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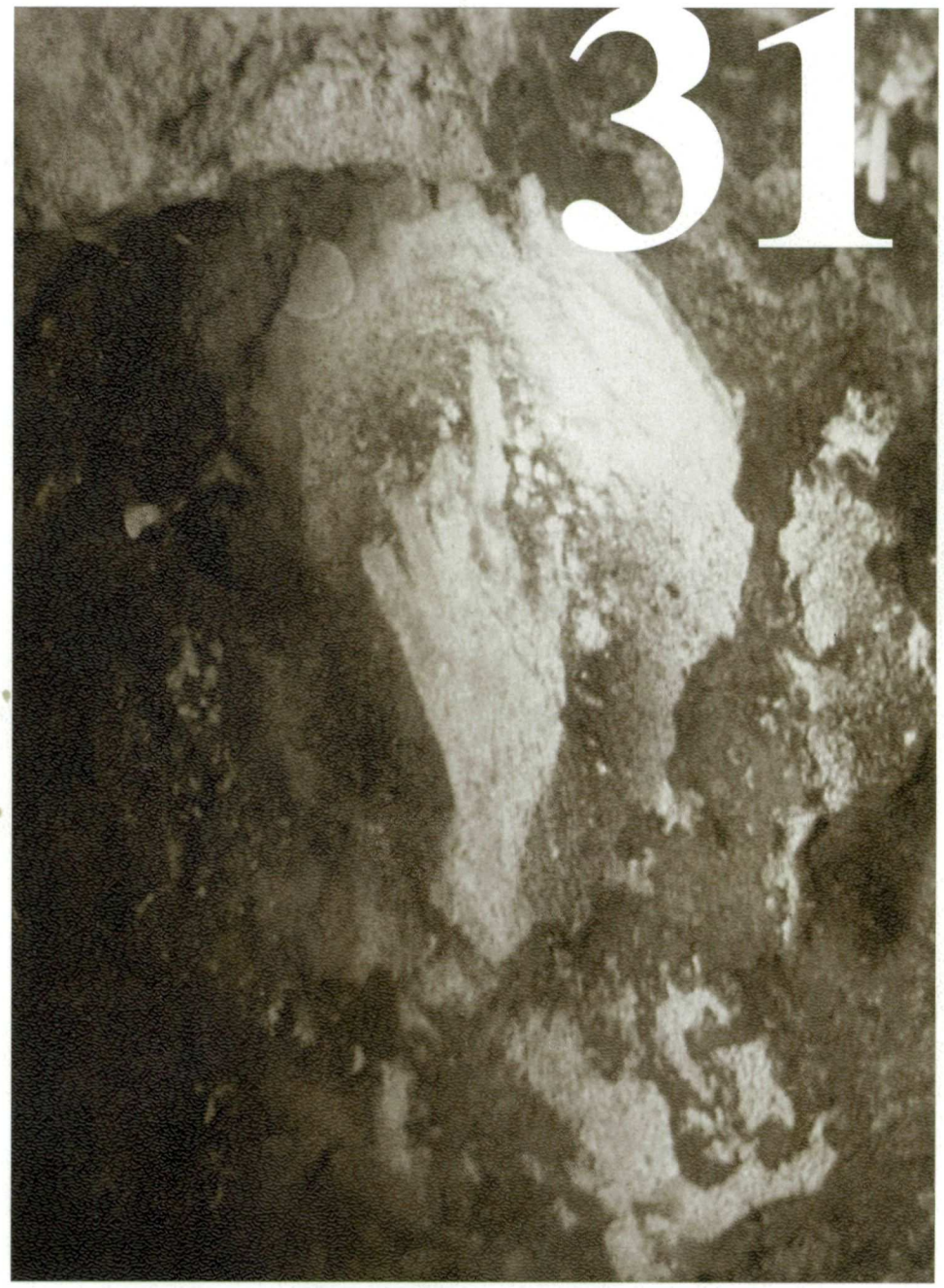

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HUNTERS OF THE GOLDEN AGE

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

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This volume is dedicated to the memory of Joachim Hahn

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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

