SUMMARIES*

Preface

The open-air Upper Palaeolithic site of Zaraysk was discovered in 1980. It is located in the centre of the small Russian town of that name, about 155 km from Moscow. Since 1995, continuous and intensive research has been carried out at the site by the Zaraysk archaeological expedition of the Institute of Archaeology of the Russian Academy of Sciences (under the direction of Prof. H. Amirkhanov).

To date, a total area of 390 square meters has been excavated in the centre and periphery of the Zaraysk site. Approximately 244 square meters of this area are included in Excavation No. 4, which represents the primary focus of the investigation *(see plan on the fly-leafs)*. The area excavated to date, however, constitutes only a small part of the total area of cultural deposits.

In terms of its stone tool inventory and typology, characteristic cultural features of its occupation layers (e.g., pits, hearths), and the organization of the settlement (at least in the area excavated to date), Zaraysk exhibits a pattern very similar to sites of the Kostenki-Avdeevo culture. Other parallels to the latter can be seen in the inventory of bone artifacts and adornments (e.g., a necklace and isolated teeth of arctic fox and wolf), and in the ornamental decoration (the types of engraving, such as nets and "oblique crosses") of bone and ivory. Until recently, little information was available about the art of the inhabitants of Zaraysk, although this aspect of their culture is an important and diagnostic component of the archaeological remains at sites such as Kostenki 1 (Layer I) and Avdeevo, which share the same culture as Zaraysk.

The previous book on the Zaraysk site (Amirkhanov, 2000) provided a summary of materials excavated during four field seasons (1995—1998). Since then, research at the site has continued each year, yielding new data accumulated over the course of eight additional field seasons. The area excavated has been almost doubled in size.

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Both the stratigraphy at the site and its relationship to the regional sequence are better understood. The pattern of site structure in *Cultural Layer II* has become clear. Categories of material that had not been encountered during the earlier excavations were recovered, including some remarkable art in the form of small sculptures. The quantity of stone artifacts now exceeds 100,000 items, and much of this material has been described and classified. A substantial quantity of worked bone has been recovered, and this material also has been analyzed, including items from 2005. On the basis of detailed zooarchaeological observations, multiple episodes of occupation have been identified — a matter of special interest in the case of the Kostenki-Avdeevo culture for which such data are virtually non-existent.

Of critical importance to the analysis of the site is the overall pattern of occupation and the problem of whether Zaraysk represents a single site or multiple sites. We define "archaeological site" as a location containing a more or less continuous distribution of artifacts and features of similar typological character within a given stratigraphic unit. On the basis of this definition, Zaraysk actually represents a complex of closely related inter-stratified sites or occupation loci. Four sites or loci may be identified, each labeled with a letter (e.g., "Zaraysk A") *(Figure 1, page 11)*.

The primary occupation locus is *Zaraysk A*, which occupies an area adjoining the Nikol'skaya Tower of the Zaraysk Castle and a promontory ("Castle Hill"). At this location, the cultural remains are contained in a sequence of four stratified occupation levels deposited in two geologic units — the upper buried soil of the Zaraysk stratigraphy and an underlying sandy loam.

The second locus is *Zaraysk B,* which occupies the upslope portion on another promontory ("Second Hill") several dozen meters to the north of the castle and separated from the latter by an ancient ravine. At this locus, the cultural remains are deposited in the upper buried soil and at the contact between this soil and an underlying loam (the layer of sandy loam described above is absent here).

The third locus — *Zaraysk C* — occupies the crest of the Second Hill promontory and contains cultural remains in the same depositional setting as *"Zaraysk A",* i.e., in the upper buried soil and underling sandy loam layer.

Finally, *Zaraysk D* represents a separate site located on a third promontory to the north of the castle in the vicinity of Pozharskii Square. The cultural materials here are found in the same depositional setting as *"Zaraysk B"* — at the base of the humic horizon of the well expressed upper buried soil.

The Zaraysk project presented an opportunity to develop some new approaches to the analysis of archaeological remains affected by frost action — both syngenetic and epigenetic processes. They included a rigorous methodology for differentiating micro-stratigraphic position of occupation levels in sites containing such remains. The vertical distribution of cultural remains at Zaraysk — which initially appeared as an amorphous mass — was subdivided into several levels representing separate occupation episodes or, in other words, stratified Upper Palaeolithic living floors.

The role of frost-wedge formation is critical to the analysis of cultural deposits at Zaraysk. Two generations of frost-wedge formation — each of which produced a characteristic pattern — were identified at the site. The first generation was

formed prior to occupation of the site, while the second formed prior to the third occupation episode at Zaraysk. The frost formations contain features ("cryo-stratigraphic markers") that permit assignment of the cultural remains to specific occupation episodes.

The distribution of artifacts and features in horizons within their defined horizons is consistent with their stratigraphic subdivision into four stages of occupation. These stages represent discrete units in terms of the archaeological stratigraphy; each exhibits a characteristic pattern in space and time.

This book includes an analysis and interpretation of materials recovered during the most recent years of excavation. However, sections describing features in the lower two cultural layers excavated during 1999—2005 are absent. These layers represent two stratified occupation levels. They contain traces of extensive habitation areas with a central row of hearths, and large storage pits *(yami-khranilishcha)*. One of these levels also contains large elongated pits *(poluzemlyanki)* sometimes interpreted as small semi-subterranean dwellings. Slightly more than half the total estimated area of these layers has been excavated to date. After they are more fully excavated, the features in these layers will be described in a monograph. A preliminary map of the features and a general description have already been published.

Chapter 1
Zaraysk: Features in Cultural Layer III

The third stage in the accumulation of cultural remains at *Zaraysk A* (Cultural Layer III, third level of occupation) is contained within the same sedimentary unit as two underlying levels, but separated from the preceding second generation of frost-wedge formation. The frost-wedges mark a hiatus in occupation of this area of the site and possibly between the second and third chronological stages in the formation of the cultural layer. Cultural remains from this occupation level are either in the filling of the second generation of frost-wedges or overlie remains of the second level of occupation. This level is dated to roughly 20,000 years BP (uncalibrated radiocarbon years before present). The horizontal distribution of remains does not fully coincide with that of the underling level.

The overall pattern of the large depressions on the third level at *Zaraysk A* may be summarized as follows. They possess similar area and depth, and contain an accumulation of mammoth remains (crania, mandibles, tusks, isolated teeth), the composition of which reflects selection by the site's inhabitants. The floor and walls of two depressions exhibit traces of ochre of varying extent. One feature thought to represent a former dwelling entrance *(Depression B)* is situated on the south-facing side of the larger depression. The relationship of the depressions to the topographic setting is significant. At *Zaraysk A,* they are oriented with the long axis of the promontory (Castle Hill) on which this occupation locus is found.

An analysis of the distribution of artifacts related to features of *Cultural Layer III* has not yet been performed. While only general observations are presently available, however, they indicate that further work along these lines could yield some interesting results. At this stage in the analysis, it is already apparent that their spatial distribution is related to their typological classification. The patterning probably reflects the functional differentiation of the associated features.

Taken together, the above observations and conclusions indicate that *Cultural Layer III* at *Zaraysk A* probably represents an occupation episode. It contains no less than three former depressions — each occupying an area of 7—8 square meters — that may be interpreted as traces of dwellings. The floor of each feature lies 25—35 cm below the former occupation surface. Alternative explanations for these features were considered. For example, it could be suggested that the depressions actually represent accumulations of material on the underlying occupation floor that have been erroneously incorporated into *Layer III*. However, the traces of ochre observed on the sides of two of the features indicate that they are more likely related to the upper layer.

