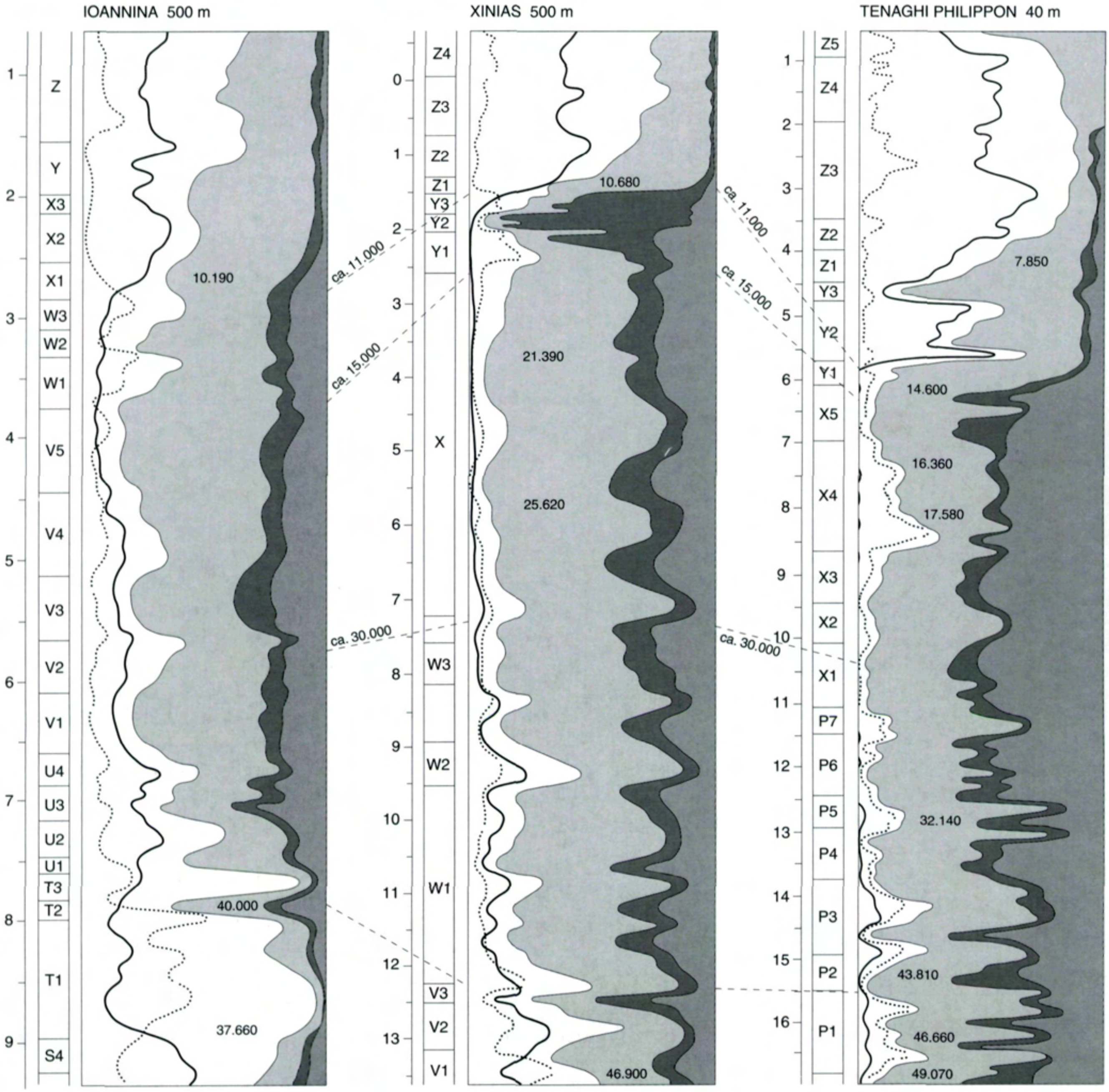

Fig. 2. Schematic pollen diagrams from Ioannina, Xinias and Tenagi Philippon, showing, from left to right, the curves of oak (thick black line) and pine (dotted line), the AP/NAP ratio (thin black line), *Artemisia* (light grey area), Chenopodiaceae (dark grey area) and other herbaceous pollens (medium grey area) (after Bottema 1979).

botanical changes between the aurignacian and the earliest 'gravettian' levels[8].

