Rudolf Musil

Jarošov-Podvršťa.
A faunal anomaly among Gravettian sites.
Osteological material analysis

(in Škrdla P., ed: The Upper Palaeolithic
on the middle course of the Morava river). *DVS,* **13**:203-216

2005

Appendix A

Jarošov-Podvršťa. A Faunal Anomaly among Gravettian sites. Osteological Material Analysis

Rudolf Musil, Department of Geological Sciences , Faculty of Science, Masaryk University in Brno

Introduction

A large number of Paleolithic sites have been found at varying elevations on both banks of the Morava River in the northern section of the Lower Morava Valley. Their significance is based on the fact that the Morava River valley, which forms a natural migration route for all animals between the Polish lowlands to the north and the Danube River flowing into the Pannonian Lowlands in the south, narrows in the northern section of its lower valley forming the Napajedla Gate, which is surrounded on both sides by a rugged highland. This is a very important area for animals migrating in a north-south direction. Petr Škrdla (2000) has presented a comprehensive summary of all research carried out in the Uherské Hradiště Area. I will mention a number of significant items here to allow for easier orientation in the remainder of this article.

An accumulation of splintered bones (Jarošov-Kopaniny), primarily from wooly mammoth, wooly rhinoceros and horse, had been previously found in the area of the western slope of the hill "Černá hora" near Jarošov (three kilometers northwest of the city of Uherské Hradiště) The discoverer of this site, R. Procházka believed that this position was most probably the result of landslides from the higher elevations of Černá hora. Research on this artifact horizon was subsequently carried by L. Seitl and Karel Valoch in 1980. They recovered osteological materials that were predominately mammoth (*Mammuthus primigenius*), including skull fragments, teeth, postcranial bones from variously-aged individuals, most however were from immature individuals. A total of 970 bones and teeth in various degrees of preservation were recovered. Wooly rhinoceros (*Coelodonta antiquitatis*) and horse (*Equus germanicus*) were very rare. Many of the bones were split by human activity. The bones were distributed on the site in a random fashion, some were cemented together with secondary calcium carbonate. The osteological material was located in the upper section of a solifluction complex. All the bones were covered by a heavy layer of $CaCO_3$ and fragments of paleogenic rocks were found in the sediments (Seitl and Valoch 1998). Given that only a relatively small area was excavated, this is a relatively rich site in terms of its palaeontolgical component. No hearths, charcoal or burned bones were recovered. The number of stone artifacts identified by the authors as Gravettian was quite small. The authors also do not consider this site to have been the initial position of the finds, but they do not believe that there was movement over a significant distance.

The original expectation was that these finds could be contemporaneous with the site studied in this article. The methods of preservation for both collections and the presence of soils impacted by solifluction is basically the same. What is different is the range of species recovered. The isotope data provided to me by Dr. Škrdla completely rules out the possibility of the sites being contemporaneous. The site of Jaršov-Kopaniny is ca. 3,000 to 4,000 years younger (Sample GrA-20495, from Seitl, Valoch 1980:23,120±200 BP, unit excavated by Škrdla 2003: 22,330±130/120 BP; data from P. Škrdla). This data is not only important for determining the chronological relationship of the two sites but for a whole series of other reasons as well. They show that large herds of mammoths were present in this region in the period between 22-23 kya, as were rhinoceroses. The disappearance of Pavlovian sites cannot therefore generally be attributed to a decline in game as had been proposed. The cause must be searched for elsewhere. This applies not only to the site of Jarošov but all other Moravian Pavlovian sites.

The following profile was noted at this site: (Seitl and Valoch 1998):
Holocene soil (35 cm)
Brownish loessal clay (25 cm)
Brownish loess (30 cm)
Brownish loess with a flaky structure (25 cm)
Solifluction complex 3-4 cm, thicker lighter and darker layers (15 cm), numerous Mn and Fe pellets and stains followed by ca. 7 cm of ochre-colored loess at the base

The osteological material studied here comes from research at the site of Jarošov-Podvršťa (excavated by Petr Škrdla 1996-2000), which is found not far from the previously discussed site, further up the slope. The osteological material previously identified (Škrdla 2000) from this site (collection prior to 1998) has been identified as being predominately reindeer (55%), followed by fox, wolf and mammoth (11% each) and hare, horse and wolverine (5% each). An analysis of charcoal recovered by E. Opravil documented the presence of pine and other unidentified conifers (Škrdla 2002)

The central part of the cultural horizon was uncovered during Škrdla's research as were some more peripheral areas. These units showed that the cultural horizon continuing to the south and west had been destroyed earlier by agricultural activities (i.e. the cultural horizon was located close to the modern surface). The cultural horizon does however continue to the east for a distance of ca. ten meters beyond the limits of the current research. This area, covering several hundred square meters has not yet been excavated.

The sediment profile here is relatively straightforward. Beneath the plow zone (30 cm) is a loess layer of varying thickness (5-40 cm) in which it is possible to identify a grey-colored horizon that according to Škrdla is similar to those identified by Bohuslav Klíma in the Dolní Věstonice brickyard above the Gravettian (Pavlovian) cultural horizon. Klíma described this stratum as gleyish layers indicating a break in loess deposition. This makes Jarošov-Podvršťa the second site where a similar gleyish horizon in loess has been identified. This horizon is in essence created in a humid and very cold tundra climate. The average temperature was lower than during periods of loess accumulation. These cycles generally repeat themselves and their number varies, e.g. at German sites eight have been identified in the period between 34 and 20 kya. The sequence of loess and gleyish levels at the German site of Nussloch documents a climatic cycle of about 1,500 years, which, with the assumption that deposit rates are constant, would make them equivalent to the cycle of 1536±563 years identified in the Greenland glacier and marine sediments (Rousseau et al. 2002). These levels have been described site of Mezin, where during the period between 32 and 24 kya they occur above the Bryansk soil, which is clearly an analogous soil to that found under the cultural horizon in Pavlov and in Dolní Věstonice: three loess layers divided by gleysih levels. At this site, these levels also show evidence of cryogenic features (frost wedges). Similar horizons have also been described at other sites in Central and Western Europe during the Lower and Middle Weichsel glaciations. They are characterized by significantly lower levels of loess accumulation, decreased wind speeds and increased vegetation cover. These are not in fact gleyish soils known from tundra environments, where they are created beneath the groundwater level, but pseudogleys created by alternating period of soaking by rainwater and associated reductive processes, and periods of profound aridity. The accumulation of loess in between the pseudogleyish horizons was much faster than the rather slow processes of forming the pseudogleyish horizons.