The technological and typological character of the lithic assemblage of this level is essentially the same as the underlying level. This cannot be said, however, of the features. The most remarkable of these are the large depressions (shallow pit houses?). There is a former hearth that is similar to a feature in the underlying level. The concave outline of the shallow depression is consistent with the presence of "hearth stones" in the filling of, and in close proximity to, the depression. The dimensions are small in comparison to the similar feature in the earlier occupation and — in contrast to the latter — there are no small "hearth pits" around it. And in contrast to the previous stage of occupation, large storage pits, which are especially characteristic of the earlier occupation, are absent on this level.

The pattern reflects a fundamental change in the organization of the settlement that is characteristic of the classic stage of the Kostenki-Avdeevo culture. This change took place shortly before roughly 20,000 years BP (i.e., at the onset of the maximum phase of the Valday Glaciation). At this time, the occupants of Zaraysk largely abandoned the construction of deep pits and semi-subterranean dwellings. These features were not completely eliminated, but their use was reduced sharply in comparison to the preceding phase of occupation.

The issue of the transformation of the cultural complex at Zaraysk has wider implications for archaeology and human prehistory. The sequence at this site reveals a radical reorganization of settlement structure without corresponding changes in technology and tools within the same cultural setting.

The occupation represented by *Cultural Layer III* at *Zaraysk A* contained several — at least three — shallow pit houses, which are characteristic of occupations in the periglacial zone of Eastern Europe during and immediately following the maximum phase of the last glaciation. At this time, a pronounced cultural decline or disintegration may be observed. The reason for the change is — most probably — tied to the changing environmental conditions of this interval.

Chapter 2
Stone artifacts at Zaraysk: Typology

The results from Zaraysk have shed new light on the Upper Palaeolithic of the Russian Plain. More than 100,000 stone artifacts have been recovered from the site. Their analysis and comparative study permits placement of Zaraysk within the framework of Upper Palaeolithic cultures in Eastern Europe. The quantity of stone artifacts has increased substantially during the course of recent excavations — up to 6,000 new items each year, excluding small lithic debris — underscoring the need for a description and characterization of the assemblage. This chapter presents a comprehensive description of the qualitative and quantitative characteristics of the lithic assemblage, including all material recovered from the initial discovery of the site (27 years ago) through the year 2000 inclusive. Formal typological classification of the tools and debris is given, along with a detailed description and statistical analysis of the assemblage.

The primary goal of this chapter is to present a typological analysis of the stone artifact inventory of Zaraysk, which includes the following: (a) review of the methods and approaches used to describe the lithic assemblage with reference to the Zaraysk material; (b) detailed description of the artifacts; (c) application of statistical methods; (d) comparative analysis of stone artifacts with those of other related sites; and (e) analysis of how the Zaraysk assemblage is related to the Kostenki-Avdeevo culture as a whole.

The Kostenki-Avdeevo culture represents one of the most striking phenomena of the Upper Palaeolithic of the Russian Plain. The excavation and analysis of sites such as Kostenki 1 (Layer I) and Avdeevo — over the course of many decades — has been central to the study of the East European Upper Palaeolithic. Although Zaraysk did not appear at first to represent a major discovery in this context, substantive excavation of the site has yielded a body of material that will make a significant contribution to research on the Kostenki-Avdeevo culture and its place within the larger Eastern Gravettian entity. In this chapter, the affiliation of Zaraysk with the Kostenki-Avdeevo culture is demonstrated on the basis of comparative statistical analysis of the artifact assemblage. Accordingly, the geographic area of the latter is expanded significantly to the north and east.

The lithic artifact assemblage from Zaraysk (excluding small debris) contains a relatively high percentage of tools: 10.46% of the total *(Table 26, page 121)*. The percentage of tools in other sites of the Kostenki-Avdeevo culture is comparable: Avdeevo (early excavations) — 11.29%; Avdeevo (new excavations) — 12.4%; Kostenki 1 (Layer I) — 10.9%. Such a high percentage (10—12%) is typical for major settlements *(Diagram 14, page 150)*.

Blades, including bladelets and micro-bladelets, which provide blanks for tool production, represent 17.37% of the total assemblage (i.e., less than one fifth of all items). Primary blade technology was used to produce wide and massive blades, and the majority of tools were made on these "Kostenki blades." Evidence of other forms of technology is absent at Zaraysk, and "Kostenki blade" production is typical for sites

of the Kostenki-Avdeevo culture. Zaraysk exhibits some differences with the other sites, however, which probably reflect its close proximity to raw material sources.

Most chipped stone at Zaraysk represents waste products of tool production, which includes flakes and blade-like flakes. Although a similar pattern is evident at other sites of the Kostenki-Avdeevo culture *(Table 27, page 122),* the highest percentage of lithic waste is found at Zaraysk. The difference between the maximum and minimum percentage in this category is 13.3% (the lowest percentage is found at Avdeevo [new excavations]). Overall, the percentage values are similar, but the raw counts for Zaraysk are 6.8 times higher than Kostenki, 2.75 times higher than Avdeevo (new excavations) — where they exceed 12,500 items — and almost 14 (!) times higher than Avdeevo (old excavations). Furthermore, most waste flakes at Zaraysk are significantly larger than those at the other sites. Again, the pattern appears to reflect the location of the site in close proximity to the source of the raw material; primary flaking was performed at the site, where spatial concentrations of primary lithic waste have been identified (Amirkhanov, 2000, p. 153; Seleznev, 1999; Trusov, 1994, p. 105).

The percentage of blades in sites of the Kostenki-Avdeevo culture ranges between 9.38% and 21.8%. The highest percentage is found at Avdeevo (new excavations), while Zaraysk lies in the middle of the range. The percentage for rejuvenation flakes (Kostenki knives and burin spalls) is not typical, however; they are two times less common at Zaraysk than the other sites, where they are 12—13% of the total. The pattern may be explained in two ways. First, the low value at Zaraysk may be due to the fact that the central area of the site — where rejuvenation flakes are most common — has not yet been fully excavated. Second, the proximity of raw material may have reduced the need to conserve it by frequent rejuvenation of tools; curated tools are more common at Avdeevo and Kostenki.

The techniques employed for tool production are a more appropriate measure of cultural affiliation than the characteristics of the debitage. Kostenki 1 (Layer I); Kostenki 13; Kostenki 18 (Praslov and Rogachev, 1982); Avdeevo (early & new excavations); Berdyzh (Polikarpovich, 1968, pp. 25—36); and Zaraysk reflect a common pattern in terms of tool-making techniques — both methods of primary flaking and tool processing.

Cores and core-parts *(Table 27, page 122)* exhibit almost identical patterns among the sites of the Kostenki-Avdeevo culture (varying by an insignificant 1%). Nevertheless, Zaraysk contains cores that represent all stages of reduction (while the other sites contain much higher percentages of heavily reduced cores).

The percentages of debitage groups are thus similar among sites, and sometimes even identical. Some variation is exhibited by Avdeevo (new excavations), where the percentage of flakes is comparatively low, while the proportion of blades is the highest among the sites. Zaraysk is comparatively low in tool-rejuvenation flakes, as already mentioned. It should be noted, however, that the four stages of occupation at Zaraysk have been lumped together for these calculations, when they actually represent separate occupations (Amirkhanov, 2000; Amirkhanov, Lev, Seleznev, 2001) and should — in theory — be considered separately as in the case of the early and new excavations at Avdeevo. This work is currently in progress.