– (d) 'Gravettian' industries succeed the Aurignacian, with assemblages characterised by abundant backed bladelets of small size. These comprise straight-sided backed bladelets, bipointed double-backed bladelets, curved-backed pointed bladelets and microgravettes (see details, *infra*). Real Gravette points are almost nonexistent. The oldest available ^{14}C date is around 26 kyr bp, at Asprochaliko (Table 4). Assemblages dominated by backed bladelets and backed

Table 2. Ungulate remains at Asprochaliko and Kastritsa in the Middle and early Upper Palaeolithic in numbers of identified specimen (after Bailey *et al.* 1983a).

	Asprochaliko stratum 5 (Mousterian)	Asprochaliko stratum 3 (Micro-mousterian	Asprochaliko stratum 1 (Upper Palaeolithic)	Kastritsa stratum 9 (> 20,000)	Kastritsa stratum 7 (c. 20,000 bp)
Cervus	128	144	38	58	194
Dama	44	170	15	0	0
Capreolus	18	34	7	0	0
Bos	6	11	0	7	6
Ibex	44	59	36	0	0
Equus	0	0	0	4	3
Sus	4	14	4	2	1
TOTAL	244	432	100	71	204

Table 3. Synthetic data on the earlier Upper Palaeolithic at Franchthi.

PERIOD	^{14}C bp	BOTAN. ZONE	BOTANICAL SPECIES	FAUN. PHASE	FAUNAL SPECIES	MARINE MOLLUSCAN ZONATION	MARINE MOLLUSCS	TERRESTRIAL MOLLUSCS	LITHIC PHASE
Probably 30,000 bp or older		Ia	*Alkanna* sp., *Lithospermum arvense*, *Anchusa* sp. (uncarbonised seeds)		Data not available	0	Small species such as cf. *Bittium* sp. (natural deposition)	A few *Helix* sp. Pupillidae and *Helicella* sp.	I
c. 23rd millennium bp	22,330±1270 (I-6140) 21,480±350 (P-2233)	Ib	*Alkanna* sp., *Lithospermum arvense*, *Anchusa* sp. (uncarbonised seeds)	A	Equids (*Equus* cf. *hydruntinus*) and Cervids (*Cervus*), plus tortoises, hares, lizards, birds, rare Microtini, Murinae and Cricetini	0	idem	*Helix* sp., *Helicella* sp. and Pupillidae, more abundant	II
c. 20/22nd millennium bp		Ib	*Alkanna* sp., *Lithospermum arvense*, *Anchusa* sp. (uncarbonised seeds)	A	idem	0	idem	idem	III
Hiatus									

points will last until the end of the Upper Palaeolithic, with the later addition of shouldered points and geometrics (Perlès 1987; Adam 1989; Kozlowski 1992; Roubet 1997).

3.2 Distribution of sites and density of occupation

Considering the traditional lack of interest for palaeolithic research in Greece[9], the abundance of Middle Palaeolithic remains is all the more striking: Middle Palaeolithic sites, and even more so Middle Palaeolithic findspots (including 'late mousterian' and/or 'transitional' industries) can be found in large numbers over wide parts of Greece. The *c.* 50 published excavations and surface findspots, most recently listed by Darlas 1994, give only a very partial image of the numerous Middle Palaeolithic tools visible on the surface or in private collections. Significantly, recent surveys are adding a whole new series of Middle Palaeolithic sites (see Runnels 1988, 1995; Darlas 1989, 1995; Papaconstantinou 1991; Bailey *et al.* 1999). These confirm the importance of water for Middle Palaeolithic groups (Bailey *et al.* 1983a and b; Rolland 1985, 1988; Runnels 1988): most of the sites are concentrated along the main rivers and lakes (the Peneios in Thessaly, the Alpheios and Peneios in Elid, the lakes and rivers of Epirus and Aetolo-Akaranania) or on the coastal plains of Northwestern Greece.

However, systematic surveys (led by the same scholars) also reveal the contrasts between the well-watered Northwestern Greece and the more arid Southeastern Greece: one site and a dozen tools only were identified during the Berbati survey in the Argolid (60 km^2), whereas 20 sites, some of which extremely rich, were discovered around Preveza (Wells *et al.* 1990; Runnels 1995; Runnels *et al.* 1999).