Concretions of $CaCO_3$ occur at the base of the loess, often cemented into a crust covering the Gravettian cultural stratum. This is clearly a carbonate horizon, which indicates the later intensive leaching of the loess by rainwater. These Ortstein horizons are especially typical for more northerly areas around Ostrava (northern Moravia, southern Silesia). But because of their presence here, I believe that the grey horizons in the loess are true gleyish horizons and furthermore that the loess must have originally been much thicker than it is today.

Sediments impacted by the solifluction of a Pavlovian cultural horizon are found in the adjacent, underlying compacted horizon. This could mean that some finds uncovered during the excavation and assigned to precise locations on the site are not necessarily in their original location. According to Škrdla, charcoal and grey-colored soil alternate in the soliflucted layers, with the thickness of the cultural horizon ranging between five and ten centimeters. Orange-brown colluvial sediments with a paleogenisis in the Vsetín strata were located beneath them.

The profile as described from the excavated areas of this site has probably not been preserved in its entirety. Clayish colluvial sediments with calcium carbonate concretions (40 cm) were found approximately forty meters down slope beneath the plow zone. Beneath this was a light-colored, loessal clay (50 cm), followed by a more clayey, more porous, brownish loessal soil. The base of the profile consists of strongly gleyed clayish soil with sand inclusions. It was in this layer that Škrdla recovered the charcoal he believes is associated with the cultural horizon.

Following the abandonment of this site, most probably during the most extreme cold period at the end of the last glacial, minor sliding by entire blocks of sediment began to occur in the site area, creating vertical cracks. The geological situation at the site is not simple from the point of view of field research and the interpretations based on it and the fact that these processes impacting the landscape could have to a certain degree impacted the current site situation cannot be excluded. The site has only one cultural horizon (Škrdla encountered this

horizon with two separate loess layers only in one corner of the site). This means that all of the osteological material recovered here comes from a relatively narrow band of time. This fact is important for possible comparisons with other sites. All the material was excavated in a very careful manner. The site surface was divided into sectors measuring one meter by one meter and each of these was divided into four subsectors (a-d). The location of each artifact was also measured in three dimensions. The entire cultural horizon was water screened. The following radiocarbon (non-calibrated) dates were obtained for the cultural horizon at Jarošov-Podvršťa from reindeer bone: 25,780±250/240 BP, and from charcoal: 25,110±240/230 BP, 26,220±390/360 BP, 26,340±18 BP and 26,950±200 BP. The latter date is from the grey-colored layer separated from the main cultural horizon. Even though the site is in essence one cultural horizon, Škrdla proposes repeated, short-term occupations on the basis of the spread of the radiocarbon dates. These occupations may be chronologically synchronized with the sites of Předmostí, Dolní Věstonice and Pavlov. The radiocarbon dates correspond with these well-known sites.

The Fossilization and Preservation of Osteological Materials

Most of the material recovered consists of difficult to identify or unidentifiable fragments of grayish-white bones, with even the smallest fragments (0.5 cm and smaller) being preserved. This leads us to the conclusion that all osteological material was preserved in the wet-screened sediments, including the very smallest. Their surfaces are frequently corroded by the roots of plants and there are basically no bones with a smooth, undisturbed surface. This is all the result of the cultural horizon's location near the surface. Dendrites occur only rarely on the bones' surfaces, but they are present even on the smallest fragments. It was possible to identify on a larger fragment, probably horse, which side was face down in the sediments and which was exposed. This type of differing preservation in bones is only possible when the bones lay exposed on the surface for a longer period of time without being moved. This type of preservation of the bone surface is rather rare (Subsectors 46b and 136c). A mammoth rib from Subsector 96a had a weathered surface on both sides, indicating that it had lain on the surface but was turned over after some period of time.

Many fragments were covered in an impenetrable calcium carbonate layer, meaning that they are inside a concretion. This layer is sometimes as much as two centimeters thick. The hollow spaces of long-bone diaphyses were also often filled with calcium carbonate, meaning that the compact bone may be missing and all that is preserved is a calcium carbonate cast. These internal coating occurred after bone fragmentation, probably after the end of human occupation (for example see Subsector 156a). Calcium carbonate casts are found on large bones as well as on relatively small bones. I can state that the calcium carbonate deposition occurred after their weathering. It is interesting to note that in addition to bones preserved in this manner, bones lacking even a hint of a calcium carbonate layer were also recovered. The types of preservation noted indicated that after the cultural materials were covered, there were significant amounts of rainfall that deposited the calcium carbonate into the subsoil and which manifested itself in the local solifluction observed at the site, and was also possibly the cause of the sliding of entire blocks down into the valley. Some of the bones were heavily weathered, with even individual teeth sometimes being quite fragile, sometimes breaking into pieces or the crown separating from the root.

A unique find was the deformed lower jaw of a reindeer, the deformation occurring as the result of pressure. The teeth were forced inwards and yet the roots were undamaged. This rules out pressure caused by the overburden and probably represents tangential pressure occurring during the movement of soil containing the bone (Subsector 117b).

All fragments of medium-sized and large animals were broken by human activity in the same manner as has been noted at other sites dating to this period. Transversely removed long-bone epiphyses, metapodialia, mandible fragments and loose teeth were found (primarily reindeer bone) along with variously-sized fragments of large animals. Reindeer teeth have sometimes been broken into small fragments with sharp edges (Sector 76). All the reindeer phalanges were transversely fractured in their middle section.

The small fragments from fox and hare are somewhat different. These fragments sometimes do have sharp edges, but they are also not infrequently rounded as if they had been transported and rolled in water, which is of course not possible. Even the smallest of bones were broken, e.g. a fox astragalus (Sector 139) and a longitudinally split vertebra of a hare or fox (Sector 140). An exceptional find was a longitudinally split fox tooth fragment (Subsector 146b). It is not possible in these cases to rule out natural causes. The fact that large debris was also recovered in

those sectors where all the faunal material recovered was in the form of small fragments supports this view. Examples of the genesis of these small animal bone fragments in soliflucted sediments are not known to me and in my opinion would require more significant transport, which can be ruled out in this case.

In contrast, there are two possible explanations for the smallest bone fragments – in contrast with the bones of larger animals: either they are the result of natural processes or the fragments are the result of human activity. The osteological material is quite heavily weathered and easily breaks into smaller pieces. This can be clearly seen in larger fragments, for example, where lengthwise and lateral cracks can be observed on their cortical surfaces. This holds not only for long bone diaphyses but can also be observed, e.g. on a reindeer vertebra. These numerous cracks are clear evidence of their natural origin (Subsector 47b). The reason why complete disintegration did not occur may be a secondary reinforcement by calcium carbonate. It is possible to observe a similar phenomenon on the long bone diaphyses of fox bones that had broken lengthwise (Subsector 47a). However, the shape of the majority of the small bone fragments of hare and fox recovered are not consistent with shapes created by such conditions, i.e. conditioned by the bone structure.