Turning to the classification of tool types, it should be noted that not all the categories of tools listed in *Table 30, page 132,* represent the same taxonomic level. For example, shouldered and leaf-shaped points are combined into one category of points, while "truncated pieces" is a broad category that subsumes truncated blades. The problem of whether Kostenki knives represent a specific type or should be placed in a higher taxonomic level is still under discussion. It is important, nevertheless, to apply the same classificatory scheme — based on traditional typology — to all the sites that are potentially part of the Kostenki-Avdeevo culture in order to ensure a systematic comparison. This was undertaken *(Table 30, page 132; Diagram 4, page 143)* for the Zaraysk assemblage.

Retouched blades and flakes, which together constitute more than half the tool assemblage (52.14%), are the most common categories *(Diagram 4, page 143)*. Two other common groups are burins and Kostenki knives, which represent a third of the tools. The remaining 18% are distributed among other categories. Only end-scrapers reach 4%; four other categories fall in the range of 2—2.5% and these include points, truncated pieces, tools with rounded and shouldered corners, and combination tools. All the other groups are 1% or less of the tool assemblage.

Kostenki knives are formally placed into the category of knives along with backed knives. However, the characteristics of the Kostenki knives render them a diagnostic type for the Kostenki-Avdeevo culture. Eight varieties of this type are recognized. Kostenki knives often exhibit multiple retouched areas, either at the same end or at two ends with a butt on each end. The maximum number of retouched areas is four. Kostenki knives are sometimes combined with other tool types on the same blank. Combination tools with burins are the most common; somewhat less common are combinations with end-scrapers and tools with a rounded corner. Kostenki knives also may be distinguished on the basis of the formation of the butt; five variations are recognized *(Diagram 6, page 144)*.

There are no fundamental differences between the Kostenki knives at Zaraysk and those of the other Kostenki-Avdeevo sites. The only significant difference lies in the low percentage of double forms. At Kostenki and Avdeevo, double knives substantially outnumber the single forms (Gvozdover, 1998), which is likely a reflection of the more parsimonious use of raw material at these sites. Among the double knives at Zaraysk, few exhibit shortened proportions; the latter are numerous at Avdeevo, where they are considered a separate tool type. Among the combination tools, Kostenki knife-burin types are the most common.

According to the traditional typology, shouldered points are categorized as a separate type. There are four variations of these points based on the presence/absence of a blade and the retouching of the base. Those with flat retouch of the face and/or base on the ventral surface are usually characterized by an elongated shoulder and often — although not always — by a larger blank and represent the first variant. Characteristic features of the second variant are a smaller shoulder and absence of flat retouch on the ventral surface. Most are produced on small straight blades with regular faceting and edges naturally converging to a leaf-shaped termination. In the traditional classification, the two variants are known as "typical" and "atypical" points, respectively, in sites of the Kostenki-Avdeevo culture.

The "classic" Kostenki-Willendorf (Eastern Gravettian) shouldered point is made on a shortened blade, sometimes sharpened and processed with flat retouch on the ventral surface. The haft is wide and its length usually exceeds half the length of the blade. The shoulder is formed by abrupt or semi-abrupt retouching. The base and/or the leaf-like surface are often modified with flat retouch on the ventral side. The edge opposite the shoulder is convex in form and may exhibit flat retouch near both the point and the base.

The "typical" point usually is made on a massive wide blade. The edge opposite the shoulder is arched, while the other edge — shaped by the shoulder of the haft — is straight with abrupt retouch. Flat retouch also shapes the upper portion of the blade, the curve along the edge opposite the shoulder, and the curve of the lower part of the haft. The retouch is usually applied to both the dorsal and ventral sides.

Shouldered points of the Kostenki-Willendorf (Eastern Gravettian) cultural complex vary significantly among sites. The presence of assemblages within this entity that contain only "atypical" points (e.g., Gagarino, Krakow-Spadzista) suggests the existence of different types (Praslov and Rogachev, 1982, p. 54). In a broader context, however, shouldered points may be considered a single type. They may be divided into two categories: those with a base and/or point modification on the ventral surface (with an elongated haft), and those without this feature (and accordingly, with a shorter shoulder).

In addition to shouldered points, the type category of points includes leaf-shaped points. There are two identifiable variants: leaf-shaped points proper and blade points. The latter are diagnostic of the Kostenki-Avdeevo culture. At Zaraysk, both forms are equally represented *(Diagram 8, page 146),* but more than half are fragmentary. Among materials recovered to date, the blade point variant appears to be more common.

Microliths at Zaraysk have been divided into three groups *(Diagram 9, page 146)*. The groups are based on the correlation between the presence/absence of retouching of the edges and the end, and the character of the retouching. The groups include: truncated backed bladelets (Group 1); backed bladelets without retouching of ends (Group 2); and unretouched truncated bladelets and micro-bladelets (Group 3). These groups may be further sub-divided.

The microlith component in other sites of the Kostenki-Avdeevo culture comprises between 8.5% and 10%. The classification of these items at Zaraysk will be expanded as they increase — at present they are only 1% of the tools. It is already apparent, nevertheless, that all the microlith forms found at Zaraysk are represented at Kostenki and Avdeevo. The proportion of bladelets used for their production is similar for all sites. With respect to production techniques, however, retouching and truncation of ends with trimming of the ventral side, as on Kostenki knives (see Gvozdover, 1998, p. 271), has yet to be documented here.

Burins are one of the most numerous tool types in the Zaraysk assemblage. They manifest a variety of forms and their classification has required an elaborate typological framework with 27 variants at the lowest level of the scheme. In addition to the traditional focus on the method used to form the butt for further burin spalls, attention was accorded to the shape of the burin tip and other features. In sites of

the Kostenki-Avdeevo culture, burins are either the most common or second most common tool type (22.9—15.3% of all tools).

Within this diverse type category, the principal sub-categories of burins (following M. D. Gvozdover) are distributed uniformly among the sites *(Diagram 16, page 152)*. Dihedral burins are the most common, followed by angle burins, and burins on a truncation. As already noted, the varieties of burin at Zaraysk are more numerous and include lateral, lateral-retouched, burins with a rounded edge, and with a flat transverse spall (exhibiting a diagnostic feature of the edge). According to the author's observations, however, all these forms are present at Kostenki 1 (Layer I). Also in the Zaraysk assemblage are two groups of burins with a rounded edge, burins with a ventrally-displaced edge, and dihedral burins with a pointed corner edge. The last of these are undoubtedly present at Avdeevo, as well. The wide variety of burin forms is therefore probably not unique to Zaraysk, but reflects a pattern found in the Kostenki-Avdeevo vulture as a whole. This hypothesis should be tested with more research on the burins at the other sites.

End-scrapers are significantly less common than burins among the sites of the Kostenki-Avdeevo culture. They range from 1% to 6%. At Zaraysk, end-scrapers represent 4.3% of tools. They exhibit considerable variety, although less so than the burins. A total of 14 different sub-types based on the thickness, width, and qualitative features of the working area were defined. Most end-scrapers at Zaraysk are made on massive blades *(Diagram 11, page 147)*. Among the defined types are end-scrapers with a nose, with a shouldered edge, and with a narrowed and highly convex working area, as well as carinated scrapers and adopted scrapers. All of these forms, including the last, are found in other sites of the Kostenki-Avdeevo culture (Beliaeva, 1979, pp. 95—103). Their presence and proportional representation serve as an index of cultural affiliation among the sites, along with the diagnostic items (fossile directeurs). Reflecting common end-scraper production techniques among the Kostenki-Avdeevo sites are diagnostic spalls in the form of flat retouch removals — struck from the working edge — off the ventral surface. Although rounded end-scrapers, which are known at Kostenki and Avdeevo, are thus far absent at Zaraysk, they may turn up during future excavation.