'Pure' aurignacian assemblages, by contrast, are much rarer. Their geographic distribution also differs, since several sites are precisely located in the Argolid: Franchthi[10], Arvenitsa[11], Klissoura[12], and probably Kephalari[13] and Ulbrich[14]. The high proportion of caves is another contrast between Late Middle Palaeolithic and aurignacian sites. Aside from the above mentioned site of Elaiochori in Achaïa, which may date to a very early phase of the Aurignacian, the only possible open air settlement was recently discovered by an American survey in the region of Preveza, at Spilaion (Runnels *et al.* 1999)[15]. Finally, a few pieces characteristic of the Aurignacian were found in the lowest Upper Palaeolithic level from Asprochaliko (Adam 1989), suggesting that a brief aurignacian occupation may have taken place. Even with the addition of these new sites, the total remains much lower than for 'late mousterian' or 'transitional' sites. This difference is all the more significant as the Aurignacian must, logically, have lasted several millennia (see discussion *supra*).

On the whole, aurignacian occupation appears to have been very sparse and geographically restricted. Many regions exploited by Late Middle Palaeolithic groups are devoid of 'pure' aurignacian settlement: Thessaly[16], Elid, the Southern Peloponnese. On the other hand, the dry conditions of the Argolid (and possibly Boeotia) do not seem to have been an obstacle to a comparatively 'dense' settlement.

Finally, at the end of our chronological spectrum, four sites only can be allocated, without doubt, to the period between *c.* 26,000 and 20,000 bp: Asprochaliko and Kastritsa in Epirus, Theopetra in Thessaly and Franchthi in the Argolid. All four sites were dated by ^{14}C (Table 4) and yielded industries dominated by backed bladelets and backed points (including microgravettes). In addition, half a dozen sites (or levels), rich in backed bladelets and points, may also have been occupied by then (Kokkinopilos and Katsika in Epirus, Seïdi in Boeotia, Ulbrich and Kephalari in the Argolid) but, given the scanty typological data and the absence of absolute chronology, they could equally well be dated between 20,000 and 15,000 bp. It should be noted that all these sites are caves, and that no 'Gravettian' is known from open air sites[17].

A sharp decrease in the number of sites would thus correspond to the onset of the very dry and cold period which lasted between *c.* 30 and 20 kyr bp. It would, at the same time, correspond to the disappearance of the last sites that can be attributed to the Neanderthals. Since the Aurignacian remains undated, it is actually possible that it predates 30 kyr bp, and that this trend started earlier. No level has been radiocarbon dated between 30 and 26 kyr bp, so that it is even possible to consider an occupation gap during this period, as appears to be the case in Italy (Mussi, this volume). On the other hand, the sample of sites and radiocarbon dates is too small to be considered reliable, and the possibility of sample biases must be discussed before Greece should be considered as a near human desert.

3.3 The Early Upper Palaeolithic vanishing occupation: sample biases?

Three factors may, in theory, account for the scarcity of sites between *c.* 30 and 20 kyr bp: erosion, coastal submersion and poor recovery during surveys.

Especially along the wide coastal plains of Northwestern Greece, eustatic rise may have led to the submersion of coastal sites. On the other hand, the prevailing dry conditions were not, *a priori*, favourable for a widespread phase of erosional activity and massive destruction or obliteration of inland sites. That no such erosion occurred is confirmed by geological studies: no alluvial phase is recorded in Thessaly between *c.* 27 kyr and *c.* 10 kyr bp,

Table 4. [14]C dates for the period c. 30,000 to 20,000 bp in Greece.

SITE	LEVEL	INDUSTRY	LAB. REF.	SAMPLE	DATE bp	COMMENT	BIBLIOGRAPHY
Theopetra	Z7-S13: 3.15-3.30 m		DEM-374		33,231±1820	Context not yet published	Kyparissi, in press
Theopetra	T10: 2.74 m		DEM-247		33,086±1573	Context not yet published	Kyparissi, in press
Theopetra	T10-I10: 2.63-3.00 m		DEM-223		30,023±876	Context not yet published	Kyparissi, in press
Theopetra	Z8: 3.02-3.23 m		DEM-61		25,354±2132	Context not yet published	Kyparissi, in press
Asprochaliko	Level 10, stratum 1	Unilat. and bilat. backed bladelets, microgravettes	I-1965		26,000 +900 -800	Also published as level 9	Higgs and Vita-Finzi 1968, Higgs 1968, Bailey *et al.* 1983
Franchthi	H1A-219, lithic phase II	Straight backed bladelets and pointed double-backed bladelets	I-6140	Wood charcoal	22,330±1270		Jacobsen and Farrand 1987
Franchthi	H1B-191-192, lithic phase II	idem	P-2233	Carbonized matter	21,480±350		Jacobsen and Farrand 1987
Kastritsa	layer 21, str. 9	Unilat. backed bladelets	I-2467		21,800±470		Bailey *et al.* 1983
Kastritsa	layer 21, str. 9	idem	I-2468		20,200±480		Bailey *et al.* 1983
Kastritsa	layer 20, str. 7	idem	I-2466		20,800±810		Bailey *et al.* 1983