For this reason, the second alternative – human activity – must be considered. In a majority of cases (of fox and hare only), it is quite clear that these small fragments were created as the result of human activity, i.e. the edges are sharp or were subject to secondary rounding and the method of breakage is evidence that they could not have possible been created by natural activities. In spite of the fact that many bone fragments are heavily weathered and therefore in poor condition, they are present in large numbers. I would have expected them to have been destroyed if movement as the result of solifluction had been the cause. Evidence against natural movement can be seen in the vertebrae of small animals, on which even the processes are well preserved – these would not have survived even the smallest of movements. We must therefore propose that these small fragments are primarily the result of human activity.

A majority of the small animal bone diaphyses were broken crosswise, most of them in a number of different directions (Subsector 146b); in one case it was even possible to observe the lengthwise splitting of a hare humerus (Subsector 138b). The method of breaking these bones is completely different than that observed at the other Pavlovian sites (Dolní Věstonice, Pavlov) with which I am very well acquainted. In contrast with the treatment of large animal long bones, almost no epiphyses were recovered from the long bones of hare and fox, in spite of the fact that they are relatively robust and they should be present if only natural processes were operating here. This therefore must reflect an anthropogenic activity (artifact retouch?).

There are two possible explanations for he creation of these small fragments and their subsequent, if we discount natural causes as a possibility: they were initially created during the retouching of artifacts and were then ground to make fuel for a fire. It is a fact that these small fragments from Jarošov-Podvršťa were used as fuel for a fire. Many, many of these fragments, including the very smallest, were clearly burned after they had been fragmented. This case may illustrate that prior to their burning in a hearth, they were further fragmented into still small pieces, one could almost say, using a more pertinent term, pulverized to make them more inflammable. The diaphysis fragments are not really small fragments so much as something significantly smaller, purposefully pulverized.

The accumulations of small bone fragments was also directly associated with the accumulations of artifacts and debitage (see the graphs). Major accumulations of small bone fragments always accompanied by large accumulations of small fragments of cherts. This relationship between accumulations of bone fragments and small debitage was not present everywhere. There were also square meter units, where there were many chert fragments but almost not small bone fragments. I have never previously encountered this phenomenon in any of my previous research, including those sites were the cultural horizon had been water screened (e.g. Pavlov). Nor am I aware of a similar description at any previously described site. Of course, this phenomenon could only have been ascertained as the result of very careful excavation techniques.

Therefore it may be stated that there are two causes for the genesis of these small fragments. To a lesser degree, they may be the result of natural processes (if these are not the result of secondary manifestations), but to a greater degree it is likely that they are the result of manufacturing stone tools, with a secondary use as fuel for fire. Everything points to this scenario.

Human Impacts on Large Animal Bones

If we set aside the small fragments, human impacts are clearly visible on all bones from medium-sized and large animals. Virtually all of the bones recovered have been chipped in a wide range of directions. The method of chipping is completely identical with finds from other Pavlovian sites. In addition, human-caused cut marks were noted, but only rarely. Two parallel cut marks were observed on the surface of a distal fragment of a reindeer humerus (Subsector 50a). I also observed evidence of trimming on one reindeer antler.

Game Animals

The number of game animal species is small and the minimum number of individuals (MNI) for each species is unbalanced.
The following species were found in the cultural horizon:
Aves, genus and species indeterminate.
Unidentifiable diaphysis fragment
Lepus sp.
Hare is the second most frequent species. But the bones here have not been preserved in a manner comparable with the situation at other Pavlovian sites in Moravia. The majority are very small fragments, small bones and loose teeth.
Lynx lynx (Linnaeus, 1758)
Only an isolated find.
Canis lupus Linnaeus 1758
The finds of wolf are relatively rare in comparison with other Gravettian sites. No complete long bones were recovered, nor was there a significant number of long bone fragments. The entire collection gives the impression of a random selection from several animals. It is not representative of purposeful hunting..
Alopex lagopus (Linnaeus 1758)
For the most part these are small fragments only identifiable as belonging to this species on the basis of size. Very few larger fragments were recovered. Once again, the situation here is quite different than at other Pavlovian sites in Moravia that we know today. This species is together with the hare the most frequent.
Vulpes vulpes Linnaeus 1758
In contrast with the arctic fox, this species is rather rare. The reasons for this are not clear.
Gulo gulo (Linnaeus 1758)
Several bone fragments, perhaps representing one individual.
Mammuthus primigenius (Blumenbach,1799)
Several smaller fragments of rib and minute pieces of tooth lamellae is all that was found in the cultural horizon. This creates the impression that this was not a game animal hunted for food but that the finds entered the cultural horizon simply by accident or some other cause.
Equus sp.
A minimal number of finds appearing to represent one adult and one juvenile.
Rangifer tarandus (Linnaeus 1758)
It is only from this species in the cultural horizon that we can observed long bone fragments and metapodialia clearly chipped by human activity. The situation is similar for the phalanges, which are mostly broken in the center of the diaphysis. The reindeer was also the only species for which even small skull fragments were recovered. The reindeer are the only species of game animal where the situation is comparable with that at other sites from this period.

However, this collection of game animals is in no way representative of the wide range of species living in the area and which might have been hunted for food. If this had been the case, then the number of larger animals should have been higher and the bone preservation should have been similar to that at other Gravettian sites. Because this is not the case, it may only be assumed that this was not necessarily a normal human settlement of the type widespread at that time. The way in which the bones of small animals have been preserved clearly indicates that they are not the remnants of food as is the case at typical sites but that they were used for other purposes entirely.

The analysis of game animals also reveals several unusual facts. The age of the animals vary from young individuals through adults. This is a situation found at other Paleolithic sites. In this case, however, the osteological material reflects a concentration on relatively small species, primarily hare and fox. The fragmentation of these species' bones is markedly different than that found at other Pavlovian sites.

Quantitative Analysis of Identifiable Bones

Given that all the sediments removed from the cultural horizon were water screened, even the smallest items were recovered. If this screening had not taken place, very little osteological material would have been recovered because the smallest pieces would have missed notice during standard excavating procedures. Only one entire bone – even it was missing the epiphysis – from a larger species (wolf) was recovered from the cultural horizon sediments of the entire site, a very unusual occurrence indeed. The larger finds are only a variety of fragments, that were most likely in the case of large animals caused by human activities. This may well also be the case for smaller species as well but the level of preservation does not allow a definitive answer. The finds include both juvenile and adult individuals, with the latte forming the majority.