Side-scrapers and side-scraper-like tools are present in all major sites of the Kostenki-Avdeevo culture. Their percentage ranges from 0.2% to 1.1%. At least a few dozen of these tools have been recovered from each site, which suggests that they are not simply accidental products of stone working (i.e., they represent a defined tool type).

Borers are known only from Zaraysk and occur in small numbers (0.05% of the tools). They are two elongated borers with symmetrical tips in the materials excavated during 2001, which have not been included in the statistical analysis. At other Kostenki-Avdeevo sites, borers range from 0.8% to 1.1% of the total tools. Elongated borers are present at both Avdeevo and Kostenki 1 (Layer I), where there are also borers with tips shaped by alternating edge retouch.

Points in the Zaraysk assemblage can be accommodated by the existing classificatory framework developed for Kostenki 1 (Layer I) (Beliaeva, 1979b, pp. 109—

114). Their representation varies between 1.3% and 4.55% among the among the Kostenki-Avdeevo sites with the lowest and highest percentages at Avdeevo (early versus new excavations). Zaraysk falls in the middle of the range (2.1%); Gravette and beak-shaped points are absent.

As already noted, truncated pieces are not considered as a separate category at Zaraysk. This category traditionally includes several tool types, which are further sub-divided on the basis of the presence or absence of retouching of the end. At Zaraysk, these tools account for 2% of the total. Many are represented by blades with a truncated end, which are known at other Kostenki-Avdeevo sites, where they range between 0.8% and 2.6%.

Naturally-baked knives constitute 0.5% of tools at Zaraysk. They are tools that possess a natural backing of limestone cortex or a vertical/beveled edge. Their presence on other Kostenki-Avdeevo sites needs to be confirmed.

Retouched flakes (including blade-like flakes) represent 23.28% of the tools at Zaraysk and, when added to retouched blades (28.86%), the combined categories comprise 52.2% or more than half of the entire tool assemblage. This is a comparatively high percentage, and it is also found at Kostenki 1 (Layer I) and Avdeevo (14.7—31.4%). Among the assemblage recovered during the new excavations at Avdeevo, they represent the most common category, as at Zaraysk. Retouched blades are sub-divided into two groups on the basis of the retouch: blades with fine regular retouch, usually on a portion of the dorsal edge; and blades with intensive sharpening retouch forming an edge *(Diagram 10, page 146)*.

Notched pieces at Zaraysk (0.83%) include flakes and blades that possess a retouched notch. They are found along with retouched flakes and blades at the various Kostenki-Avdeeevo sites that probably do not represent a defined tool type.

Tools with a rounded corner and a shouldered corner occupy a significant place in the Zaraysk assemblage. Their combined percentage is 2.5%. The author has observed both forms in the Kostenki 1 (Layer I) assemblage. However, their overall representation in the Kostenki-Avdeevo sites is unknown, because they have only recently been recognized as a diagnostic type at Zaraysk.

Combination tools at Zaraysk are 2.68% of the total and include 13 types *(Diagram 12, page 148)*. At Kostenki and Avdeevo, the percentage of combination tools is 3% and 7.4%, respectively. The pattern of combination tools is similar among the sites. Combinations of Kostenki knives and other types — especially burins — are the most common (Gvozdover, 1998, p. 271). At Zaraysk, combination burin-scrapers are also common.

For summary comparison, the numbers and percentages of stone tool types among Avdeevo (early excavations), Avdeevo (new excavations), Kostenki 1 (Layer I), and Zaraysk are presented *(Diagrams 13, 14, pages 149, 150)*. The assemblage from Zaraysk represents an adequate sample of lithic material illustrating the full array of techniques for primary production and secondary processing. Although the site has not been fully excavated, the assemblage recovered to date exceeds those of the other Kostenki-Avdeevo sites in terms of tools and unretouched artifacts.

All of the diagnostic stone tool types of the Kostenki-Avdeevo culture are present at Zaraysk. Nearly all other categories of tools also are present. Comparative analysis of the technology and typology reveals a similar pattern with only minor differences at Zaraysk and the other sites of the Kostenki-Avdeevo culture *(Table 27, page 122; Diagrams 13, 17, pages 149, 152)*. Some differences may be accounted for by the close proximity of Zaraysk to the sources of lithic raw material, reflected by the primary production that took place at the site. Most of the tools exhibit a wide range of variation within the previously defined type categories. Especially noteworthy is the variation within the burins and end-scrapers. These types have not been viewed traditionally as particularly characteristic of the Kostenki-Avdeevo culture, but the range of forms present in the Zaraysk assemblage is not confined to this site. Most are present in the Kostenki 1 (Layer I) assemblage, and at least some of them are found at Avdeevo. It has long been apparent that Zaraysk is part of the Eastern Gravettian complex (or Kostenki-Willendorf cultural entity); the analysis presented here demonstrates a more specific regional affiliation with the Kostenki-Avdeevo culture.

The author has developed a system for the description and classification of the lithic artifacts at Zaraysk that can be applied to new materials as they accumulate during future excavation of the site. The same system may be applied to other sites of the Kostenki-Avdeevo culture in order to provide a higher level of resolution to the analysis of these assemblages. This system may also help differentiate multiple stages of the Kostenki-Avdeevo culture at the site (i.e., different episodes of occupation by bearers of the same cultural tradition). Differences have already been recognized in the upper layer of occupation relative to the earlier occupation episodes (Cultural Layers I—III) with respect to raw material selection and the spatial distribution of remains. Comparative analysis of the lithic assemblages from the various occupation levels may also reveal some significant differences.

Chapter 3
Worked Bone at Zaraysk: Technology and Function

Zaraysk is among those Upper Paleolithic sites of the Russian Plain that contain a rich inventory of worked bone objects. The material described here was recovered from horizons that belong to the second stage of occupation *(Cultural Layer II)* at *Zaraysk A* and represent the most important group of Upper Paleolithic bone objects at the site. The latter are typical for a habitation complex of the Kostenki-Avdeevo culture. At *Zaraysk A,* slightly more than half of the occupation area had been excavated by 2005.

Methods used for the study of worked bone objects included micro- and macro-analyses developed by the experimental-microwear school at the Institute of the History of Material Culture, Russian Academy of Sciences (IIMK RAN) in St-

Petersburg. Also used were observations of one of the authors of a paper on experimental research on worked ivory and bone.

Worked bone artifacts related to the first and third stages of occupation were not numerous (7 and 9 objects, respectively). They did not provide much information on the technology of the bone industry. Nevertheless, the results of their analysis indicated that the techniques of primary production of bone and ivory objects were the same as those used to manufacture the larger sample of materials representing the second stage of occupation.

Four objects from the first occupation stage were produced on mammoth ivory. They include the bison statuette, a decorated rod, an object in the form of a sculpted representation of a metapodial, and an object in the form of a truncated cone. Also present is the only example of an awl at Zaraysk, made from the ulna of a small mammal. Production techniques confined to this occupation stage include drilling and shaping a piece of ivory into a truncated cone.

Among the ivory objects recovered from the second stage of occupation at Zaraysk are four points, a mattock, and a polisher. Another polisher and two shovel-shaped objects were produced on mammoth rib. Also found were retouchers and fragments of flat bone with traces of wear. Undoubtedly important for understanding the character of bone working techniques at Zaraysk is the technological and microwear analysis of the two known female sculptures.