and the latter is of very limited extension (Demitrack 1986; van Andel *et al.* 1990). In the Argolid, the last extensive phase of alluviation ended before 32 kyr bp, and a stable landscape persisted until about 4500 bp (Pope *et al.* 1984). After extensive archaeological and geological work in Thessaly, Epirus and the Argolid, Runnels and van Andel are quite clear in their conclusions: the drastic contrast in the number of Middle and Upper Palaeolithic findspots is not related to the erosion of contemporary sediments or their burial under younger sediments. They conclude in favour of a definite occupational hiatus in Thessaly (Runnels and van Andel 1999) and suggest that, in the Preveza area, "it appears that the use of polje sites for encampments was abandoned in the Later Pleistocene, during the high glacial, perhaps because of a return to a sharply colder and drier climate" (Runnels *et al.* 1999: 10). Similarly, in the Argolid, they estimate that the potential loss of sites under recent alluvium would amount to less than 8% of the present land surface (Jameson *et al.* 1994: 243). Although idiosyncratic factors may have entailed local erosion, especially in caves, this cannot have been sufficiently widespread to account for the scarcity of inland aurignacian and gravettian sites.

Poor recovery during surface surveys must also be considered, since the small backed blade industries of the Upper Palaeolithic might be more difficult to spot than the larger Middle Palaeolithic ones. Nevertheless Runnels in particular conducted very thorough surveys along the Peneios river in Thessaly and on its Old Terrace (*Niederterrasse*), and carefully searched for evidence of Upper Palaeolithic industries. Although he identified 32 palaeolithic findspots, none could be attributed to the Upper Palaeolithic *sensu stricto* and not a single backed bladelet or backed point was discovered (Runnels 1988). In the Preveza region, Runnels and his colleagues found one possible aurignacian site (as opposed to 20 mousterian ones) but no Gravettian, and they consider it unlikely that this absence is the result of inexperience on the part of fieldwalkers (Runnels *et al.* 1999: 10). A similar situation obtained in Elid and Achaïa, where the French surveys yielded only one backed bladelet and one backed point, whereas Middle

Palaeolithic findspots (sometimes including aurignacian types) amounted to more than 40 (Chavaillon *et al.* 1967, 1969).

In these inland regions at least, the scarcity or absence of Upper Palaeolithic sites, from *c.* 27 kyr bp on, is real. Often this situation lasted until the advent of the Neolithic (Perlès 1995): the inner alluvial basins were deserted by palaeolithic hunter-gatherers, whose settlements were found mostly in the mountains and hillsides. But these sparse occupations cannot, as we shall discuss now, have represented the full territorial range of these hunters. Since the sea level was drastically lower at the time, liberating wide coastal plains (especially in Northwest Greece), there remains the possibility that the densest occupation occurred in the now submerged coastal areas.

3.4 Territorial exploitation

This possibility leads us to consider changes in settlement patterns from another point of view, territorial exploitation. Middle Palaeolithic sites and 'transitional' ones tended to cluster in well-watered low-altitude and coastal areas (Rolland 1988; Runnels 1995)[18]. Upper Palaeolithic sites, by contrast, are more evenly distributed over the wetter and drier areas of Greece[19], but they desert the large alluvial basins. In Epirus, sites spread further inland in mountainous environments, although the highest zones will only be occupied after the Pleniglacial (Bailey *et al.* 1984, 1986a and b, 1999).

This apparent shift in settlement patterns is linked by Rolland (1985, 1988) and by Bailey *et al.* (1983a and b; Bailey and Gamble 1990) to a transformation in subsistence strategies. Small, mobile, Middle Palaeolithic hunter-gatherer residential units would have exploited a diversified and rich biotope from a restricted home range, occasionally intercepting migrating herds, but without important seasonal migrations of the human groups themselves. According to Runnels (1995), the distribution of late mousterian sites in the Argolid indicates some form of logistical planning, with specialised stone working camps and hunting stands within a day's walk of the base camps (caves like Franchthi and Kephalari, for instance), and isolated lost weapons on elevated grounds further away.