The total number of all osteological finds is 5,856 variously-sized bone fragments. The number clearly identifiable is quite small, only cc. 330 items, which represents only six percent of the total. I remain unaware of any Paleolithic site from this period where the difference between identifiable and unidentifiable finds is so marked.

As was indicated, the number of individual animal species is not very large. In the next section, I analyze the finds associated with each species based only on the number of bones present and not on the minimum number of individuals (MNI).

Alopex lagopus
Loose teeth from both the upper and lower jaws are the most frequent elements from this species – 76 teeth in total. Lower jaw fragments were quite rare, numbering only for, mostly without teeth. No upper jaw fragments were recovered. Finds from the postcranial skeleton were limited to one vertebra, two pelvis fragments and two calcanei. Limbs were represented by the following long bones (all fragments):
Humerus (distal): 4
Radius (distal): 1
Ulna: 5
Femur (proximal): 1
Tibia (proximal): 1
Give the large number of very fragments of very small bones that could only come from hares or foxes, it is difficult to explain the ratio of these small fragments and the small number of larger fragments.

Vulpes vulpes
This species is quite rare. There are only three loose teeth, one astragalus and one calcaneus.

Canis lupus
A complete tibia, missing only the proximal epiphysis, was recovered. This bone was not broken but was disturbed by natural processes. The distal epiphysis is not yet fused indicating a young individual. This is the only complete bone from the whole site. Other bones recovered from the postcranial skeleton include a fragment of the proximal end of the tibia, a small fragment of scapula and a calcaneus. Cranial elements included two mandible fragments and eight loose teeth.
Given that wolves must have been quite numerous in the area at that time, this is an exceptionally small collection, indicating that it could not possibly represent the result of systematic hunting as has been observed at other sites from this period.

Lepus sp.
Virtually all parts of a hare's skeleton are represented, be it in small numbers. The most frequent element are loose teeth – a total of 76. Five fragments of the lower jaw and two fragments of the upper jaw were identified. The limbs are represented by the following bones:
Humerus (distal): 5
Humerus (proximal): 1
Radius (distal): 1
Radius (proximal): 3
Ulna: 5
Femur (distal): 2
Tibia (distal): 2
Tibia (proximal): 2
Additionally two scapula fragments, one astragalus and eleven heel bones were identified.

Gulo gulo
Wolverine remains include two fragments of femur, an ulna and calcaneus. A minute fragment of tibia either comes from a wolf or wolverine.

Lynx lynx
Only one first lower molar from a relatively small animal was identified.

Rangifer tarandus
As was the case with other species, loose teeth are the most frequent item (26). Lower jaw fragments from three individuals were identified; upper jaws are missing. The remaining identifiable bones are:
Metatarsus (with proximal and distal epiphyses): 2
Metacarpus (with distal epiphysis only): 2
Metapodialia (fragments): 3
Rudimentary metapodialia: 2
Vertebrae: 1
Rib: 1
Pelvis: 1
Antler: 6
Phalanx I (distal. and proximal ends): 11
Phalanx II (distal and proximal ends): 7
Phalanx III: 2
Phalanges (distal ends): 2
Humerus (distal epiphysis): 1
Tibia (distal epiphysis): 4
Tarsus III (left): 1
If we compare the number of loose teeth identified with the number of other bones, there is a certain imbalance. Based on the number of teeth, there should be more bones. This holds not only for reindeer but for all other species at the site.

Equus sp.
Only two tibia fragments were identified: one right and one left epiphyses. It is quite possible that they come from the same individual, evidence for which can be seen in the size of the joint surfaces (76.7 × 47.1 and 76.6 × 48.8 mm). Additionally, a patella from a juvenile individual was identified as horse.

Mammuthus primigenius
No fragments of any long bones were identified, nor were any tarsal or carpal bones. All that was identified were rib fragments (five), minute lamellae fragments (four) and a tusk.

The total number of identifiable bones for each individual species is as follows:
Unidentified bird: 1
Wolf: 14
Wolverine: 2
Horse: 3
Mammoth: 9
Red Fox: 5
Arctic Fox: 76
Reindeer: 73
Hare: 83

Jarošov-Podvršťa is equivalent to other sites from this period in terms of the range of species present. But it does differ in a fundamental way from all previously excavated sites associated with the Upper Gravettian-Pavlovian in terms the quantitative proportions of individual species. It cannot be compared to any Moravian site of similar age, making it a unique site. If no Pavlovian artifacts had been found and no radiocarbon dates carried out, it would be very difficult to distinguish from a Magdalenian site in terms of the paleontology. Jarošov-Podvršťa is remarkably reminiscent to them in terms of osteological finds. All other standard Pavlovian sites are quite different in terms of the presence and preservation of osteological finds. The primary food sources at this site were reindeer, followed by hare and fox.

Paleoecological Characteristics

Game species are in no way representative of the entire range of species living in the environment. For this reason, any discussion of the immediate environment based solely on a limited number of game animals is of questionable value. In this case, where the site may not even represent a true settlement, it is really only possible, given the selective nature few species recovered there, to make some very general paleoecological analysis.

I suppose that the hill bounded by riverine lowlands was treeless, covered only in grass. It was a steppe on which neither trees nor bushes grew in significant numbers. The predominance of artic fox over red fox is telling. It is evidence that the climate was quite harsh. The identification of a lynx – even though there is only one case – is evidence of trees growing in the river valley. Any further paleoecological discussions would be too theoretical.