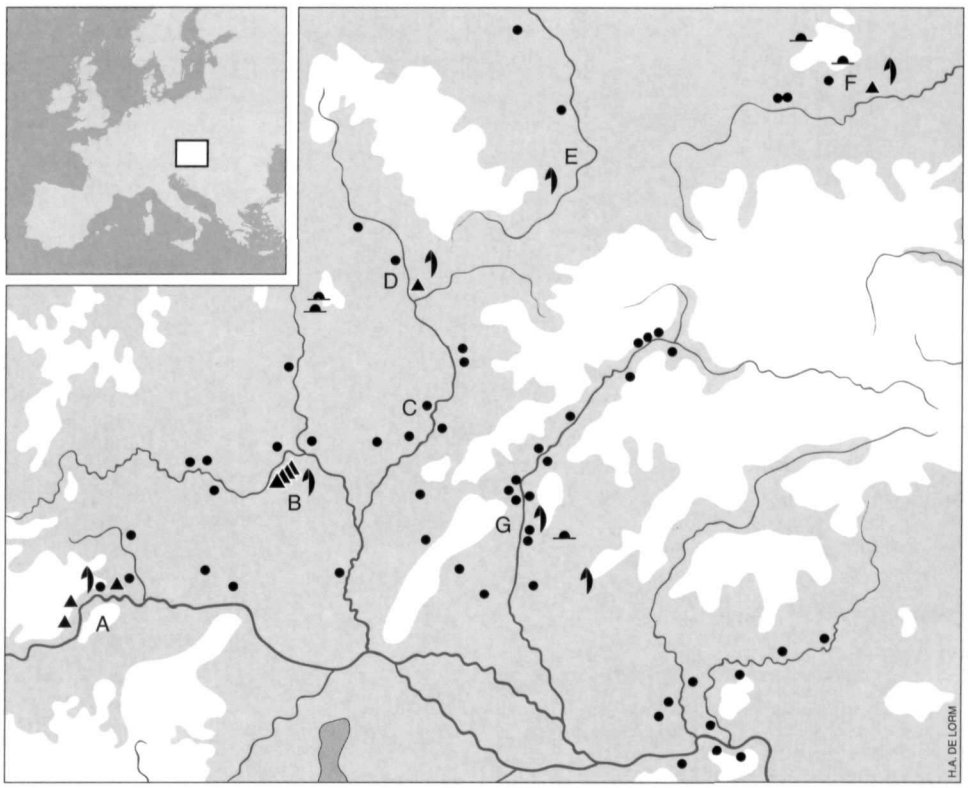

Fig. 1. Schematic map of the gravettian settlement in the Middle Danube.
Key: Triangles: Pavlovian stage. Shouldered point sign: Willendorfian-Kostenkian stage. Points: Undetermined Gravettian.
A. Danubian sites (Aggsbach, Willendorf, Krems-Wachtberg);
B. South Moravian sites (Dolní Věstonice, Pavlov, 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).