In contrast, the Epirotes Upper Palaeolithic groups, after 30 kyr bp, would have practised a seasonal migration between coastal and inland sites, respectively occupied during the winter and summer seasons (Bailey and Gamble 1990). Asprochaliko, as already suggested by Higgs (Higgs *et al.* 1967), would have been used during the spring and autumn deer migrations from the coasts to the mountains. Its main interest, however, would have resided in the control of an isolated grazing area to the north of the site where the herds could be diverted (Bailey and Gamble 1990: 161). In parallel, ibexes could have been intercepted during their vertical movements between highlands and lowlands. Inland sites, such as Kastritsa and Klithi, would have constituted specialised hunting stations, exploited during the summer, each concentrating on the most abundant species locally available. But the focus of activities would have remained centred on lowland coastal sites, as yet to be discovered or submerged under water (*ibid*: 162).

There is little evidence, however, to support this model for the early phases of the Upper Palaeolithic. Hunting specialisation is suggested by the differences in the faunal spectra from Asprochaliko and Kastritsa and by the strong predominance of *Cervus* at Kastritsa. The predominance of two large ungulate species at Franchthi (*Equus* and *Cervus*) may also result from hunting specialisation[20]. On the other hand, Klithi and the other high-altitude specialised hunting stations were not yet occupied, the Upper Palaeolithic faunal spectrum from Asprochaliko is hardly less diversified than the 'micromousterian' one (five species versus six) and it is not more specialised in terms of species proportions. In addition, it appears difficult to reconstruct subsistence patterns and territorial exploitation when the samples from each site or level are so extremely small.

The poverty of artefactual and faunal remains *is indeed the main, and probably the most significant characteristic of all sites* for which information is available. The whole of stratum 9 at Kastritsa yielded only 71 identified faunal specimens and 28 tools (squares R2, R4 and R5, Adam 1989)[21]. Level 10 at Asprochaliko was 'richer', but the 1335 stone fragments listed in Bailey *et al.* (1983a: table 10) comprised only 47 retouched tools (square R2, Adam 1989: 78). The same situation obtains at Franchthi: 30 retouched tools in Phase I, 138 in phase II and 52 in phase III, associated with scant faunal remains. The early Upper Palaeolithic levels at Kephalari are also very poor (Reisch 1980), while fewer than 50 faunal remains were identified from Seïdi (Stampfuss 1942); during her subsequent excavations at Seïdi, Schmid recovered only *c.* 650 stone pieces in a sounding of 12 square metres and more than 1.50 m deep (Schmid 1965). At Franchthi at least the sediments were water-sieved and dry-sorted, so that the meagreness of the industry is not the result of poor excavations. In addition, in sites such as Franchthi, Kastritsa and Asprochaliko, there is a sharp contrast in the density of material before and after 20,000 bp (or, more accurately, 15/16 kyr bp). The small samples are not merely an effect of smaller excavated areas at the bottom of the trenches, and there is little doubt that extremely sparse occupations characterise all the sites presently known during the period 30-20 kyr bp. Each of the first three lithic 'phases' at Franchthi, for instance, covers a depth of 50 to 80 cm which might represent, according to Farrand's estimates of the rate of sedimentation (Farrand

1993), a duration of about 5 to 10 centuries. Accordingly, the number of discarded artefacts would not be above 10 to 20 pieces a century in the excavated area. As a further confirmation of the low intensity of activity, one can note that no excavation unit (of a few centimetres deep each) has yielded more than 20 lithic artefacts (Perlès 1987).

The nature of these occupations is best illustrated at Franchthi, where, in lithic phases II and III, backed bladelets and points represent 75% and 79% of the total assemblage. In contrast with the following periods, no molluscs were collected, no fish was brought back to the cave and there is no evidence of plant gathering: plant remains are mostly uncarbonised and of natural origins. This, linked with predominance of two large animal species and the very small number of bones, suggests a hunting station with very brief, discontinuous occupations. The activities would have been focused around the treatment of the carcasses and the maintenance of the hunting equipment. The same picture probably holds true for the other rock shelters and caves[22], where backed bladelets and points must be severely underrepresented in the absence of water-sieving (or of any kind of sieving). At Kastritsa, the absence of bone tools and burins in stratum 9 contrasts with what obtains in levels 1-5 and may be taken as a further confirmation of the specialised nature of the occupation[23] (Bailey *et al.* 1983a, table 10).

Thus, as Bailey and Gamble (1990) underlined, excavated sites cannot represent the full range of settlements and activities of hunter groups in Greece between 30 and 20 kyr bp. Whether these specialised activity camps are related to larger settlements in the now submerged coastal areas, or whether the groups were constantly moving around from site to site is difficult to state. Given the dryness of the climate and the nature of the steppe, it may well have proven difficult to settle for several weeks or months in the same location. But, even thus, a site such as Franchthi appears to be too specialised (and lacking in domestic equipment) to represent the full range of tasks and activities of a mobile group. The fact that all presently-known sites are rock shelters or caves (often of small size) also points to their specialised nature.