Quantitative Analysis Based on All Bone Fragments

The diversity of game animals in terms of the individual species is quite low. It is not possible to establish a minimum number of individuals (MNI) for any of the species based on the osteological material recovered without seriously distorting the actual figures. This is the result of the fact that the majority of the osteological material is from fox and hare and is preserved in only in minute, indeterminate fragments – in contrast with all other known sites. It is only because we know what species could have been present that we are able to make a species identification for these small fragments. For this reason, we have adopted a different method of quantitative analysis. The majority of the finds are in the form of fragments of various sizes of variously sized animals and for

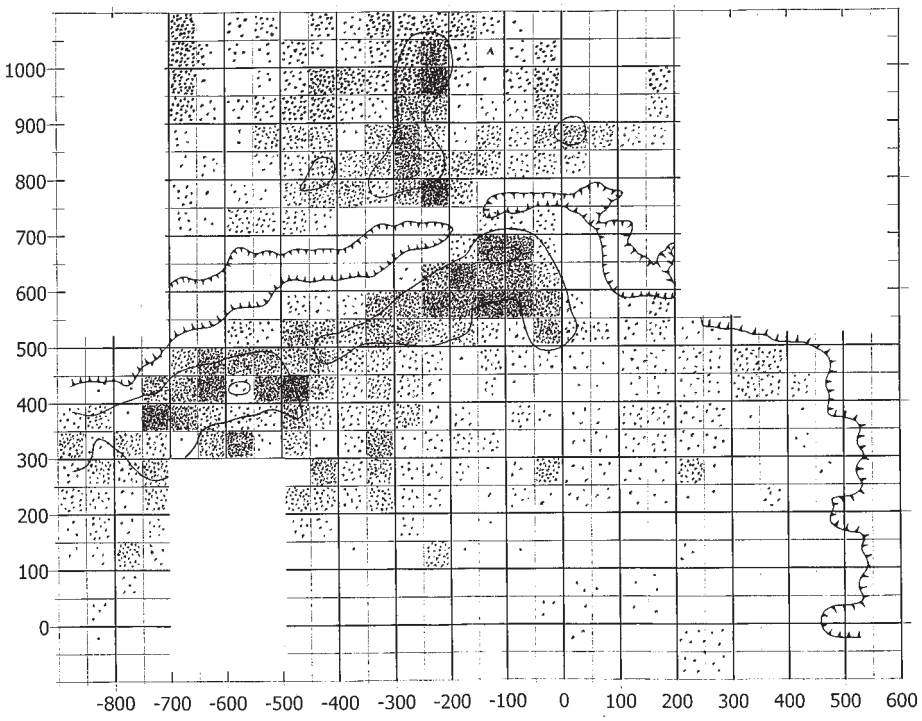

Fig. A.1. Distribution of all osteological material in individual sectors. Each recovered item is indicated by one dot, meaning that their density indicates the amount of osteological material and their location in each sector. The solid lines outline the maximum concentrations of artifacts, the spiked line marks breaks in the sediments. The maximum bone concentrations are located in two separate zones: Zone A – Sectors 155, 146, 137 and 77, with highest density occurring in Subsectors 146b and 77b (upper part of the site. The second concentration (Zone B) is much larger, spreading out over an area between Sectors 123 and 70. Zone B is made up of two subzones (central part of the site), with the highest density in the first occurring in Subsectors 69b, 70a, 69c, 59b, 60b and 61b and the second in Subsectors 46b, 46d, 47d, 48c, 123b, 124a and 125c. Note the sharp boundary between areas with faunal remains and those without. The sector numbers are identified in Chapter 2, Figure 2.7.

that reason I have divided all the osteological material into several size-based groups, with identifiable and unidentifiable bones grouped together.

The first group contains fragments that given their size and strongly compact diaphyses could only come from hare and fox (Fig. A.3). These finds were primarily recovered during screening and their sizes range from several millimeters to several centimeters. These are primarily hare and arctic fox, with the red fox have only a minimal representation.

The second group is made of up bone fragments from medium-sized animals, i.e. reindeer, wolf and wolverine. The most numerous are reindeer, with wolves making up a small group and wolverines present only rarely (Fig. A.4). The third group contains fragments of horse bone and the fourth broken mammoth bones and teeth (Fig. A.5).

The total number of recovered bones is 5,856. The first group contains the largest number: 5,455. The second group of medium-sized animals contains 861 items. The third and fourth groups are much smaller, with only thirty fragments in the third and a mere ten in the fourth. What conclusions may be drawn from this information?

In Group 1, hare and arctic fox are the most common, accounting for 93.1% of the group. The presence of red fox is not significant. The second group is primarily made up of reindeer, with a small amount of wolf and an insignificant amount of wolverine. Only the reindeer was purposefully hunted, with the others being chance kills. This group accounts altogether for 6.2% of the total. Horse and unidentifiable bones from similarly sized animals are rare, accounting for only 0.5% of the total. The number of mammoth bones is still smaller, only 0.2% of the total.

Even though the percentages presented here only express the frequency of bones of individual species and not the number of individuals of each species, I believe that these figures do to a rather high degree reflect the representation of individual animals. There was a focus primarily on hare and fox, i.e. a high usage of small game, with all other species making a less significant contribution. Of course it is not possible to imagine that no other species were living in the area. This has been convincingly shown in the analysis of game at the nearby (both in terms of distance and time) site of Předmostí (Musil 1968). The fact the nearby accumulation of bone from large animals (Jarošov-Kopaniny) is not chronologically associated with this site – i.e. more recent than the site of Jarošov-Podvršťa means that mammoths were still present in this region in large numbers. Furthermore, based on the overall preservation of individual bones and even the species represented, it may be deduced that this site is not a standard settlement where game represented the fundamental basis for human survival. Instead it is necessary to adopt a different explanation for this anomaly in comparison with other sites from this period. In any event it is also clearly not focused on the specialized exploitation of a limited number of species as the result of their being the dominant presence in the area, as is known from the Magdalenian.

Burned Bones

Burned bones are very frequent and occur in almost all sectors. This corresponds with Škrdla's discovery of hearths in the cultural horizon. The burned bones represent only minute fragments of hare and fox bone; burned bones of larger animals or larger fragments of smaller animals are missing. It appears that the hare and fox bones were pulverized before they were put in the hearth. There are two types of burned bones. Some are completely grayish-white and show compact cracks on their cortical surface, others are rather black. The first group was clearly exposed to more intense heat.

Spatial Distribution of Osteological Material

Finds are distributed variously. Bones of medium-sized and large animals are scattered across the entire site. In contrast, artifacts and small bone fragments of hare and fox are concentrated in specific areas. Across the entire site, two such large accumulations may be noted (Fig. A.1 and A.2). As far as artifacts are concerned, accumulations of small debitage are found (with even more than 100 pieces in one square meter) that are the result of artifact retouch.

An analysis of the spatial distribution of the first group (small fragments), which is the most numerous, reveals that there was a certain degree of accumulation. There are two types of accumulations – the first is a large accumulation coving a larger area, i.e. a greater number of sectors. Within this area, it is possible to find the maximum concentrations of bone in only one or a few parts of several sectors (Fig. A.1).