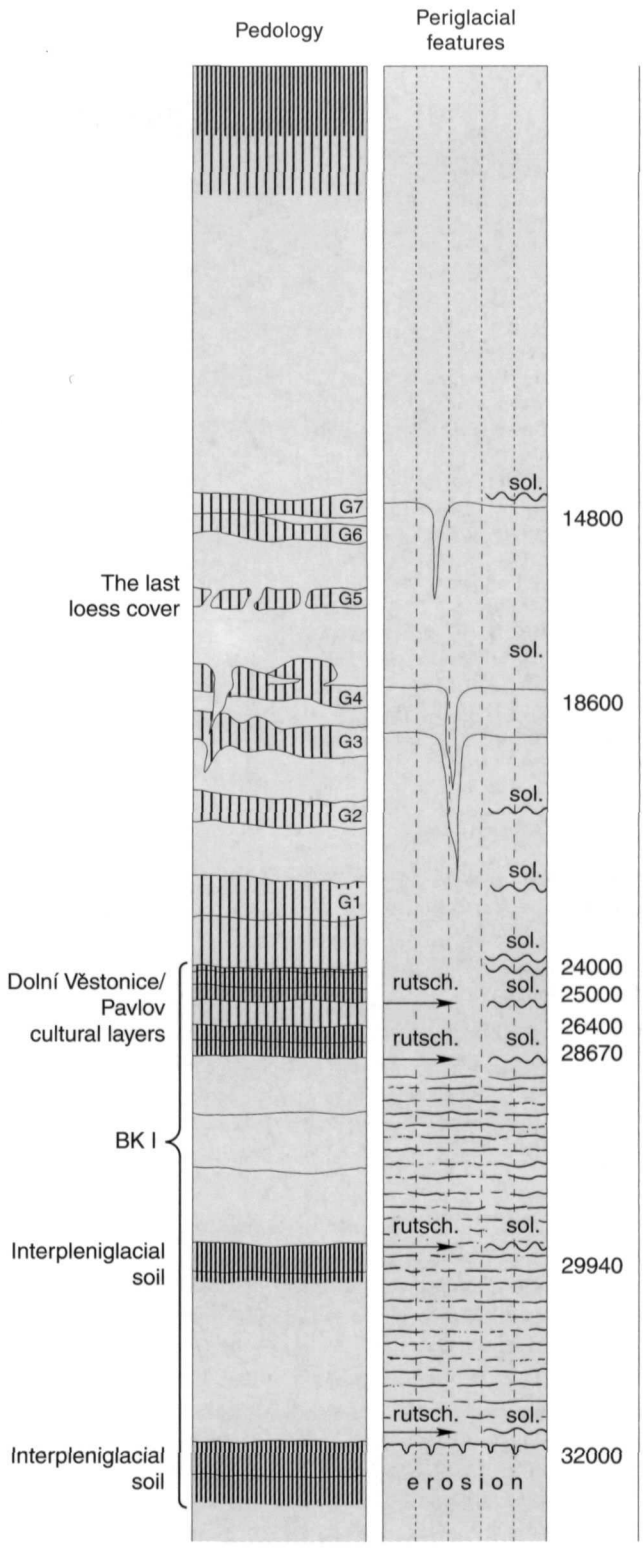

Fig. 2. Composite loess stratigraphy of the Pavlov region (adapted from Klíma 1994a and 1995). Key: G1-G7: gley horizons, BK1: pedocomplex I, sol: solifluction.

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: 24,040	23,700
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

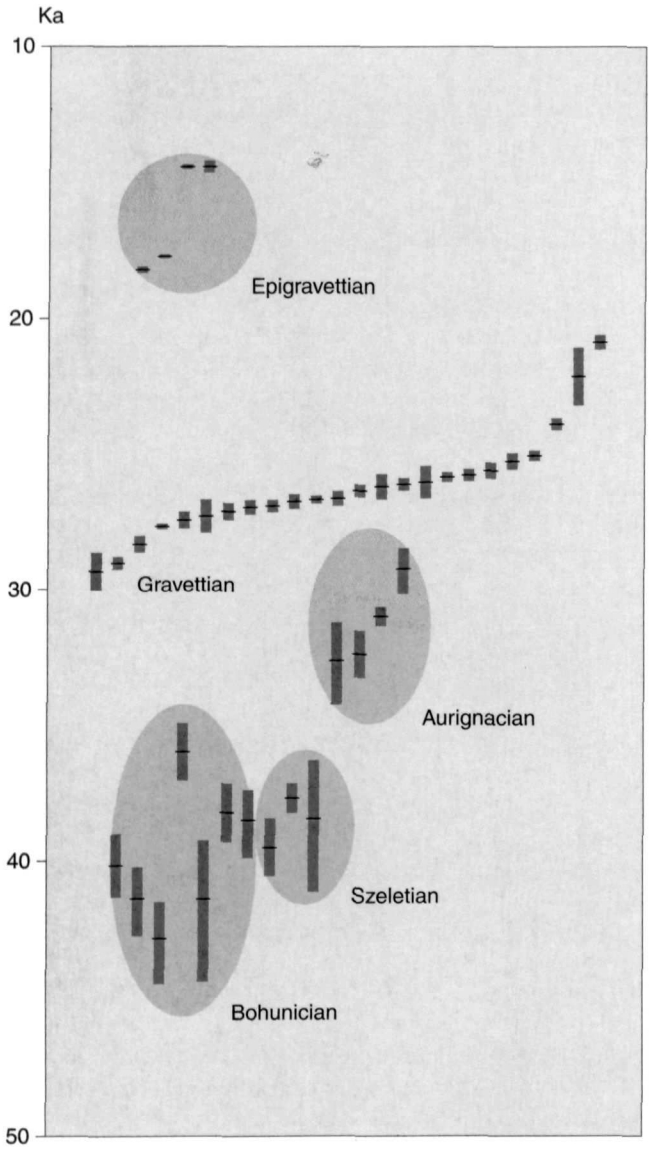

Fig. 3. Radiocarbon dates of the Upper Palaeolithic in Moravia, based on the Groningen data. From the base to the top: Bohunician, Szeletian, Aurignacian, Gravettian, Epigravettian.
The scale is given in thousands of years.