This appears to have held true throughout the ten millennia between 30 and 20 kyr bp. A most remarkable feature of these sites, so far as the evidence goes, is how little change there is in terms of intensity of occupation, nature of occupation and activities. Even if, as will now be shown through Franchthi, technical or stylistic transformations did occur in the lithic assemblages, the latter cannot be related to changes in the function of the sites.

4. Cultural data and cultural change

The specialised nature of the excavated sites precludes a fair assessment of cultural changes during the 30-20 kyr bp period. No bone tools (except for an odd point at Kastritsa), and, to my knowledge, no element of mobile art or ornaments[24] can be attributed with any certainty to the levels between 30 and 20 kyr bp.

No clear patterning emerges from the 30-20 kyr bp lithic assemblages at Asprochaliko and Kastritsa, which appear to include both aurignacian and gravettian elements (Table 5). The succession is clearer at Franchthi (Table 6), where three lithic phases can be recognised: (a) an aurignacian phase (phase I), which, it will be recalled, can be dated anything between 26 and 40 kyr bp. Though the sample of tools is extremely small (30 retouched pieces), the assemblage is characteristic: besides notches and denticulates, it includes characteristic carinated and nosed endscrapers as well as the corresponding twisted bladelets. Phase II, which was dated to 21,480 ± 350 and 22,330 ± 1270 bp, is dominated by single-backed, obtuse bladelets (64% on a total of 138 retouched pieces), followed by double-backed, pointed bladelets (12%). Truncated pieces, endscrapers, notches and denticulates are all scarce. Phase III, which was not radiocarbon dated but appears to be in direct stratigraphic continuity with phase II, only differs from the preceding one by the replacement of the long double-backed pointed bladelets by short, single-backed curved pointed bladelets. No real 'microgravette' or Vachon point was found at Franchthi. Though the total number of tools is smaller than in phase II, the percentage of backed elements remains remarkably stable (79%).

The extent to which this typological evolution, which differs in details from that of Temnata Cave, for instance (Kozlowski *et al.* 1992) or of Italy (Mussi, this volume), can be generalised to the whole of Greece is not known so far. In addition, at Franchthi at least, there is no indication that changes in the lithic assemblage can be directly related to environmental or economic transformations. They are better accounted for by idiosyncratic transformations of the hunting equipment. Similarly, the absence of mobile art and the scarcity of bone tools is a general phenomenon in the Upper Palaeolithic of Greece, that does not appear to be related to specific environments or to a given category of sites. Even when the site's occupation shifted to a more residential pattern at Franchthi, during the Late Upper Palaeolithic (Perlès 1987, 1999), no element of mobile art or bone tools was recovered[25].

5. Conclusions

All available data, whether coming from pollen cores, macrobotanical remains or faunal remains, point to a long period of environmental stability between *c.* 30 and 20 kyr bp. There are no 'deteriorating climatic conditions' of any significant scale at the time: the major episodes of climatic deterioration had taken place long before, and the trend towards a progressively colder and drier climate had started

Table 5. Stone tools from the early Upper Palaeolithic levels at Kastritsa and Asprochaliko (after Adam 1989).

TYPE	ASPROCHALIKO LEVEL 10, R2	KASTRITSA STR. 9, R4	KASTRITSA STR. 9, R2	KASTRITSA STR. 9, R5
Simple endscraper	4		1	
Atypical endscraper			1	1
Double endscraper	2			
Endscraper on retouched blade or flake	2	1	3	
Endscraper/truncation			1	
Bec			1	
Bitruncated piece		1		
Truncated flake or blade			2	
Truncated bladelet	1	2		
Microgravette	2			
Plain unilateral backed bladelet	5	1	2	
Unilateral backed bladelet with opposed retouch	4			
Bilateral backed bladelet, plain	5			
Backed bladelet with inversely retouched end		1		
Truncated blacked bladelet	4		1	
Piece with continuous unilateral retouch	1		2	
Aurignacian blade	1		2	
Dufour bladelet	2			
Notched piece	1		1	
Notched bladelet			1	
Bladelet with semi-abrupt retouch	5			
Sidescraper	5		1	1
Totally or partially retouched piece	1	1		
TOTAL	47	7	19	2

some ten millennia earlier. Conditions were already extreme just after 30 kyr bp (when a minor amelioration is perceptible), and the small fluctuations in the representation of the trees cannot have had any perceptible impact in the widely open *Artemisia* steppe.