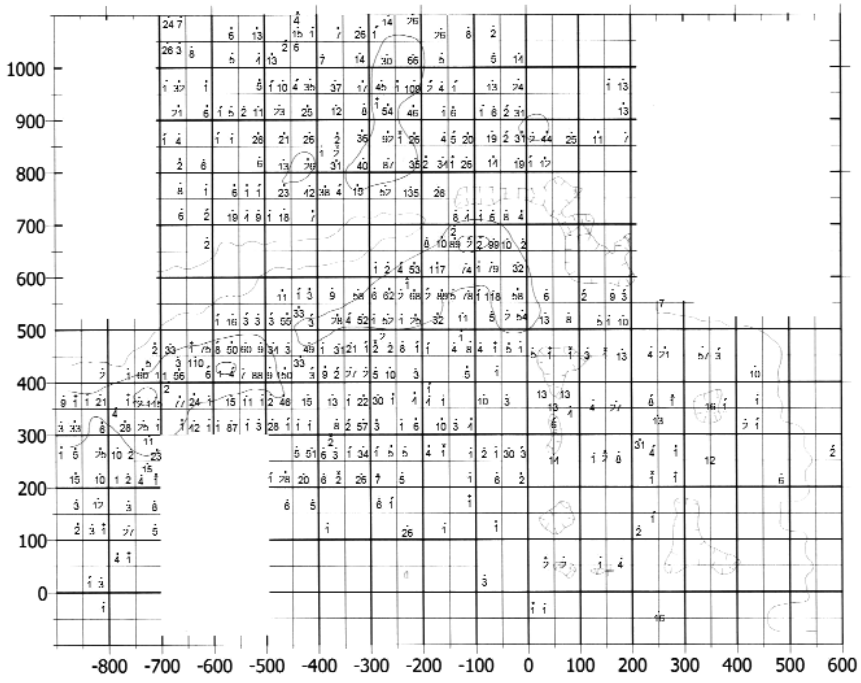

Fig. A.2. The distribution of large bone fragments regardless of species. Sectors without numbers mean that no fragments were recovered in that sector. The solid lines outline the maximum concentrations of artifacts, the spiked line marks breaks in the sediments. Bone fragments were divided by size, with dots above the numbers indicating fragments of hare- or fox-sized animals (5,455 fragments, i.e. 93.1%), lines above the numbers indicated medium-sized (wolf or reindeer) animals (361 fragments, i.e. 6.2%), an "x" above the number indicates bones of horse-sized animals (30 fragments, i.e. 0.5%), crosses above the number indicated mammoth bone fragments (10 fragments, i.e. 0.2%). Unmarked numbers mean that the size of the fragment is unknown.

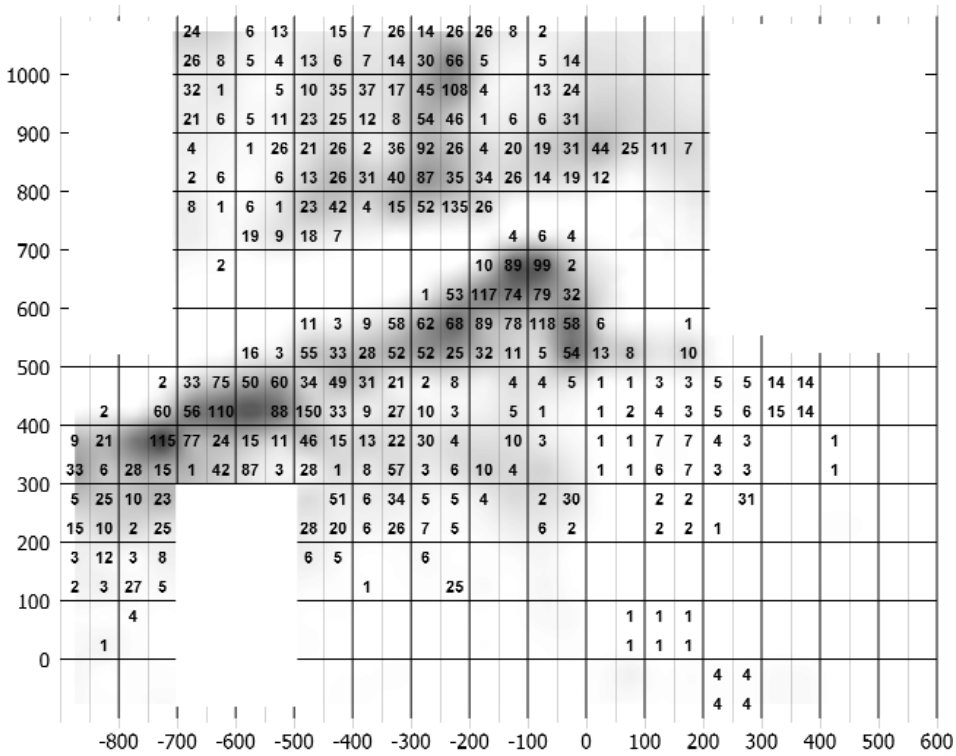

Fig. A.3. Absolute numbers of tooth and bone fragments from hare- and fox-sized animals in individual sectors. Sectors with no numbers indicate no finds. The shading indicates the number of artifacts recovered (darker shades = higher numbers).

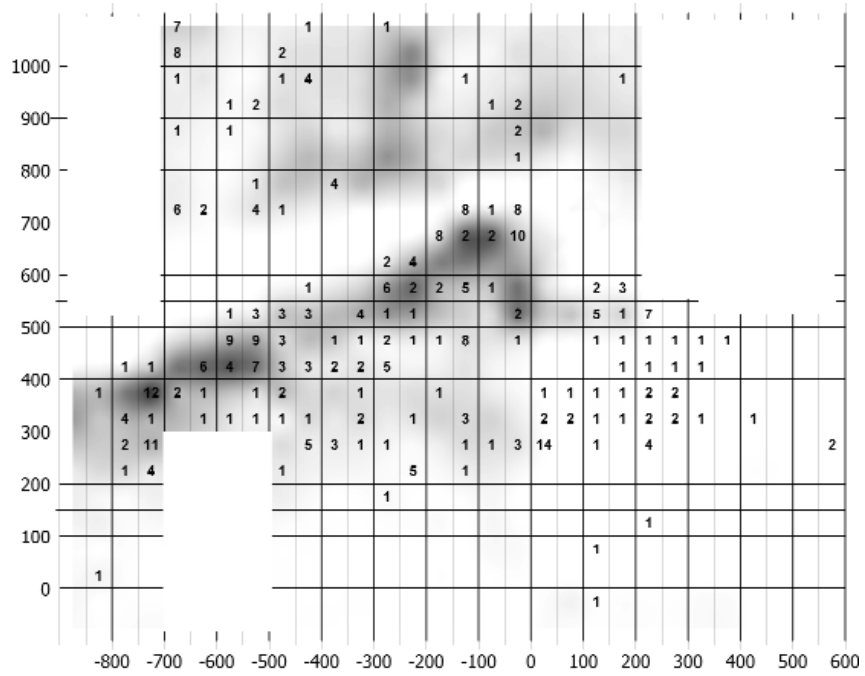

Fig. A.4. Absolute numbers of tooth and bone fragments from wolf- and reindeer- or wolverine-sized animals in individual sectors. Sectors with no numbers indicate no finds. The shading indicates the number of artifacts recovered (darker shades = higher numbers).