Despite the lack of complete excavation and corresponding limitations on the analysis, the bone inventory from *Zaraysk A* yields some valuable information. As in other Eastern Gravettian sites, the principal raw material was mammoth tusk and rib. Primary production methods at Zaraysk are similar to those observed at other sites of the Kostenki-Avdeevo culture.

The principal production techniques included linear and transverse flaking, transverse blows for preliminary cutting, cutting with the corner of the proximal end of a stone blade, cutting with a chisel-like edge, sawing, and planing. Objects were fashioned primarily through planing, shaving, a technique known as "pressure-planing," and application of abrasives (of varying hardness), including stone for polishing the surface.

The transverse sectioning of mammoth tusk was initiated with a groove, which exceeded 5 cm in diameter and extended around the circumference of the tusk. The tusk could be severed along the groove with a blow applied with a small wedge. Thin tusks were severed with shallow grooves, and in these cases negative scars are typically transverse. The sectioned tusk yielded two units of ivory from which were removed long blades and other blanks used in turn for the production of objects. Tusk fragments in the shape of cylinders and cones are well represented in the assemblage. Traces of the removal of long flakes that could be used for shaping complex objects (e.g., statuettes) are visible.

The principal blank produced from mammoth rib was a blade, removed by wedging into previously cut grooves. From the blades were prepared shovel-shaped implements and polishers. Transverse planing was used to round the ends, and pressure-planing was used to create deep lateral grooves.

The diaphyses of ungulate and small-mammal long-bones were extracted by sawing off the proximal and distal ends or epiphyses. The intentional breaking of flat bones from large mammals (e.g., mammoth) also provided material for artifact production.

The bone inventory from Zaraysk contains five decorated pieces of mammoth tusk derived from the second and third stages of occupation. One of these tusks is decorated with an "oblique net" pattern formed by long cross-hatching lines, which is a tradition in the Kostenki-Avdeevo culture. Another recognized type of decoration comprises rows of cross-hatched lines of varying shape and size covering virtually the entire tusk in the form of a spiral. Especially noteworthy is a checker-board motif, which is a diagnostic pattern of decoration at Zaraysk.

A mammoth scapula exhibits decoration on the articular surface, which is covered with numerous cross-hatching incisions extending the full length of the surface. The lines intersect almost at right angles creating a grid pattern, the longitudinal curved incisions also aligned with the long axis of the articular surface.

Analysis of the fracture patterns and physical alterations of the bone artifacts, blanks, and production waste recovered from the second level of occupation indicates that both fresh and old (weathered) bone and tusk of mammoth were used. For the manufacture of small rod-like and blade-like implements, layers of ivory removed from a tusk were the primary raw material. We suggest that for the production of statuettes, on the other hand, better quality ivory was used. In the third occupation level, most large fragments of ivory extracted from the teeth and tusks lack traces of secondary working. The analysis of the blanks, production waste, and performs indicate that processing of raw material and production of ivory objects took place at Zaraysk; the same is true for the working of ribs, long-bones, and flat bones of mammoth.

The technological and functional analyses of the materials from Zaraysk reveals the wide range of bone and ivory production activities at the site. At the same time, they underscore an absence of bone tools related to working hides (excluding isolated hide polishers) and points. It is possible that other materials (stone and/or wood) were used to make such implements. And it is interesting to note that at a site containing numerous pits, there are no bone tools that exhibit traces of digging (i.e., sediment abrasion).

The similarity of the worked bone and ivory at *Zaraysk A* to the materials from Kostenki 1 (Layer I) and Avdeevo is manifest not only in the technology but also in the typology. The most similar items among these sites are the female statuettes and shovel-shaped objects *(lopatochki)*. The Kostenki-Avdeevo culture is characterized by a broad application of techniques for grinding and polishing with abrasives of varying degrees of hardness. By contrast, the working of bone with stone abrasives is not characteristic of other cultures of the middle and late Upper Palaeolithic on the central Russian Plain. Items common to sites of the Kostenki-Avdeevo culture include female statuettes, shovel-shaped objects, mattocks, polishers (or burnishers), rod-like points, and arctic fox teeth cut from both sides and perforated. The similarity also is manifest in the decorative motifs used to ornament objects, which include "nets," "oblique nets," and "oblique crosses."

The assemblage from *Zaraysk A* illustrates continuity in the bone industry during first two stages of occupation at the site. The similarity is evident first of all in the techniques used for bone-working. Even more significant are the diagnostic decorative patterns, which reveal cultural uniformity in the archaeological stratigraphy of the site. The study of bone-working technology and bone objects at Zaraysk enhances our understanding and knowledge of the material culture of the Kostenki-Avdeevo sites. More broadly, it improves our understanding of the middle Upper Palaeolithic of the Russian Plain.

Chapter 4
Art Objects from Zaraysk

In addition to the engraved pieces described above, Zaraysk yielded three figurines; the carved image of a hare or arctic fox metapodial made from mammoth ivory; an engraved image of mammoths on a fragment of a mammoth rib; a necklace comprising 41 teeth of arctic fox; and isolated teeth of arctic fox with perforated roots.

During the 2001 excavations, the ***figurine of a bison*** made from mammoth ivory was recovered from Zaraysk. In comparison with known Upper Palaeolithic sculptures from Eastern and Central Europe, this piece of figurative art not only represents a highly expressive and original creation and reflects a high level of artistic skill, but is also notable for its size and the fact that it was found in a stratified context. The description that follows contains only preliminary information about this find.

The figurine was found on a platform at the base of a storage pit of dimensions typical for sites of the Kostenki-Avdeevo culture. The pit was 60 cm deep, with an upper diameter of 55—70 cm and a lower diameter of 87—90 cm *(Figures 3, 4, pages 292, 293)*. In terms of its spatial and stratigraphic context, the pit is associated with the central line of former hearths on the lowest occupation level of the site, which is dated to about 22,000 years BP. At the time of its discovery, the figurine seemed to be reasonably well preserved. No holes or obvious deformations were observed. The only obvious defect was that both left legs of the bison had been broken off. The character of the fracture surfaces and the absence of broken leg fragments in the pit, suggested that the damage had occurred before the figurine was placed in the pit.

The bison figurine exhibits another form of damage that consists of multiple hollows with irregular edges concentrated in the area of the chest on the left side of the animal. The impact scars can be identified as the result of strong blows made by a sharp, solid subject. Also of interest are traces of paint on various parts of the figurine's surface. First and foremost, red-ochre paint can clearly be seen in the chest area on the right side. In addition, irregular areas of black pigment in the form of small paint dabs are spread over the entire surface of the figurine; these

reflect the application of manganese salts. The measurements of the figurine are as follows: length = 16.4 cm; height = 10.4 cm; and maximum width (stomach) = 3 cm. The length : width ratio is 1.6 : 1, which coincides with the body proportions of an adult bison.

The most striking characteristic of the Zaraysk figurine is the naturalistic style. The representation of animal body as a whole, as well as the majority of the body parts, are rendered with extreme realism. Each part complements the others and none is overemphasized. The anatomical proportions of the body are correct and the pose of a standing animal is a natural one. There is, nevertheless, some stylization of parts. The tail and an udder are depicted in a conventional manner. The hooves are not sculpted in detail. The body hair is absent, although the forelock, mane and beard on the neck are engraved.

One rather remarkable feature is the complete separation of the legs. Significantly, this is not a primitive attempt to show legs partly separated, with each leg still tree-like, which is typical for Upper Palaeolithic sculptures with combined legs. From this perspective, the Zaraysk figurine represents an artistic advance in comparison with the portable art from the early Aurignacian layers of caves such as Vogelherd and Geissenklösterle (more than 32—30,000 years BP) in southwest Germany. Comparison with the most significant figurine in this case — the mammoth from Geissenklösterle — is particularly indicative.