These steppes were exploited by groups of hunters, who preyed on deer and ibexes in the mountains of the North, deer and *Equus* cf. *hydruntinus* in the lower plains and hills of Central and Southern Greece. They used to stop briefly in hunting stations, leaving behind a few bones, tools and weapons (backed bladelets and points). These hunting stations are, apparently, all that was recovered from these aurignacian and gravettian hunter-gatherers. They are few in number, and, even more so, poor in remains. Recently discovered open air aurignacian sites may represent the other end of the functional spectrum, i.e. richer and more diversified residential camps. But these sites are as yet undated, and could easily pre-date the period under consideration. In the latter case, they would fit well in the general pattern of more numerous and richer occupations prior to 30 kyr bp.

The present picture, albeit based on drastically limited data, shows that the 30-20 kyr bp period is indeed

Table 6. Typological composition of the early Upper Palaeolithic industries from Franchthi (after Perlès 1987).

	LITHIC PHASE I	LITHIC PHASE II	LITHIC PHASE III
Nosed endscrapers	1		
Carinated endscrapers	5		
Steep-front endscrapers	4		
Endscrapers on blades		2	
Simple endscrapers on flakes		3	4
Notches	7	5	-
Denticulates	4	1	-
Continuous lateral retouch	4	9	3
Fine abrupt retouch	1		
Proximal truncations on flakes		4	1
Truncated bladelets	1	4	1
Mesial or prox. fragments of single backed bladelets		42	16
Straight single backed bladelets		40	18
Curved, pointed, single backed bladelets		3	7
Truncated backed bladelets		2	
Mesial or prox. fragment of double backed bladelets		9	
Pointed double backed bladelets		7	
Backed flakes		2	
Unidentified backed fragments		2	2
Geometrics		1	
Burins		1	
Becs	2		
Splintered pieces	1		
Varia		1	
TOTAL	30	138	52
Number of typological group	6	9	4

characterised by the diminution in the number of sites and in the density of their occupation. The limitation in the database is the most characteristic feature of the period. Sites were far more numerous in the Early and Late Middle Palaeolithic, and even in the scarce sites of the Tardiglacial, the density of occupation was substantially higher.

Does this imply that Greece was depopulated as a consequence of climatic changes? Probably yes, but certainly not to the extent suggested by the presently available database.

The onset of this period apparently corresponds with the disappearance of the last Neanderthal groups in Greece. If, as suggested by various authors, the Neanderthals were attracted by well-watered environments, the increasing dryness after 30 kyr bp may have had direct bearings on their disappearance. But the striking phenomenon is that in many regions of Greece, they were *not* replaced by Upper Palaeolithic groups. Large areas of Greece appear to have remained unexploited and unpopulated until the Neolithic, and the overall Upper Palaeolithic population in Greece seems to have remained very low.

On the other hand, Greece never seems to have been completely deserted. Minimal breeding populations had maintained themselves in Epirus, Thessaly, Central Greece and the Peloponnese. Obviously, the number of sites presently known is far below the number of sites that such populations must have left behind. It will be recalled that, if Bailey's, Rolland's and Runnel's hypotheses are right, now-submerged coastal sites would have been the most important foci of activities during the Upper Palaeolithic. Whether more important sites are indeed to be found in coastal areas, rather than inland, is impossible to assess. Let us note, in favour of inland sites[26], that I know of no remains of coastal origin in any of these sites.

But it is difficult to escape the conclusion that the progressively drier environment limited the density and spread of animal and human populations. This situation, which started around 40 kyr bp and culminated after 30,000 bp, lasted until the end of the Pleniglacial. It was probably reinforced by the relative isolation of Greece, where lithic assemblages demonstrate many idiosyncratic features. There is no evidence of close contacts with the nearby Southeast Balkans, and even less of influx of populations. Even the milder climate of the Tardiglacial and Early Holocene did not lead to a rapid increase of the human population, and it is not until migrant colonists arrived, at the beginning of the Neolithic, that the trend was drastically reversed.

Note: This synthesis was elaborated before any data were available on the ongoing excavations at Klissoura Cave (Argolid). A preliminary report has been published since on this sequence of major importance, that includes thick EUP deposits (see Kouzoumelis *et al.* 1996). The inclusion of those preliminary data, which so far do not seem to contradict the general picture drawn here, would have required a substantial revision of the text and tables. The latter did not seem justified, since further reports will probably render a synthesis based on the presently available data rapidly obsolete.

notes

1 This extremely long and important sequence has only been presented in a preliminary report.

2 Greig and Turner 1974. This figure seems more plausible than the figure of 500-800 mm published in Turner and Greig 1975.