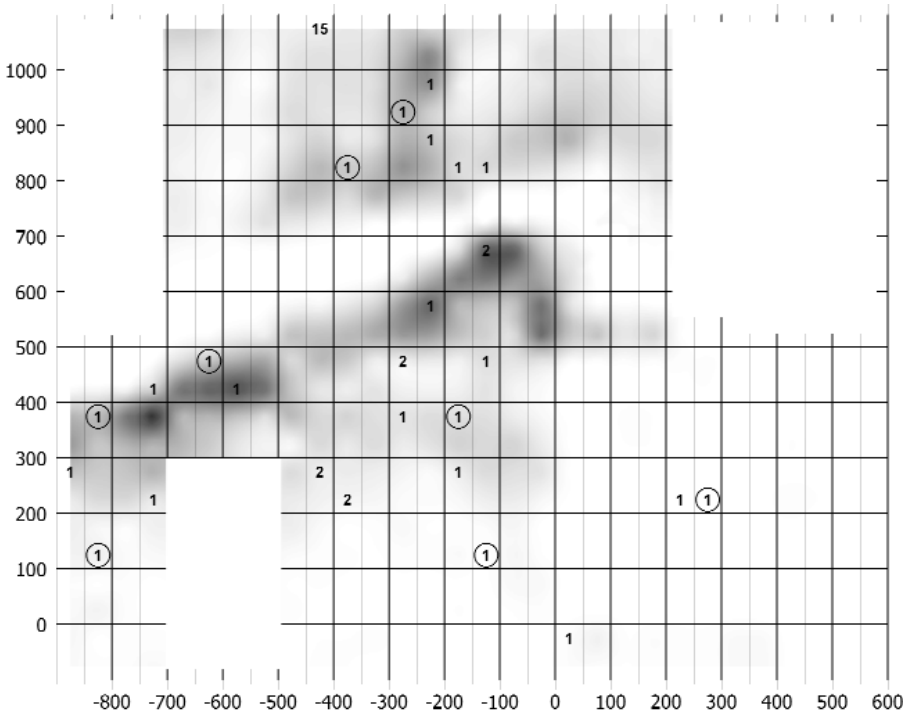

Fig. A.5. Absolute numbers of tooth and bone fragments recovered from horse-sized (non-circled numbers) and mammoth-sized (circled numbers) fauna. Sectors with no numbers indicate no finds. The shading indicates the number of artifacts recovered (darker shades = higher numbers).

Two examples of this type of accumulation were uncovered. The first (A) is located in the upper part of the site (Fig. A.1), and runs in a more or less vertical direction in Sectors 155, 146, 137 and 77. The maximum bone densities are however restricted to two subsectors: 146b and 77b. The second bone accumulation (B) more towards the center of the site was substantially larger. This accumulation runs perpendicularly to A and has two density highpoints in the upper and lower parts of the accumulation, coving Sectors 123 to 70 (Fig. A.1). The subsectors of maximum density were more numerous, with the upper accumulation covering the adjacent subsectors of 69b, 70a, 69c, 59b, 60b and 61b. In the lower accumulation, the subsectors with the highest densities were not adjacent but rather more scattered: subsectors 46b, 46d, 47d, 48c, 123b, 124a and 125c. Between these two high-density zones was a transitional area with moderate bone densities.

One important factor associated with these concentrations is that they are coterminous with the major artifact concentrations, extending beyond it in only a few locations. In some sectors, large amounts of small debitage created in the process of artifact retouch were noted but bone fragments were relatively scarce or completely absent. One example is Sector 49, where there is a fairly high amount of retouch debitage (ca. 150 pieces) but relatively little bone (only 70 pieces); a similar situation was noted in Subsector 122a, with forty pieces of debitage but only nine small bone fragments. The number of sectors in which there was relatively little debitage and no bones whatsoever is quite frequent. I will not list them here. It seems likely that the opposite will also be true, that there will be sectors with larger numbers of bone fragments and fewer artifacts. One of the most important facts is that the number of small bone fragments does not extend into neighboring sectors but rather represent strictly bounded spaces with large numbers surrounded by sectors with small numbers. It can be generally stated that sectors where there is little debitage, there are generally few or no bones but in those sectors where there are large bone concentrations, there are large concentrations of debitage.

There may be two explanations for this phenomenon. Debitage from the retouching of stone tools and small bone fragments were not distributed into neighboring sectors because there was some barrier that prevented their spread. We might imagine that this barrier was the wall of a dwelling or a screen of some type. There is of course another possibility using a natural explanation. These accumulations may have formed as a result of the movement of sediments that was halted as the result of a natural barrier, creating in effect this accumulation. But it would seem that the first explanation is more likely to be valid. This would mean for the first time structures have been identified that were not used as dwellings but as workshops for manufacturing tools.

Bones from the second group are primarily reindeer and even these are not numerous, their concentration in sectors within the central part of excavation (B) was noted. This accumulation is not coterminous with sectors with larger numbers of artifacts or other bones. All other finds in this group were distributed randomly. It is worth noting that not one osteological find from this group was recovered in the large concentration of artifacts in the upper part of the site (A). Finds from the third and fourth groups are rare and occurred more or less randomly throughout the site.

The situation described here cannot be random and the following conclusions may therefore be drawn:

- The accumulations of artifacts and debitage and the accumulations of bone have a direct, coterminal relationship.

- These accumulations, while varying in size, have relatively well-defined borders in comparison with areas with smaller numbers of artifacts.

- Reindeer bones follow these accumulations only to a certain degree and not in all cases. Therefore, the explanation for their accumulation must not be the same as was proposed in the first case.

What conclusions may we draw? First, it is important to note the strong relationship between large numbers of artifacts and debitage and large numbers of small bone fragments. It is possible that further archaeological studies may reveal a different explanation, but it my opinion this can represent nothing else than the manufacture of artifacts inside a structure. I completely reject the possibility that these accumulations represent animal bones for consumption or the preparation of skins and hides. This assertion is based on the sharply defined boundaries between larger and smaller artifact numbers, from which workshops may be deduced. In any event, these facts have no parallel at any other sites from this period.