To sum up, the uniqueness of the Zaraysk figurine lies in its combination of naturalism or realism in the representation of the animal as a whole with the stylization of some parts (which were of minor importance for the identification of the species represented). Another important feature is the inclusion of decorative elements in a piece of figurative art. These elements, which are common in other forms of fine art (ornamentation, painting), can be found in some of the details (beard, mane). But they also are represented by other means. The artistic syncretism is supplemented by partial colouring of the figure. However, this does not necessarily involve enhancement of the work's artistic expressiveness; it may have served rather to add verisimilitude to events when the figurine was playing a role in ritual ceremonies.

In the context of evolutionary frameworks developed in Western Europe for Upper Palaeolithic art, we feel that the Zaraysk bison figurine can be assigned to the second ("Solutrean-Magdalenian") stage of H. Breuil, or the first phase of the fourth (classic) style of A. Leroi-Gourhan. In terms of a similar scheme developed for Central and Eastern Europe, it fits into the stage of naturalistic Epigravettian art in Eastern Europe. Regardless of which scheme is chosen, the Zaraysk figurine has established that this art style was present several millennia earlier than previously thought.

Female figurine No. 1 was found in a storage pit (No. 116) located in the centre of a large occupation complex of typical Kostenki-Avdeevo form and dating to the second stage of habitation. The pit is situated in the space between the central line of hearths and the internal contour of the oval formed by deep depressions *(poluzemlyanki) (Figure 1, page 289; 17, page 322)*. The figurine was found lying horizontally on its back, with the legs adjoining the wall and the head oriented towards the centre of the pit. Roughly 3—4 cm north of the figurine's head was a lens of red ochre

measuring 11 cm in length and up to 4 cm in width *(Figures 14, 15, pages 320, 321)*. Beneath the figurine and extending southwards was a lens of light fine-grained sand. The figurine had been carefully placed in the pit when it was about one-third full of sediment. The pit apparently was covered by a mammoth scapula at the same time.

The measurements of the figurine are as follows: height = 16.6 cm; width at the shoulders = 4 cm; width at the waist = 5.1 cm; width at the hips = 5.5 cm; thickness at the shoulders = 3 cm; thickness at the waist = 4.3 cm; thickness at the hips = 4.4 cm. The correlation of the length of the body to the length of the legs is 8.6 cm to 7.6 cm. The figurine's overall preservation is poor. Its head and legs are the best preserved parts; they exhibit traces of polish. The head is particularly accurate in shape; it was rendered with short, regular vertical cuts. The figurine is typical of the "Avdeevo style" of such objects.

Female figurine No. 2 is an unfinished, presumably female statuette. Like the first one, it was found in a typical Kostenki-Avdeevo storage pit (Pit No. 117), situated near the pit that contained the other figurine. This pit also was covered with a mammoth scapula. The figurine was found lying horizontally in the southern portion of the pit. It was oriented parallel to the side of the pit, lying on its back with the head pointing east, nearly adjoining the wall *(Figure 17, pages 322)*. Deposited 3—4 cm north of the head was a patch of red ochre. Under the figure and extending slightly to the south was a thin lens of light fine-grained sand. The figurine was lying 2—3 cm above this sand lens.

Although preservation of the external surface was better than that of the first figurine, the structure of the material was damaged. It is difficult to assign this figurine to a defined stylistic group due to its unfinished character. However, the profile and proportions of the body suggest that it is similar to the "Avdeevo style."

Another noteworthy art object is a small fragment of a thin ***tubular bone*** (presumably bird) ***with engraving*** (also from Pit No. 117). The engraving probably was performed with a sharp angular flint tool. The ornamentation is in the form of oblique cross-hatching *(Figure 24, pages 331)*. The fragment was part of a larger object decorated with longitudinal ornamentation. In the Kostenki-Avdeevo culture, ornamentation of this type is found on the handles and upper parts of spatulas, needle-cases made from the long-bones of birds, bracelets, zoomorphic "fibulas" ("pins"), and sometimes large bone points.

The Zaraysk site yields an example of the use of ornamentation on another category of object, previously unknown in the Kostenki-Avdeevo culture. ***The object is of mammoth ivory in the shape of a truncated cone*** with a narrow, vertical perforation through the centre *(Figure 25, pages 332)*. The top of this truncated cone is 22 mm in diameter; the diameter of the base is 37 mm. The oblique cross-hatching decoration is applied on the edge of the round platform that forms the top of the item. The ornamentation is fine and dense, with the crosses mostly touching each other. The function of this decorated object remains a puzzle. There are no direct analogies in other Upper Palaeolithic sites, except for one particular not published object from Kostenki 1, Layer I, Complex 2, excavations by N. Praslov.

The only example of figurative engraving at the Zaraysk site was unearthed in the centre of the sediment filling of Pit No. 117 near the location of female figurine No. 2. The engraved object is a fragment of mammoth rib, 18 cm in length. The carving covers a small area on its flat surface — only 3 cm in length and 2.5 cm in width. The carving is thin and shallow, and not readily observable. Nevertheless, the principal lines are clear; they were made by confident, continuous movements. There is a certain hierarchy in the intensity of the lines. The lines that form the primary contours of the image are wider and deeper while those relating to the details are less noticeable. The images of three overlapping mammoths, from left to right, are visible *(Figures 26, 27, pages 333, 334)*. The figures are partial. In each case, the external contours of the trunk and head, the back, and apparently the tusks, are depicted.

Stylistically and artistically this image corresponds to the second style of Upper Palaeolithic art in the scheme of A. Leroi-Gourhan (Leroi-Gourhan, 1995). Besides the figurative part, there are two groups of lines forming "tufts" on the engraving. Both tufts are oriented towards the heads of two of the depicted mammoths. There is clear damage on the images; they exhibit a series of holes with irregular edges, which might be the result of direct piercing with a sharp tool. There is a clear relationship between this damage and the engraved area. There are no traces of piercing on the rest of the surface, although it is six times as large as the engraved area. Thus, the engraved image from Zaraysk, along with the bison figurine, provides another likely example of the use of art objects for magical purposes.

The finds described above enrich the inventory of Upper Palaeolithic mobiliary art and broaden the known distribution of specific types of art objects in the East European Upper Palaeolithic. In terms of the splendour and variety of its art pieces, Zaraysk is on a par with such famous sites as Kostenki 1, Avdeevo, Gagarino, and Khotylevo 2.

Chapter 5
Isolated Human Tooth from Cultural Layer II at Zaraysk

An isolated human tooth was recovered from the second cultural layer which dates to 23,000—20,000 years BP (Amirkhanov, 2000; Amirkhanov, Lev, 2007). The tooth was found at the base of a large pit (Pit D in unit I, D-10, 13) classified as an "earth-dwelling" *(poluzemlyanka),* which is a common feature in sites of the Kostenki-Avdeevo culture.

The Zaraysk human tooth comprises a worn crown and a broken root *(Figure 5, page 345)*. The destruction of the root is due in part to resorption from the incoming permanent tooth (Bass, 1995). The tooth was therefore lost antemortem through the process of dental development.

The crown has a labiolingual diameter of 4.9 mm, a mesiodistal diameter of 5.9 mm (maximum diameter of the surviving portion), a mid-labial height from the

cervix of 3.1 mm, and a mid-lingual height of 2.0 mm. All of these dimensions have been affected by attrition or postmortem destruction. The angle of attrition is more severe on the lingual surface, indicating that it could be an upper tooth.