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.

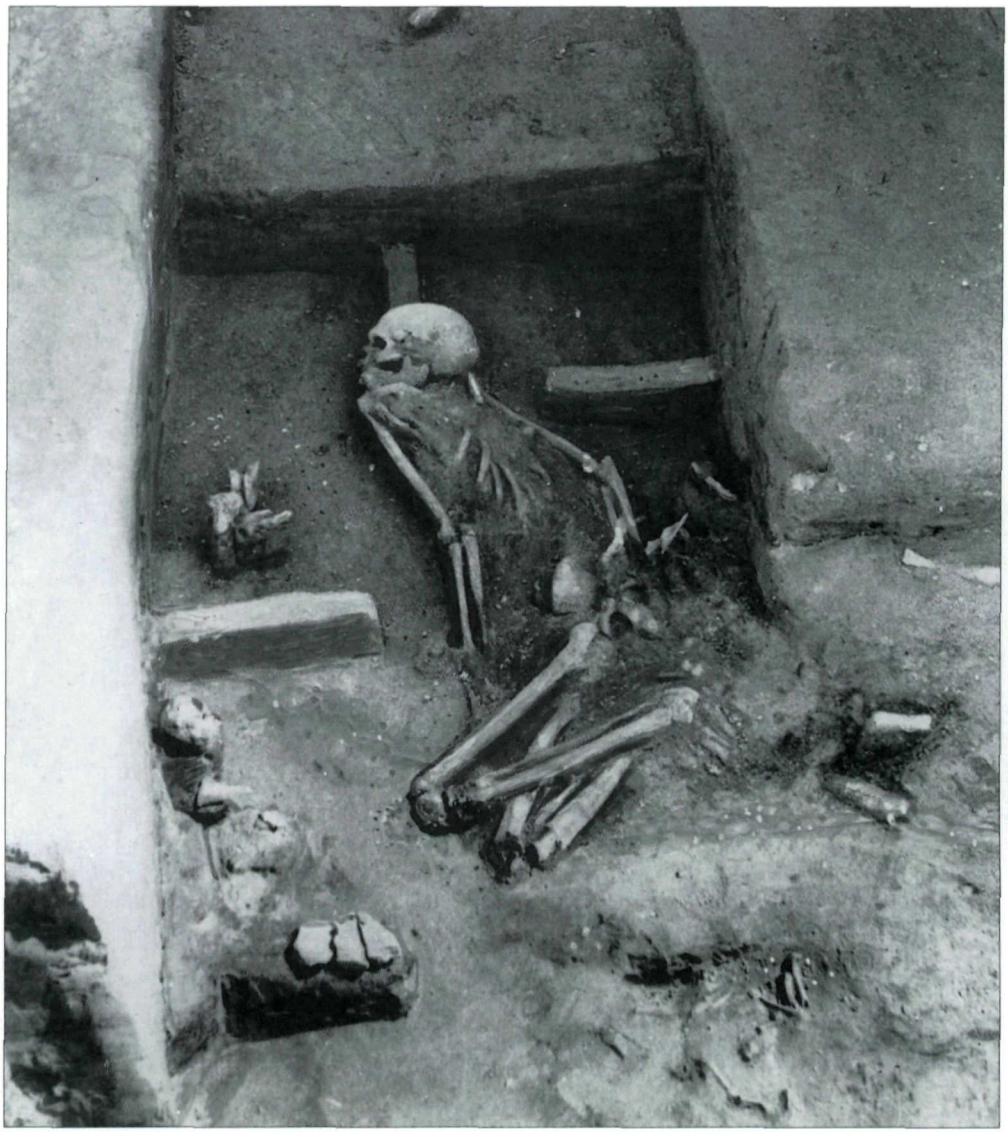

Fig. 6. The single male burial from Dolní Věstonice II (1987 excavations).

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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