Primary Conclusions

1. Following the abandonment of this site, a period of high rainfall occurred that led to the creation of a carbonate horizon and the formation of calcium carbonate concretions on the bones. It is possible that this rainy period began while the site was still occupied and may have in fact been a reason for the site's abandonment. The majority of the casts and the carbonate horizon itself must have been created after abandonment. This can be seen in the fact that the bones were clearly fragmented by human activities and only then covered in calcium carbonate.

2. The finds excavated by Procházka and later by Seitl and Valoch (Jarošov-Kopaniny) were found in similar solifluction-impacted sediments to those at the site excavated by Škrdla. For that reason, it was possible to assume that they came from the same period. The preservation of both sites was basically the same (bones covered in calcium carbonate concretions). Where they differ is in a complete different range of species present and the small number of artifacts recovered. These facts together with the radiocarbon dates mean that this assumption must be abandoned.

3. The cultural horizon occurred in sediments disturbed by solifluction and in the sediments vertical cracks and the shifting of blocks of sediments were clearly visible. It is evident that this last phenomenon occurred after site abandonment. As for the first two phenomena, it would seem to most likely that they did not have a significant impact on the cultural horizon and so it may be assumed that the artifacts are more or less in their original locations. It is clear that there was some minor movement, as can be seen for example in the deformation of a reindeer mandible clearly the result of pressure. Its teeth were force inwards and the roots remained undisturbed. Pressure from the overburden can be ruled out and the most likely explanation is tangential pressure created during movement. Seitl and Valoch (1998) also noted minor movement during their excavations of the lower-lying but similarly impacted site. These movements probably did not affect the entire excavated area.

4. Debris, often relatively large (in Subsector 146b, measuring up to 7 by 7 cm). This debris was separated from the underlying strata and through solifluction forced into the cultural horizon.

5. Given the range of game species recovered, the residential area must have been elsewhere and has not yet been discovered. Jarošov-Kopaniny may be ruled out because it is more recent in time.

6. The analysis of osteological material shows that the number of individuals represented in each species is not comparable to other Moravian sites from this period and is significantly different from the game species recovered at standard Pavlovian sites. This does not hold for the range of game species, which is similar to other Pavlovian sites. It is clear that this site does not represent a residential settlement in the true sense and that the preserved bones (with the exception of reindeer) do not come from animals hunted for food. It may be that the smaller game, i.e. hare and fox, were brought to the site from a nearby residential site. At this site, however, these bones were used as tools and fuel for the hearths.

7. The concentrations of artifacts and debitage and the concentrations of small bone fragments from hare and fox are coterminous. They can represent nothing else but a location devoted to some sort of specific activity, in this case the manufacturing of artifacts with the use of hare and fox bones. I would completely reject the possibility that these bone concentrations represent animals used for food or for their fur.

8. The number of game species present is relatively small and the number of individuals within each species highly variable. These facts are not comparable with the situations at other sites from this period, not even those in the immediate vicinity. The fauna is dominated by fox and hare with other species (mammoth, horse, wolverine, lynx) being relatively insignificant, probably unplanned kills. This only serves to confirm the fact that the site of Jarošov-Podvršťa does not represent a standard human settlement.

9. Bones from small animals (fox and hare) are preserved in great numbers as tiny fragments, sometimes without sharp edges, often more reminiscent of their having been pulverized rather than simply chipped or broken. It is very unusual to find such a large number of small fragments with larger, identifiable fragments, in a cultural horizon. The bones are very frequently burned. It cannot therefore be ruled out that after they were first used in tool manufacture, they could then serve then as fuel. None of the larger bone fragments were burned. Evidence of hearths and charcoal were present in the cultural horizon. I believe that the state of preservation of small animal bones is clear evidence that they were not used as food as is normally the case, but that they were brought to this

site and their use was completely different (tool manufacture and then as fuel). I am not convinced that these animals were used for food or fur. Although the impacts of human activity are responsible for the vast majority of the small bone fragments, natural processes cannot be entirely ruled out.

10. The significance of this site and others in the area is based on the fact that it is near the Napajedla Gate, which is surrounded on both sides by highlands. This area was at the time the only suitable north-south migration route in the region.

11. The site of Jarošov-Podvršťa differs in a whole series of ways from all other known sites and it must therefore be interpreted differently. It is not a site similar other Pavlovian sites in Moravia. For the first, time, there is evidence of the specialized use of a site for the production of artifacts and their manufacture inside structures that were not used as dwellings.

Literature

Musil, R., 1968: "Die Mammutmolaren von Předmostí (ČSSR)." – *Paläontologische Abhandlungen* 3/1, 1-192, Berlin.

Musil, R., 2003: "Jarošov – faunistická anomálie gravettských sídlišť." – 9. *Kvartér* 2003, Abstrakta 10-11, Brno.

Procházka, R., 1983: "Záchranný výzkum paleolitické stanice v Uherském Hradišti-Jarošově, okr. Uherské Hradiště." *Archeologické rozhledy* 35, 552-554.

Rousseau, D. D., Antoine, P., Hatté, C., Lange, A., Zöller, L., Fontugne, M., Othman, D. B., Luck, J. M., Moine, O., Labonne, M., Bentaleb, I., Jolly, D., 2002: "Abrupt millennial climatic changes from Nussloch (Germany) Upper Weichselian eolian records during the Last Glaciation." *Quaternary Science Reviews* 21/14-15, 1577-1582.

Seitl, L., Valoch, K., 1998: "Stanice gravettienských lovců mamutů v Jarošově (Uherské Hradiště-Jarošov, okr. Uherské Hradiště)." *Acta Musei Moraviae, Sci. Soc*. 83, 67-81.

Škrdla, P., 1999: "Uherské Hradiště-Jarošov (okr. Uherské Hradiště)." *Přehled výzkumů* 40 (1997-1998), 179-183.

Škrdla P., 2000: "Předběžná zpráva o výzkumu tábořišť pavlovienu na Uherskohradišťsku." *Slovácko* 42, 91-101.

Škrdla, P., 2002: "Uherské Hradiště (k.ú. Jarošov u Uherského Hradiště, okr. Uherské Hradiště)." *Přehled výzkumů* 42, 122-126.

Škrdla, P., Kruml, O., 2000: "Uherské Hradiště (k.ú. Jarošov u Uh. Hradiště, okr. Uherské Hradiště)." *Přehled výzkumů* 41 (1999), 88-92.

Škrdla, P., Musil, R., 1999: "Jarošov II – Nová stanice gravettienu na Uherskohradišťsku." *Přehled výzkumů* 39 (1995-1996), 47-62.