The diameter of the root at the cervix is 4.1 mm labiolingually and 4.0 mm mediodistally, which represents a rounded shape. The tooth is too small and constricted at the cervix to be a permanent human incisor or canine. Both the size of crown and the rounded shape of the root fit best with patterns seen in deciduous upper teeth. The mesiodistal diameter exceeds the labiolingual diameter and the crown is oval in cross-section, so it most likely represents a deciduous incisor. The asymmetry of the crown with a tendency to roundness of the distal margins suggests a lateral right upper incisor (Zubov, 2006).

The tooth exhibits full development of the crown and at least 1/5 of the root remains after resorption. The degree of wear on the crown and the root resorption suggest that this incisor had gingivally erupted. Given patterns in dental development among human groups, this would place the individual at 7—8 years, which is the median age of upper lateral incisor eruption in several modern populations (Dobryak, 1960; Bass, 1995). There is no evidence for enamel hypoplasia or a pathological condition like caries.

Metrically, the labiolingual and mesiodistal diameters are close to those of a deciduous right lateral incisor from Upper Paleolithic Pavlov 1 (individual 16), which was measured by E. Trinkaus (Sladek et al., 2000). Both are close to measurements on Upper Palaeolithic teeth from Cisterna, Italy and Le Peyrat 1, France, and contrast with modern deciduous incisors, and especially teeth associated with the Middle Palaeolithic *(Figure 6, page 348)*. Upper Palaeolithic teeth exhibit a reduction of labiolingual and mesiodistal diameters in comparison with those of the Middle Palaeolithic, and modern populations reflect reduction of the mesiodistal diameter in comparison with Upper Palaeolithic samples. The trend towards reduction of the mesiodistal diameter at the end of Upper and beginning of the terminal Upper Palaeolithic (sometimes Mesolithic) was described by D. Frayer (1977) with samples of permanent teeth. Thus, the pattern among both deciduous incisors from Upper Paleolithic sites in Europe illustrates — at least to a marginal degree — the trend towards reduction over time.

Chapter 6
Archaeozoological Studies at Zaraysk

Zaraysk occupies a special place among Upper Palaeolithic sites of Eastern Europe as one of the northernmost settlements of the Last Glacial Maximum. It also occupies a special position with respect to the complexity of analysis and interpretation of data related to the economy of its inhabitants. This chapter presents the results of zooarchaeological, taphonomic, morphological, and stable-isotope analyses of the mammalian remains recovered from each cultural layer.

From the area designated as Excavation Area 4 (244 square meters), excavated during 1996—2005, a total of 1,289 bones and teeth of mammals was recovered. Among the total, 352 fragments could not be assigned to a specific taxon.

The mammalian fauna of Zaraysk comprises species that belong to the Mammoth Fauna Complex, and specifically, to the Arctic Subcomplex of the Late Pleistocene. The species diversity of the site fauna is relatively low. Ten species, representing five mammalian orders, are present: lagomorphs: hare *(Lepus sp.);* rodents: ground squirrel *(Spermophilus sp.)* and lemming *(Dicrostonyx sp.);* carnivores: wolf *(Canis lupus L., 1758),* arctic fox *(Alopex lagopus L., 1758),* bear *(Ursus arctos L., 1758),* and wolverine *(Gulo gulo L., 1758);* proboscideans: woolly mammoth *(Mammuthus primigenius Blum., 1799);* artiodactyls: reindeer *(Rangifer tarandus L., 1758)* and steppe bison *(Bison priscus Boj., 1827).*

Bones and teeth assigned to mammoth represent 62.6% of all the mammalian remains recovered at the site. Remains identifiable to other mammalian taxa comprise 10.56% of the assemblage, and unidentified fragments are 26.8% of the total. Among the unidentifiable fragments, the majority (roughly 80%) probably belong to mammoth. Mammoth predominates in all occupation levels at Zaraysk. The greatest diversity of species is found in the second and third occupation levels.

The preservation of mammoth bone at the site is poor. Many fragments cannot be assigned to specific parts of the skeleton. The bones exhibit a gray colour and surficial cracking of the outer bone layers, and some represent heavily weathered pieces. A large number of isolated mammoth tooth fragments are found in the upper cultural layer.

All crania, mandibles, and tusks have been subjected to significant deformation. The remains of other mammals in all cultural layers possess a dark brownish colour and are much better preserved.

The representation of skeletal parts of mammoth is similar in all occupation levels, although skeletal-element percentages vary. Tusks, crania, mandibles, isolated teeth, and ribs dominate in all levels. Long-bones are comparatively scarce, and vertebrae are virtually absent, along with the bones of distal extremities (metapodials, carpals, tarsals, and phalanges).

Comparison of principal morphometric parameters for mammoth teeth from Zaraysk with specimens from Kostenki 1 (Layer I), Kostenki 2, Byki 1, Sungir', Rusankha, Avdeevo, Berdyzh, Yurovichi, Eliseevichi, and Dolni Vestonice yields similar values. They are within the range of variability for Late Pleistocene Mammuthus primigenius of the East European Plain. For the M3/m3: enamel thickness = 1.5—2.0/1.2—2.0; number of lamellae = 9—11/11.5—12 (Mashchenko et al., 2003). The similar values for the specimens from these sites probably reflect the presence of a single population, or gene flow among several local populations, during this time period (23,000—17,000 years BP) in central Russia.

Data collected from the mammoth remains at Zaraysk indicate that different age groups are represented. However, in all layers, with the exception of two remains of very young animals in the second and third levels, and two remains of young animals from the third and fourth levels, only adult mammoths are present. Bones and teeth of other mammals — with the exception of a wolf phalanx — all represent adults.

An analysis of the spatial distribution and microstratigraphic context of the faunal remains in relation to the cultural features (pits, hearths) and natural features (frost wedges) indicates that the same pattern of skeletal representation for mammoth is found in all levels of the lower layer. However, there are variations within the levels with respect to the provenience of the skeletal parts. In the first and second levels, bones are deposited primarily in the pits and frost wedges, and few remains are found outside these features. In the third level, most of the bones were found in the area of the large depressions or pits; bones in smaller pits and in the areas outside the pits were less numerous. In the upper cultural layer, bones were deposited only in the areas between the pits.

Stable-isotope analysis of mammoth bone from Zaraysk yields $\delta^{13}C$ values between -17.6 and -22.2 (vs VPDB). $\delta^{13}C$ values increase from the first to the fourth stage of occupation. The stable-isotope data reflect a diet of grasses and chenopods, which were widespread on the periglacial landscape, as indicated by the pollen-spore data (Shilova, 2000). They also suggest that animals in the lower cultural layer (22,000—19,000 years BP) were exposed to colder climates than those of the upper cultural layer (16,000 years BP).

The number of bones that exhibit traces of damage inflicted by humans is low in the first and third levels. However, the second level yielded bones that reflect not only heavy utilization, but also butchering. According to one of the authors (N. D. Burova), a mammoth hyoid bone exhibits oblique cut-marks that probably were made during removal of the tongue. Another possible indication of butchering was observed among a group of various skeletal parts found in a large pit that were covered with a clayey calcium-rich layer, which often forms in the presence of high local concentrations of organics.

Also present are traces of damage from the use of bone as raw material. These include old fractures and abrasions from the scraping of soft substances to prepare fresh bone for other uses, and negative flaking scars. These types of damage indicate that the bone was used when fresh (see Bonnichsen, 1979; Shipman, 1981). The cold and moist climates of this time period created ideal conditions for long-term preservation of animal flesh and bone-both for those that died of natural causes and those that were killed by human hunters. At Zaraysk, fresh mammoth bone may have been obtained from kills, as well as from natural mortality. The heavy use of bone at the site reflects in part no doubt the availability of fresh bone (i.e., bone with high organic content).