3 The faunal data, in particular, have not yet been published according to the stratigraphy.

4 For a discussion of the notion of 'Micromousterian' at Asprochaliko, see Papaconstantinou 1989.

5 With the exception of *Bos*, but it amounted to 3% only of the 'Micromousterian' assemblage.

6 This is again a typical situation in Central and Southeastern Europe (Boëda, oral comm.). For a discussion of 'acculturation' in the Middle/Upper Palaeolithic transition, see Perlès 1990b.

7 The forthcoming publication of Theopetra may thus be of utmost importance.

8 On the other hand, the absence of sedimentological change can be taken to support a late dating.

9 A trend which has fortunately been recently reversed, as demonstrated by the success and quality of the First International Conference on the Greek Palaeolithic, organised at Ioannina in September 1994 (Bailey *et al.* 1999).

10 Although a few, usually patinated, Middle Palaeolithic flakes have been found in the Upper Palaeolithic levels of Franchthi, these are clearly intrusive and not especially associated with the aurignacian levels (Perlès 1987, *contra* Runnels 1988).

11 There is only a very brief preliminary report on this site (Protonariou-Deïlaki 1975), but the material exhibited at the Museum of Nafplion appears to be Aurignacian.

12 Several stratified aurignacian levels have recently been reported from the ongoing excavation of Klissoura, under the direction of J.K. Kozlowski. No detailed information was available to the author when this paper was sent to press.

13 If the presence of Middle Palaeolithic elements is due to contaminations, as I suspect.

14 Where Markovits (1928) specifically mentioned some "Aurignacian".

15 The industry has not yet been described in detail, and the attribution is only given by the authors as provisional.

16 Unless there is an aurignacian level at Theopetra.

17 A very rich "Upper Palaeolithic" site was discovered near Mavrommati during surveys in Boeotia, but no details on the industry were published (Bintliff and Snodgrass 1985: 137). Similarly, it seems that industries with backed bladelets were discovered during test excavations in caves and rock shelters of Boeotia (Spyropoulos 1973). It is thus probable that the Seïdi cave was isolated, but the exact period of occupation of these other sites cannot be ascertained.

18 According to Runnels (1988) the older Middle Palaeolithic sites were concentrated in the better watered Western Greece; penetration east of the Pindus and in southern Greece would have occurred only after 50,000 bp, an extension which may have been required by the contraction of the coastal plains during OIS 3. The recent discovery of Middle Palaeolithic artefacts in eastern Macedonia or in Messenia, as well as unpublished artefacts from Attica, shows, however, that this regional distribution may be an artefact of research.

19 Maybe because the difference was less pronounced at that time?

20 But it may also reflect their relative abundance compared with other species.

21 Bailey *et al.* indicate much more abundant stone artefacts in stratum 9 at Kastritsa (see Bailey *et al.* 1983a, table 10) but their counts do not correspond to Adam's detailed study (1989) and were presumably done before the natural debris, dominant in stratum 9, was sorted out. The same probably holds true for Asprochaliko.

22 According to Bailey *et al.* (1983a) backed bladelets constitute the single dominant category at Kastritsa (stratum 9) and Asprochaliko (layer 10) but the counts do not match those of Adam (1989).

23 Even if the volume of excavated sediment is substantially lower than in the more recent strata.

24 Except for 9 *dentalia* at Franchthi, which show no evidence of work or use, contrary to later examples.

25 Interestingly, the Upper Palaeolithic levels of Franchthi yielded 7 humain remains, including shed milk teeth (Cullen 1995). None, however, came from the earlier phases, which would confirm a shift in the nature of the cave's occupation (Perlès 1999).

26 Here again, the publication of Theopetra, located in an altogether new region and environment for the Upper Palaeolithic, may shed new light on settlement patterns. With the recent excavations of Klissoura, this demonstrates the potential for new and important discoveries in Greece.

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Catherine Perlès
Département d'ethnologie
Université Paris X
200 avenue de la République
92001 Nanterre Cedex
France

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colophon

• wordprocessing
Olga Yates

• scanning & imaging of photographic material
Jan Pauptit

• editing, styling & draughting of maps, graphs, diagrams and tables*
• imaging & lay-out of artefact drawings and photographic illustrations**
• typographic design & lay-out of the printed interior
• cover-design & -realisation for the ESF hardback edition
Henk de Lorm

• technical support & advice
Bruno Vanden Eynde and Freddy Persijn

• pre-press & printing
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• binding
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* Table 2 on page 360 by M. Mussi.

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