The remains of arctic fox, wolf, and wolverine evidently are related to the procurement of furs. The skeletal representation for these taxa indicates that this was the primary reason for hunting and/or trapping them. Phalanges, metapodials, carpals, and tarsals are found in anatomical order, along with some long-bones that sometimes are removed with the hide and subsequently extracted for other uses. Several metapodials exhibit abrasions from scraping with soft materials, which may have been caused as they were separated from the hide. On the second and first occupation levels were found several third phalanges (claws), which typically remain attached to the hide, suggesting that skins were taken from the site.

The skeletal composition of the mammoth remains at Zaraysk is consistent with the argument that these bones and tusks were collected for various uses by its inhabitants, but does not exclude the possibility that this taxon was being hunted. In all cultural-stratigraphic levels, the same skeletal parts are present, the majority of which possess little food value and belong to adult animals. In contrast to mammoth, the remains of the small and medium carnivores are easy to interpret. The skeletal-part representation of arctic fox, wolf, and wolverine suggest that these taxa were sought primarily for their furs, which were processed and then removed from the site.

With respect to the seasonality, the bones of a wolf with an estimated age of 7 months recovered from the second cultural layer at Zaraysk suggests late fall or — at the latest — early winter occupation.

Chapter 7
The Archaeozoology of Zaraysk and the Biology of the Woolly Mammoth

The interpretation of mammoth bones in Palaeolithic sites, as well as the general relationship between humans and mammoths, continue to be a subject of debate. The quantity of mammoth bones in Upper Palaeolithic sites often numbers in the thousands, and a variety of explanations are offered to account for them. There are two major hypotheses. The first hypothesis is that the large accumulations reflect the hunting of a major game species, sometimes in mass kills. The other major theory is that they represent the collection of bones and tusks — for use as raw material — from natural accumulations.

The Russian Plain archeological sites yield remains of mammoth and other mammals characteristic for the Mammoth Fauna. The estimated minimum number of individual mammoths varies from site to site, but typically is no less than 25—30. Mammoth remains dominate the assemblage at Zaraysk and comprise a variety of skeletal parts. In this chapter, we explore the hypothesis that mammoth was the principal game animal of the site's occupants, drawing on knowledge of the biology of this species.

Existing data on the woolly mammoth and its relative the Columbian mammoth of North America suggests a population structure similar to that of modern elephants. Differences between the ecology and behavior of the woolly mammoth and modern African and Asian elephants likely reflect adaptations of the former to the extreme climatic conditions of the Holarctic during the Late Pleistocene. Family groups of females and subadults probably were relatively sedentary within small territories (family territories) during summer, but migrated constantly over large territories during winter when food resources were scarce. The limiting factors likely were the productivity of the Late Pleistocene vegetation communities, the energy demands on an

animal foraging to support daily nutritional needs, and the availability of water and mineral resources throughout the year.

Analyses of landscapes and vegetation in Eastern Europe indicate that it was probably 2.5—3 times less productive than the modern plant communities within the range of modern elephants. Ecological conditions in Eastern Europe during the Late Pleistocene suggest that woolly mammoth was not abundant anywhere and probably lived at population densities of less than 100 individuals per 1,000—2,000 square km.

Moreover, plant foods consumed by mammoths apparently were dispersed in mosaic vegetation communities that required wider foraging movements and increased energy consumption relative to modern elephants. The most productive areas probably were river valleys, where foraging costs were reduced.

The area necessary for the survival of one family group comprising 20—25 individuals probably ranged between 2,500 and 3,000 square km. In the Zaraysk area, where the width of the river valley is less than 12 km, the territory of a mammoth family group might have extended from the site up to 200 km along the river in each direction. To account for the accumulation of bones at the site, it would be necessary to procure several family groups. Modern data on hunting and butchering of large mammals by foraging people (South African Bushmen) indicate that the maximum distance between a kill site and camp is no more than 35—45 km. Over this distance, only the meat can be transported. The transportation of bones, or animal parts butchered hundreds of kilometers from Zaraysk would have been impossible, for the site's occupants without four-wheel-drive pickup truck.

The mammoth rate of reproduction apparently exceeded that of modern elephants, and individuals matured at a younger age. However, even with these advantages, the slaughter of an entire family group would have created a temporary void in the local territory for at least 5—7 years and possibly more. After such an event, the site's occupants either would have had to radically alter their hunting strategy, procuring other large mammal species, or continue hunting mammoths by moving their own territory some distance every 1—1.5 years (i.e., after each successful mass slaughter).

The quantity of mammoth bones and the identified gender and age of animals that potentially represent at least 3—4 family groups at each archaeological site, suggests the non-selective death of a large number of mammoths. At Zaraysk, a negligible number of infants and sexually immature animals were encountered. Among the estimated 25—30 individuals recovered from the site, only one juvenile was present.

During winter, mammoth survival depended on constant migration over a vast territory. Under especially severe conditions, families might have been dispersed into smaller groups composed only of a mother and her 1—3 calves. Mammoth procurement during winter — probably far away from camp — would have been extremely difficult or impossible.

Another significant factor in mammoth winter survival was the availability of running (i.e., unfrozen) water, usually springs, which were common along river valleys. On average, an adult mammoth must have consumed over 120 liters of water each

day. With the temperature below 40°C, intake of ice and snow by an animal over 4 tons would compromise thermal regulation and lead to irreversible energy loss.

There is some direct evidence of hunting mammoth (i.e., the Lugovskoe site on Mammoth Creek in Western Siberia), which suggests that an atlatl would not have been effective for mass-kills of a large number of mammoths or an entire family group. Besides the ineffectiveness of such Late Palaeolithic tools for mass-kills, mammoth family size and organization probably were the chief constraints on slaughtering 30—40 individuals. The modern elephant herd structure is based on close relationships, which promotes collective defense and protection of family members. The composition of mammoth groups composed of females and calves suggests similar behavior on the part of mammoths. Such behavior is potentially dangerous for hunters lacking firearms. If death or serious injury occurred during mammoth hunting, it might have jeopardized the survival of the whole Upper Palaeolithic community of 25—35 people. Finally, most of the sites containing numerous mammoth remains are situated within river valleys — not bluffs or hilltops — where opportunities for surrounding and herding mammoths to slaughter would have been limited.

The ethology of modern elephants reveals that continued hunting leads to the development of new behavioral patterns among these animals, who attempt to minimize contacts with, or completely avoid, hunters. The high intellectual level of elephants (and presumably mammoths) precludes mass roundups and similar types of hunting of this species. In the case of the death of the family head, the group disperses and leaves the territory. For this reason, hunting and ambushing mammoths in the same area has a small chance of success and is impractical, even in areas of constant mammoth migration.

Given the likely behavioral and ecological patterns of woolly mammoths, mass-kills of these animals probably were uncommon, and it is unlikely that the inhabitants of Upper Palaeolithic sites were specialized hunters of mammoth. The hunting of individual mammoths and the scavenging of mammoth carcasses, however, most probably took place. The mass accumulation of mammoth bones at Upper Palaeolithic sites were caused by the non-selective, natural death of mammoths attracted to watering places and exposed mineral resources over the course of centuries. These bone accumulations, in turn, attracted Upper Palaeolithic people because of their economic value, and they were used and modified for various economic, ritual, and artistic purposes.

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